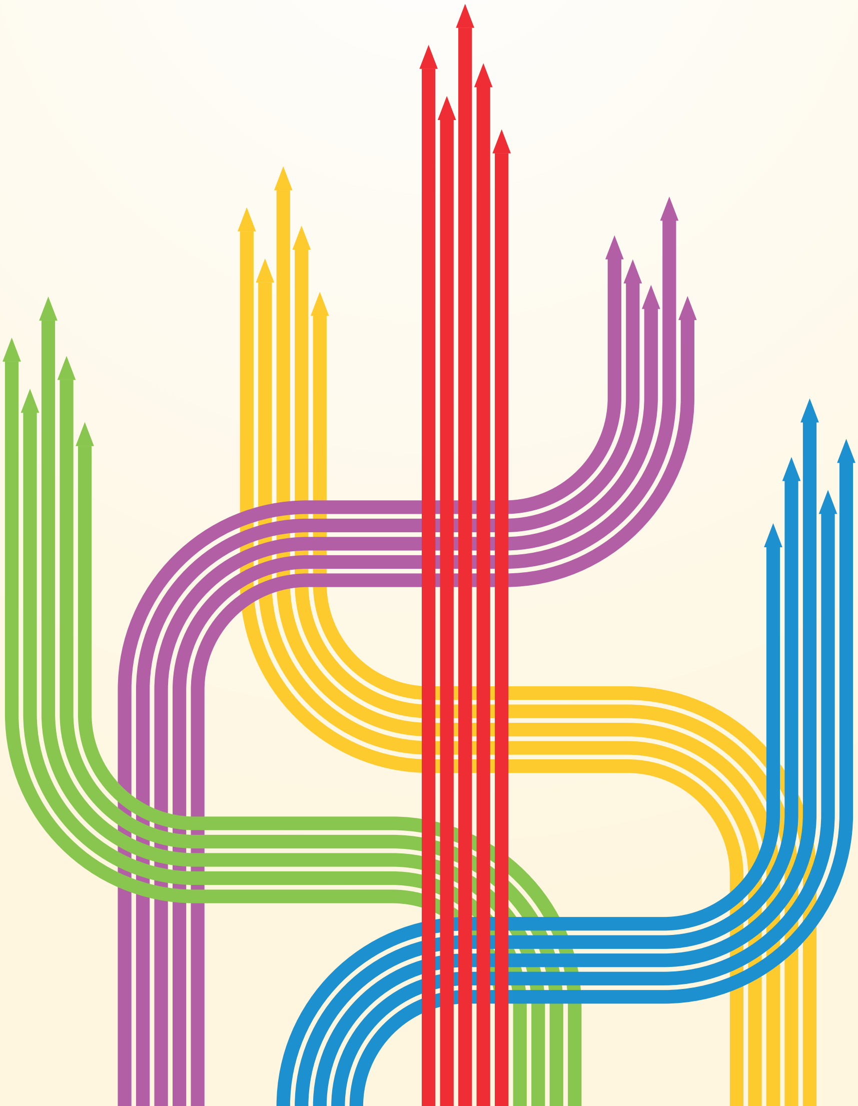
Edited by Thomas Heller & Alicia Seiger

SETTLING CLIMATE ACCOUNTS

Navigating the Road to Net Zero



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Thomas Heller · Alicia Seiger
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To Zoe and Anna.
—Alicia Seiger

To Mimi, Zac, Aarno, and Lil.
—Thomas Heller

Preface

This book aims to settle climate accounts in three senses of "accounting." The chapters study climate accounting in its most familiar form—as the process of analyzing, verifying, and reporting financial accounts. The book's introduction and conclusion wrap this analysis in a narrative account, with storytelling that grounds the reader in the past, present, and future of the climate action story. And finally, the book drives home the need for greater accounting in its form as the root of accountability.

We begin our story by retracing the road from Rio to Copenhagen to Paris—cities marking the locations where significant global climate conferences took place in 1992, 2009, and 2015, respectively. The road from Rio to Copenhagen was not the uncongested superhighway the original drivers of climate action had hoped for and anticipated. And so, along the particularly dark stretch between Copenhagen and Paris, climate advocates began to contemplate alternate routes, ones that considered the unanticipated obstacles and departures that had slowed progress along the initial pathway.

It remains to be seen whether the next global Conference of Parties in Glasgow (COP26, scheduled for November 2021, as of the writing of this book) will emerge as a pivotal milestone on the road to decarbonization. In the approach to COP26, and in anticipation of its aftermath, this book offers a climate narrative in the context of three recent and significant "Turns" in the drive toward climate stabilization. These turns are imagined in our telling of the climate action story rather than a formal characterization of the current narrative. They are largely concurrent, overlapping, and often ambiguous in their conceptual and practical implications. The first two Turns: the Turn to Green Finance and the Turn to Risk materialized in earnest after the Paris Agreement in 2015. The third Turn and the primary focus of this book, the Turn to Net Zero, hit escape velocity in 2020 and has taken the lead as the world's next, and perhaps last, best hope to get climate action on track. Understanding history, and these Turns in particular, through a narrative that both organizes and explains how climate action has oriented and reoriented over the past three decades will be critical to successfully navigating the terrain ahead.

The chapters of this book are a compilation of essays by researchers at Stanford University's Sustainable Finance Initiative (SFI) and Steyer-Taylor Center for Energy Policy and Finance (STC). The first part of the book investigates the rough edges of Net Zero in practice. The second half of the book focuses on states, markets, and transitions and explores possible solutions that raise further questions about the adequacy and reach of the Net Zero agenda.

While we encourage readers to derive practical insights from the chapters, this book is less tactical than fundamental. It offers context and foundation to ground the rapidly evolving practice of Net Zero finance. For readers who seek even greater technical detail and depth, we invite you to visit the Stanford Sustainable Finance Initiative Web site and explore the working papers that undergird the introduction, conclusion, and several of the volume's chapters.

Our intended audience includes seasoned climate practitioners, newly activated leaders, educators, and students of climate action the world over. While it is relatively easy to "get up to speed" on climate, it is more difficult to find the time and resources for the careful contemplation required to learn from the past and better orient future pathways.

Climate accounting, in its narrative sense, tends to fall into one of two genres: pep-rally optimistic and dystopian despair. We aim for this volume to strike a middle ground. Climate advocates prefer to tell success stories and mobilize forces with simple, easy-to-digest messages. This tendency is understandable (humans don't generally gravitate toward dark and deeply complex problems), but this tendency is not without risk. As Spencer Glendon has prophetically observed, "If optimism is the uniquely American trait of trusting that things will work out in the end; hope is the belief that with hard work, things will get better." By casting climate narratives with successful heroes, defeated villains, and Hollywood endings, we risk a world where climate action is driven by willful optimism. This book embraces the complexity of climate action and, in so doing, proposes to animate and drive hope.

This book is by no means comprehensive. While we consider economics, finance, and governance in a global context, our perspective is by nature western and privileged. The Turns in our introductory narrative do not explicitly account for underlying questions of equity and justice. Long at the center of the climate crisis, these themes are justifiably rising in volume and centrality in the midst of a racial reckoning in the US, and in the face of mounting and unequitable economic and human losses at the hands of flood, fire, draught, and heat worldwide, further exacerbated by the COVID-19 pandemic. The initial climate narrative—the one shared on the road from Rio to Copenhagen—was more attuned to questions of equity, justice, and global development than the corrective Turns taken since Paris. The directions of Green Finance, Risk, and Net Zero depart from the founding principle of nations and sub-groups having differentiated responsibilities and capacities. In the book's conclusion, we anticipate a need to turn back to the multilateral and redistributive elements of the original formulation for the sake of humanity.

We set out to capture a significant moment in the world's climate action story. We offer historical context, tease apart the limitations of current practice, identify the most pressing decisions on the road ahead, and offer possible solutions. Time will tell how policymakers, investors, and business leaders respond. We hope readers of this book will be better equipped to ascend the road ahead, because navigating the next turns will determine how the story ends.

Stanford, CA, USA
June 2021

Alicia Seiger
Thomas Heller

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This book would not have been possible without our team of contributing authors: Lorenzo Bernasconi, Esther Choi, Soh Young In, Richard Kauffman, Marc Roston, Gireesh Shrimali, and Uday Varadarajan. From the summer of 2020 through the spring of 2021, we gathered weekly over Zoom, across many time zones, and in the face of the many challenges COVID-19 presented. The substance of these group discussions not only appear in the chapters but also in the wider currents of the introduction and conclusion. We are so grateful for our team's dedication and companionship.

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The contributing authors' chapters were workshopped (virtually) with leading academics and practitioners around the world who reviewed and critiqued the main ideas and findings. We wish to thank all those who attended those workshops for their valuable time and feedback. We also wish to thank SFI Program Manager Katie Taflan Cerneka, who carried the weight of scheduling and managing these workshops.

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It has been said that what it will really take to solve climate is an unprecedented act of love and generosity. This book is an act of love supported by decades of devotion to advancing effective climate action. We would not be able to engage in this work without the generous and loving support of our family and friends. For that we are eternally grateful.

Contents

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List of Figures

1

Introduction—The Rise of Net Zero

Thomas Heller and Alicia Seiger

"You cannot disclose without renouncing."
Michel Foucault
Technologies of the Self

The original climate action plan, to the extent there was one in 1992, was to put a price on carbon. If governments had appropriately priced carbon then, when the climate science was well-understood, we wouldn't be writing a book about Net Zero as the unlikely hero to which the world has turned in the face of extreme heat, drought, fires, floods, and storms.

The driving force of this book is an investigation into the data, metrics, and impact of climate action, which is increasingly framed by a new emphasis on achieving "Net Zero" targets. Net Zero describes a state of balance between greenhouse gas emissions produced and removed from the atmosphere, and it has emerged as the organizing principle for climate action. The chapters that follow are not a comprehensive recording of the multitude of initiatives that collectively compose what we call the "Turn to Net Zero" as much as a deliberate search for their leading, often rough, edges.

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Settling climate accounts requires attention to accounting in its trio of forms. In perhaps its most common usage, accounting is a technical practice of summarizing, analyzing, and reporting financial transactions, a.k.a, "keeping the books." Most of the following chapters attend to the techniques and challenges of data collection and management that embody the practice of financial accounting in the Net Zero context. But accounting is not only a technology; it also connotes an account in narrative form. Storytelling is a principal force in the imagination and diffusion of instructive pathways toward the betterment of human conditions, certainly including the felicity of the climate in which we as a species have prospered. This Introduction offers an account of the sequences, direction, meaning, and appeal arranged by the Turns to Green Finance, Risk, and Net Zero. The Turns are more or less competing, pedagogical, dramatic plots in which different actors and their assigned lines—states and markets, financial and real economy firms, technology systems and projects, nations and multilateral regimes, East and West, heroes and villains—take lead and supporting roles in resolving climate from crisis to (happy) ending. We revisit this plot and its characters in the conclusion, focusing on open accounts and envisioning a possible turn back to states.

Our modern record of human fallibility dictates a third sense of climate accounting that recognizes the need for regular mechanisms to keep examining and correcting the roads down which the goal of climate stability send us. In this third sense of accounting, as the root of accountability, climate accounting is about the mechanisms for staying on course, and the responsibilities or duties that attend the practice of shepherding, stewarding, governing, regulating, and integrating complex systems. In the end, accounting for climate in its full scope would tie together operationally, conceptually, and politically, the multiple pieces of a systemic and orderly transition from high- to low-carbon societies.

And so, here we begin a narrative accounting for how Net Zero emerged as the ascendant frame for climate action. In the nearly 30 years since the 1992 Rio Earth Summit, global progress on climate has been delivered in halting, local, and subscale measures. Needless to say, the road from 1992 to 2021 did not unfold as anticipated. As a result of unexpected detours and obstacles along the way, drivers of climate action pursued three overlapping "Turns" to steer global emissions in line with temperature targets.

These turns: (1) the Turn to Green Finance, (2) the Turn to Risk, and (3) the Turn to Net Zero, have redefined the contours of climate action, putting finance at the center. This series of turns, with Net Zero now ascendant, marks the new plan for climate action. The plan, as this book will portend, is unfinished. To better understand the challenges of the terrain ahead, it is instructive to consider the road already traveled.

From Rio to Copenhagen to Paris

Looking back to the 1992 Rio Earth Summit's Framework Convention on Climate Change (UNFCCC), the aura of optimism and simplicity surrounding the original collective attempt to define climate action is somewhat painful to recall, let alone recapture. The starting lap of the climate action race can be marked as the period from 1992 to the fifteenth UNFCCC convention (Conference of Parties or COP) in 2009 in Copenhagen. This initial stage took shape around three shared articles of faith. First, participants shared the belief that action on climate would be governed at the country level through political actors engaging in legal agreements and operating through multilateral institutions. The UNFCCC and the Inter-governmental Panel on Climate Change (IPCC) are prominent examples of this first principle. Second, there was consensus that internalizing environmental costs through a single instrument (i.e., a price on carbon) was both rational and necessary. And finally, there was widespread acceptance of the geopolitics of global development so that a universal set of rules could be applied inclusively to advanced economies and emerging economies, complemented by exceptional treatments for developing nations until expected economic growth allowed their graduation to full and equal status (e.g., the Clean Development Mechanism [CDM], financial and technological transfers, and adjustments for fossil exporting states.)

Implicit in these central beliefs was a vision of the future with stable growth creating increasing demand for cleaner energy, transport, agriculture, and industry. In this assumed future, institutionalized innovation would shift the relative prices of low- and high-carbon technologies to meet new incremental demand. Inefficient and corrupt state owned firms and state budgeted infrastructure would give way to private sector replacements that would respond to market forces. There was to be a smooth process of gradual adjustment that would mitigate dislocations of labor and capital associated with the transition from high- to low-carbon economies. Finally, it was initially assumed that institutions, systems of governance, and cultural norms would converge around democratic and market-centered principles, with coordinating multilateral regimes to support emerging and poorer nations traversing the process of economic development.

If this description of the recent past seems incredible, dim, or simply ancient history, it may be useful to ask: what came to pass, what didn't, and how did climate actors attempt to correct course? Some forecasts transpired as predicted, or at least played out on the positive side of the ledger. Relative prices of renewable electricity fell toward the costs of fossil electricity and, in many places, to parity or below. Similar progress down learning curves can be traced for electric vehicles. Beyond technology-driven predictions, the haze of climate skepticism that impeded the political and market force of leading-edge science lifted across large and politically significant populations in advanced industrial and developing nations. The acceptance and socialization of this knowledge facilitated the mainstreaming of climate concern and action from a limited number of informed actors in particular geographies to consumers, companies, financial institutions, municipalities, and sub-national governments around the world. Reinforced by the empirical evidence supporting largely accurate predictions of climate science and impacts, and the incidence and volatility of extreme weather events, the climate agenda climbed out of an environmental basement toward a better illuminated and widely recognized status that made credible claims on everyone's attention.

On the flip side of the post-Rio record, established expectations have gone astray. After the 2009 COP in Copenhagen, the UNFCCC multilateral regime abandoned its central role and responsibilities, having failed to update the Kyoto Protocol and its logic of mandatory targets. The 2015 Paris Accords represented a near-spectacular repair of the then much depleted enthusiasm for widely coordinated climate action. But its restructured constitution to "pledge, review, and ratchet" non-standardized national contributions abandoned the original creed that prioritized legally binding and close to universal climate framing. Similarly, after its adoption across the European Union, attempts to enact carbon pricing through cap and trade stalled in most major jurisdictions. Instead of a single, monitorable instrument that would have allowed an easy integration, tracking, and review of national climate actions, countries proliferated a diverse portfolio of regulations, subsidies, and low-level fiscal charges that far underpriced estimates of the social cost of carbon. The CDM was another costly detour on the post-Rio roadmap, as the trading regime meant to extend cost-effective mitigation of emissions to emerging and developing markets was jettisoned after pervasive gaming undercut the quality of underlying projects.

The departure of real-world politics and economics from the expected expansion of democracy and free markets was even more disruptive than the displacement of multilateralism. Predicted growth in demand and availability of public and private capital for national infrastructure was constrained in the wake of the 2008–2009 financial crisis in the West, and again from 2010 to 2015 in the wake of slow growth in the lead emerging market economies of Latin America, Southern Africa, and South and East Asia. Even with declining relative prices for renewable energy, the pace of retirements, additions, and system reforms aligned with the low-carbon transition was impacted by these low-growth environments, driven both by economic and political constraints. The new macroeconomic reality contributed to a surprising resistance from policymakers in developed economies to converge on democratic and market-centric norms and institutions. Especially in the carbon-intensive sectors of energy, transport, heavy industry, and agriculture, state production and finance remained prominent, if not fortified, across East Asia where the record of economic growth attracted envy throughout the developing world.

It is only against this juxtaposition of what proceeded as anticipated and what went off course that we can understand and evaluate the three principal turns from that initial course that have evolved since the Paris Agreement. These three Turns—the Turn to Green Finance, the Turn to Risk, and the Turn to Net Zero—are largely concurrent, overlapping, and often ambiguous in their conceptual and practical implications. They are imagined in our telling of the climate action story rather than formal characterizations of the current narrative, and their scope may be clarified with reference to the observed problems around which they arose and were intended to correct.

Three Turns in the Post-Paris Climate Action Story

Green Finance

The "Turn to Green Finance" was the earliest, simplest, and most consistent with the assumptions inter-woven in the first stage of climate action. It arose in the face of disappointment with multilateral legal regimes post-Copenhagen and the austerity programs adopted by advanced and emerging market governments after the financial crisis and its associated recessions. The Turn to Green Finance, despite these twin setbacks, reaffirmed the belief that climate progress could be assumed on a type of autopilot in which falling technology prices, a cyclical (rather than a structural) resumption of economic growth, and efficient private market operations, even in the absence of expected state action, would propel the world on the path to a low-carbon transition. The optimism of Green Finance centered on the perception that falling prices would make it easy to build (only) green.

Green Finance has three central tenets: (1) as long as demand sustains growth and capital markets are efficiently informed and economically motivated, each increment of investment advances transition to a low-carbon system; (2) replacement of higher cost fossil with lower carbon assets yields job growth with only a marginal reliance on taxes and public subsidies, which could sunset as market penetration increased; and (3) financial market regulation and the facilitation of built-to-purpose financial vehicles to reduce organizational inertia might accelerate Green Finance, but neither the limitations of public budgets nor the need for substantial reform of public policy will impede the transition. These revised articles of climate faith are consistent with the ongoing experience in Northern European and North American renewable energy markets with private capital, light doses of carbon prices or public tax incentives, scheduled retirements of aging (and fully amortized) fossil generation, and flexibility services from abundant gas and dispatchable hydro-electricity sources. This evolved version of climate doctrine has been, since the COVID-19 pandemic, reinforced in these same OECD economies under the rationales for increased public debt and infrastructure investment in the Build Back Better and Green New Deal rubrics. Outside of US and European electricity markets, the basic tenets of the Green Finance faith may prove more problematic.

Even in advanced economies, where falling costs of renewable energy projects have attracted mainstream investors, questions of systems integration and the uneven rates of technical innovation across carbon-intensive activities call into question the ability of a market-driven transition to meet the necessary pace. For example, in the power, mobility, and agriculture sectors, it has become apparent that the capacity to scale new low-carbon technologies toward agreed emissions goals depends upon reforms in market design, business organization, and financial mechanisms retooled around differentiated patterns of risk and return (more on this in Chapter 5.) When added to the increasing recognition of innovation gaps in harder to abate activities like industrial processes and heat, as well as in emissions removals like carbon sequestration, the limitations of Green Finance as a sole savior, at least in the short run, are clear.

Risk

Where Green Finance focuses on a low-carbon transition driven by the economic incentive to deploy new, cheaper technologies, the "Turn to Risk" inverts the lens. The focus on risk followed the rise of the Green Finance narrative by several years. The risk narrative noted that while most new energy investment in advanced economies was in clean technologies, the slow pace of dirty infrastructure retirements in low macro-growth conditions was not aligned with expected trajectories to global decarbonization. To reframe climate action around its risks, rather than its returns, highlighted the downside of transition (who gets left behind and who bears their losses), and shifted the focus of the story from economics to political economy and finance.

From the abstract heights of theory, a climate risk frame compensates for the broad failure of governments to enact realistic carbon prices since a proper assessment of risks could reprice assets accounting for climate. Green Finance assumed that the increased productivity and job creation of low-carbon energy would, over time, yield benefits to compensate for the sum of downside losses. The Turn to Risk addresses the problems that arise when Green Finance is not enough. (A hotter planet is both more expensive to maintain and less hospitable to growth.) The focus on risk also brought attention to the problems of political motivation and the embedded fossil interest groups that aim to stall the transition. Their lobbying has been reinforced by the widespread realization among sovereigns that, unlike the benefits of transition, which would be diffuse and decades away, the cost of meaningful climate action would be near-term and concentrated. The Turn to Risk attracted attention because it explained, as Green Finance did not, the reasons for re-thinking the value of government policy, the institutions and mandates through which nations might engage with climate change, and the nature of the analytical models that would be needed to do so.

The Turn to Risk successfully brought to the post-Paris depleted climate armory new vehicles and instruments that may ultimately breed the institutional capacity for the coordinated management of transition risk, as exemplified by the recent organization of central banks and regulators into the Network for Greening the Financial System (NGFS). Along this alternative route to effective climate action, there lie both political issues, such as contestable political mandates, and technical questions, such as how to combine financial and macroeconomic modeling with new data-intensive methods capable of managing radical uncertainty. There also lie significant issues of equity. The irony, if not the limits, of an NGFS driven by European Central Banks, with likely US federal Reserve backing in the offing, is that transition risk in these nations is relatively light. The bigger risks lie in South Africa and across Asia, where infrastructure fleets are young, natural gas is too costly, and where Central Banks are less independent and less enabled.

The Turn to Risk has revealed both methodological and institutional puzzles that may already be constraining its application. First, while its central focus has been the downside risks to companies, investors, communities, and governments of losses incurred from winding down carbon-intensive production, there are a largely unexamined set of risks associated with the timing and value of the replacement of these activities. A more accurate estimation of transition risks will depend on the pace and quality of the implementation of new production systems. That is very difficult to calculate. Second, the efficiency, order, and fairness of winding down a high-emissions dependent economy implies risk metrics and management that are methodologically closer to bottom-up financial rather than top-down macroeconomic models. These financial models require dynamic, bespoke, and costly risk analytics not typically found in the climate modeling community. Lastly, both physical and transition risks are highly subject to strategic and political economic behavior. The final risk tally will depend on the comparative ability of firms and investors to defer policy measures or transfer prospective losses to the government in the form of disaster relief, unemployment benefits, and other bailout schemes.

Another source of resistance to the Turn to Risk is the depressing emphasis on what may well go very wrong. Downside risks are less likely to win politicians' votes than green rebuilds. Moreover, at the societal level, effective response to climate risk requires a non-market ultimate bearer of risk (e.g., the government), which either itself takes on new risk or governs its allocation, timing, and distributive effects. Politically, the Turn to Risk implies institutional mandates within governments for monetary policy (e.g., green and dirty subsidies such as collateral interest paid on returns and asset support programs like QE2), and prudential (reserves) regulation. These mandates, if extended from classical macroeconomic policy goals like financial stability and full employment, can both justify the recent engagement of central banks, and create confusion over federal divisions of authority. Turning to Risk therefore implies a structure and a process of governance that is hierarchical before it is market-driven and self-enforcing.

Perhaps its greatest disadvantage is how far the Turn to Risk may depart from issues of equity and justice. Those who stand to suffer the most from climate impacts, including Black, Brown, and Indigenous communities in the US and poor countries and citizens around the world, typically find access to a non-market ultimate bearer of risk only after enduring physical disaster or suffering financially through inadequate provisions of social insurance. The COVID-19 pandemic has made matters worse. The Turn to Risk has the potential either to attend seriously to communities and nations who bear the downsides of climate risk or, to create a new wave of climate red-lining, further exacerbating injustice and the pain of loss.

Net Zero

The "Turn to Net Zero," characterized by disclosure and targets for emissions reductions, has amalgamated themes developed in both Green Finance and Risk, but with its own particular added references and emphases. It extends the Green Finance narrative of climate action heroes from private corporations to assign primary, if not disproportionate, roles to financial institutions and financial markets. In this way, the Turn to Net Zero is similar to the Turn to Risk. But at the same time, it situates its climate frame in a wider ambit of socio-economic transition and adds the appeal of a more mainstreamed coalition to the politics of climate. Net Zero then contrasts a deadlocked and state-driven multilateral process with an implicit nod to the upside future of low-carbon production. The inclusivity of Net Zero pledges from companies, banks, asset owners and managers, cities, provinces, and countries, mirrors the fourth industrial revolution storylines of "Here Comes Everybody" (Shirky 2008), and the effective engagement of everyone through platforms and crowds. The Turn to Net Zero both reanimates post-Paris climate politics through its allusions to the politics of democratization and equality, while capturing the upside growth promises of Green Finance and the regulatory (financial) apparatus of the risk focused climate frame.

The history of Net Zero has many founts of origin, as any movement to decentralization should, but there are useful links to the widely recognized and well-regarded Task Force on Climate-related Financial Disclosures (TCFD). While processes for monitoring, reporting, and verifying (MRV) greenhouse gas emissions have been a core endeavor of multilateral attention since the beginning of the UNFCCC regime, the negotiation of those rules always concentrated on national carbon levels to be carried on as state obligations. In contrast, the TCFD, chartered by the G20 Financial Stability Board (FSB), is comprised of private financial banks, insurers, corporates, accountancies, data users, and data preparers. The TCFD framework describes standards around four areas of climate-related action: governance, strategy, risk management, and metrics and targets. TCFD has attracted widespread global adherence and is held up as a credible manual of Net Zero content and practice.

Net Zero has emerged as the predominant focal point of this book because of its trending adoption to describe and organize climate commitments at all levels, from the UNFCCC's Glasgow convening to Fortune 500 companies, local banks, and city neighborhoods. It combines the Green Finance frame, with recorded and prospective clean technology installations serving as proxies for emissions, and the Turn to Risk, with recorded and prospective emissions serving as proxies for risk. Net Zero steers around the principal difficulties in the other two Turns—sliding past systems transition risks on the upside and the granular and strategic nature of downside risk. While Net Zero seeks an outcome that eliminates, or manages, emissions in the real economy, it borrows from the divestment movement by putting heavy emphasis on financial institutions impacting their real economy counterparties. Undergirding this turn, and critical to its success, are disclosure accounting conventions. Yet a notable feature of Net Zero disclosure accounting in practice is the absence of scenarios, granularity, strategy, and management that would be hallmarks of the Turn to Risk. Of the two main tracks that might have emerged from the TCFD disclosure warehouse, the upside and more optimistic practice of aligning emissions with normative climate goals (which can be achieved through creative accounting) seems to be in the driving position, ahead of the more costly, and more depressing, metrics and management of confronting transition losses. In other words, Net Zero is at risk of taking the easy road and, in so doing, missing its desired destination.

Settling Net Zero Accounts

The chapters that follow elucidate both the state of play and a set of directions that help form a set of judgments about whether Net Zero is going to carry climate action far enough. The book is divided into two parts. *Part 1: The Dynamics of Net Zero Finance* explores concerns centered on the quality of data and financial analysis deployed principally around emissions alignment (rather than climate risk) that has preoccupied the mass confession of Net Zero accounting. *Part 2: Beyond Net Zero: States, Markets, and Transition* investigates the holes (methodological or institutional) within trending Net Zero practice that question the adequacy or prospective reach of the now emergent agenda. A very brief preview of each chapter can be found below.

Part 1: Dynamics of Net Zero Finance.

- Chapter 2. In *A Portfolio Approach to Hedging Climate Risk*, Marc Roston lays out the application of Modern Portfolio Theory to Net Zero financial markets and products, and questions the outperformance claims that abound.

- Chapter 3. In *Carbonwashing: ESG Data Greenwashing in a Post-Paris World*, Soh Young In & Kim Schumacher examine the ecology of data sourcing, provision, and rating in Net Zero accounting, drawing on broader economic and organizational insights about incentives to selectively publicize or otherwise game disclosure behavior.
- Chapter 4. In *The Road From Scope 3 to Net Zero,* Marc Roston investigates Scope 3 emissions accounting in practice and explores its rough edges as a tool for achieving Net Zero goals for financial services, corporates, and governments.
- Chapter 5. In *Fixing the Plumbing: Asset Management, Clean Energy Technology and the Valley of Death,* Richard Kauffman and Marc Roston review the history of the asset management industry, asking if specialization, fees, and intermediation have delayed or stalled financing of climate transition.

Part 2: States, Markets, and Transition.

- Chapter 6. In *Blended Finance for State-led Decarbonization*, Esther Choi and Soh Young In look at the detailed intertwining of government and private actors in Korea's ambitious Green New Deal, raising both global and Asia-specific queries about the concurrent governance of technology and sustainability transitions.
- Chapter 7. In *A Natural Approach to Net Zero*, Lorenzo Bernasconi attends to the emerging reliance on nature-based offsets to balance Net Zero accounts, pointing out the interdependence of private market and state solutions that add up to effective carbon management.
- Chapter 8. In *A Note on Transition Bonds and Finance*, Gireesh Shrimali and Tom Heller report on the movement from green to transition bonds, connecting the current dynamics of proliferating financial products with the largely prospective issues of what will define transition pathways and plans to be negotiated between markets and states.
- Chapter 9. In *Securitization as a Model for an Equitable Transition*, Uday Varadarajan travels still more deeply into the scope of transition risk management. This chapter looks at political economic theory, US state regulatory practice, and the fairness and effectiveness of distributing the gains and losses associated with transitions to low-carbon energy systems.

Previewing our concluding observations, we invite the reader to be on the lookout for four areas that remain unsettled: (1) increasing levels of *noise* in the information Net Zero accounting sends out to its users; (2) contested rules over Net Zero's boundaries for *coverage*; (3) unclear enforceability of future-centric commitments that create incentives to defer compliance and transfer responsibilities (i.e., *timing*); and (4) undefined *management* obligations that both over-simplify risk and, through decentralized accounts, fail to add up to a coordinated politics of climate.

These most difficult and intractable accounts of noise (greenwashing), coverage (Scope 3), timing (offsets), and management (obligations) require remedies in order for Net Zero to add up. Net Zero associations have emerged to define and perhaps enforce resolutions to these issues. Yet we anticipate these valiant and voluntary attempts will fall short, and test or cross political boundaries. We will revisit this discussion in the conclusion, as well as the question of whether a fourth Turn will be necessary to steer climate action more effectively down an emissions path required to sustain a stable, if not thriving, civilization.

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Part I

The Dynamics of Net Zero Finance

2

A Portfolio Approach to Hedging Climate Risk

Marc Roston

Editorial Note

As the book's introduction suggests, there are limits to what finance can and cannot accomplish with regard to climate action. In the absence of government mandates or incentives that change relative asset pricing and risk, we believe the impact of finance on emissions reductions will remain limited. In this chapter, Roston acknowledges that, even in the case of perfect data, the feat of translating a climate risk model into portfolio performance remains a complicated endeavor. By walking us through the approaches available to asset managers and owners to integrate climate risks in useful and interesting ways, he also reveals the limitations of these methods. While incentives exist for asset managers and owners to claim the ability to outperform the market by using this data, Roston's conclusion suggests that asset owners and managers should be focused on managing climate risk, rather than trying to use this information to outperform the market.

The Net Zero Asset Managers Initiative has, as of September 2021, 128 signatories representing $43 trillion in assets under management "committed to supporting the goal of Net Zero greenhouse gas emissions by 2050 or

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sooner." The members agree to work with asset owner clients to target Net Zero emissions by 2050, setting interim targets, subject to regular review (Net Zero Asset Managers 2021). For financial markets to reach such ambitious goals, asset managers and asset owners must impact the real economy.

While owners and managers align in their desire to achieve Net Zero targets, there will be competition for the best solutions and ideas. As discussed in detail in Chapter 5, the business of asset management does not lend itself to cooperation. Asset management responds to opportunities to capture value from someone else. In the broadest sense, a new investment product or strategy needs to increase return or reduce risk for an asset owner to buy it. Most asset managers have focused on returns to attract asset owners considering climate focused investments.

Few, if any, asset managers attempt to address the question of whether incorporating climate metrics into a portfolio *should* improve performance, let alone why an investor might still be compelled to invest in a climate-driven strategy without the prospect of near-term superior performance.

In this chapter, we consider the pathways in public equities through which climate-related data may impact decision making and product design. We take this approach for three reasons. First, well-established and familiar tools and techniques allow for a manageable, structured discussion. Second, investors choosing to implement these strategies will find public markets the quickest path to practical action in an efficient, liquid market that stakeholders will understand. Finally, we expect this approach will provide satisfactory results driving investors in the direction of better decisions and outcomes—maybe even superior performance.

This essay offers one key message to asset owners and their managers: focus on resilient risk management approaches rather than performance. Superior performance lacks a logical or theoretical basis. Performance gains, frequently fleeting, risk falling short of expectations, discouraging investors and therefore moving off the path to favorable long-term change. If investors focus on risk, and the low cost of managing that risk, they will more likely stay the course for long-term success.

Data Collection and Metrics

Climate Confusion

Chapters 3, 4, and 8 of this volume cover and assess the current landscape for climate and sustainability data. Berg et al. (2019) (BKR) have meticulously studied environmental, social, and governance (ESG) ratings by major providers. They develop a taxonomy of ratings methodologies that help researchers understand the drivers of ratings variation. One of their primary conclusions is that disagreements may arise over the relevant metrics, as well as relative importance of these metrics. Investors, moreover, have different goals and preferences that may justify different ratings for different circumstances.

Any measure of superior performance depends on the benchmark for comparison; one cannot independently distinguish superior performance and bad benchmark choices, or vice versa. (We will investigate this problem in more detail in a later section.) BKR identify a similar problem: ratings agencies provide inputs to an investment process. Those ratings depend on raw data and a recipe that processes the data. In trying to evaluate ratings, one cannot easily separate the recipe from the ingredients.

For example, most organizations rating company climate performance collect backward-looking data (e.g., "Describe the method used to estimate CO_2 emissions and your estimate for 2020",) and forward-looking plans or forecasts (e.g., "Describe your plans to reduce emissions next year.") Designing a single rating requires weighting the relative importance of these two questions, and implicitly evaluating the accuracy of the responses.

Asset owners evaluating asset managers and investment processes must understand by whom and where in a process gains occur. BKR attribute significant variation in ESG ratings to variation in recipes. But we also need to understand that even basic ingredients with seemingly innocuous processing result in varied outcomes. In the next section, we will closely examine some simple ingredients to show achieving this understanding is harder than we might expect.

Calculation Chaos

It is widely agreed upon that corporate disclosures around climate risks fall short. Inconsistent reporting, measurement differences, the voluntary nature of disclosure, all conspire to muddle the ability to answer questions about climate impacts. In this section, we examine a straightforward metric based on greenhouse gas (GHG) emissions to highlight complications that arise *even with perfectly accurate data*. By understanding the ambiguous results derived from perfect data, we hope to highlight the importance of accurately reported emissions data, and the robust use of data that does not require perfection.

Start with a simple question: how might one measure GHG emissions for a company, and thereby translate into a useful emissions measure for a portfolio? The Greenhouse Gas Protocol established a taxonomy for carbon emissions accounting by "scope." Scope 1 emissions count a company's direct carbon emissions; Scope 2 covers purchased power carbon emissions; Scope 3 covers supply chain emissions.[1] Several vendors collect data on Scope 1, 2, and 3. More reliable and consistent data exists on Scope 1 and 2, yet concerns remain that much of this data, self-reported and voluntary, may be inaccurate, either via errors of omission or commission. In this paper, we focus on Scope 1 and 2 both because of reliability and because vendors have longer histories collecting this data (see Chapter 4 for more on Scope 3).

Cross company comparisons require normalization. If we compare two major producers of fossil fuels, we need to adjust for their activities and size to make use of the data. For example, according to MSCI, Inc.,[2] Marathon Petroleum Corp. (MPC) and EOG Resources Inc. (EOG) have Scope 1 emissions of 36.8 and 5.3 million metric tons, respectively, at year-end 2020. Mostly, those figures tell us MPC is much larger than EOG. Efficient efforts to reduce GHG emissions should focus on emissions per unit of *something* so we make judgments based on efficiency.

What *something* should we use? We might choose to estimate carbon emissions divided by Gross Domestic Product (GDP) contribution,[3] but such estimates require layers of assumptions about contribution to GDP. We might consider less complex measures, such as emissions to equity value of a company, but those results, and several related measures, would not be invariant to the capital structure of a company.[4] Frankel et al. (2015) consider several measures using different weighting schemes and normalizations. We focus on one of these measures: a company's *sales normalized carbon intensity* (CI), calculated by summing annual Scope 1 and Scope 2 emissions as reported by MSCI, divided by gross sales, providing a measure in units of *tons of* CO_2 *emissions per \$1 million of sales* (tn/\$sales). By this measure, MPC and EOG have nearly identical CI, at 363 tn/\$sales at year-end 2020.

One goal for a climate motivated investor could be to minimize CI of their portfolio. The path to Net Zero heads in the direction of minimizing carbon intensity of the total equity market, and ultimately, the total economy. Different investors might have different goals that would require different denominators. Some investors might prefer to add Scope 3 emissions into the numerator in some way. All the examples and methods that follow could directly incorporate such modifications.

We use MSCI equity indices to make some basic observations. Broad coverage, transparent construction rules, and general availability make these indices a convenient choice. Figure 2.1 plots year-end CI for three indices: MSCI USA Equity Index (MSCI USA), MSCI All Country World Index excluding the USA (MSCIACWIxUS), and MSCI Emerging Markets Index (MSCI EM).[5]

MSCI EM has the highest carbon intensity, trending downward materially. In many emerging markets, energy companies historically made up a large fraction of public equity markets. Similarly, our globalized economy has pushed manufacturing offshore from developed markets. Manufacturing-driven economies tend toward higher CI than service and technology-driven economies. USA and ACWIxUS start at similar CI level at year-end 2014 and each trend favorably, with the USA falling faster than ACWIxUS, but not as quickly as EM.

At first glance, one might take some satisfaction from these results. Carbon intensity has dropped materially from 2014 to 2020. Emerging markets emissions dropped extraordinarily, from 438 tn/$sales to 259. US emissions fell over 40%, from 232 to 134. The ACWI ex-US emissions did not fall as dramatically, but the direction looks like positive progress.

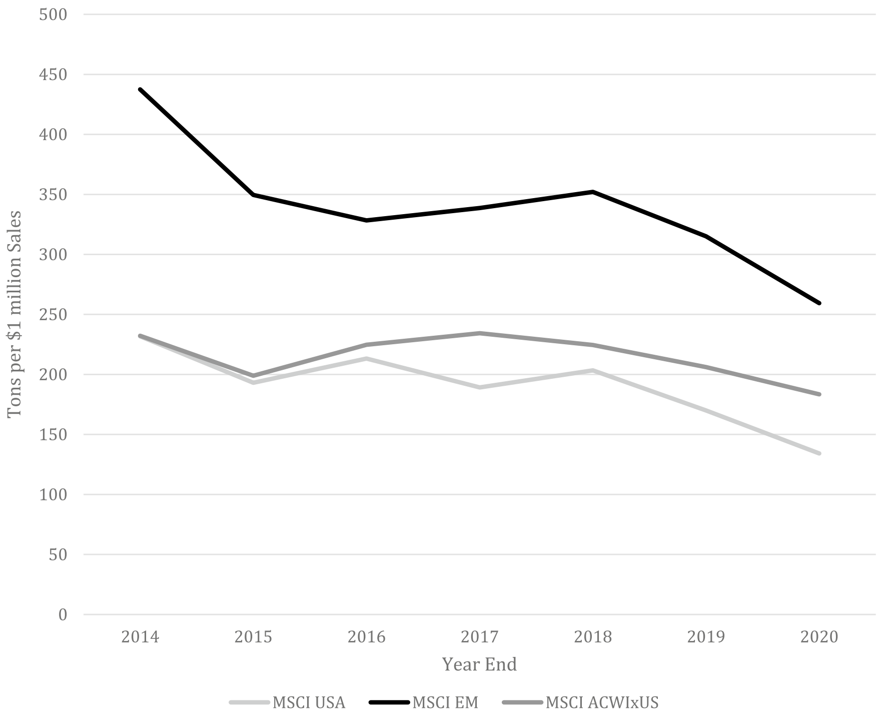

Fig. 2.1 Index carbon intensity, 2014–2020 (*Data Source* MSCI ESG Research LLC and MSCI Inc)

For the three indices MSCI USA, MSCI Emerging Markets, and MSCI All Country World Index excluding USA, the figure plots carbon intensity, as measured by Scope 1 and Scope 2 tons of carbon emitted per $1 million sales, at each year end. MSCI Inc. provided the index and emissions data.

However, on careful consideration, several problems arise in reaching these conclusions. First, consider a single commodity price: oil. *Assuming no change in oil consumption, an exogenous price increase would lower carbon intensity for oil companies*. That does not tell us oil companies are greener when oil prices are higher. That tells us that they are potentially more profitable because they sell the same goods at higher prices. If we knew with certainty the price elasticity of oil, and other state variables describing economic activity, we could correct for this error. Unfortunately, we do not.

Second, consider relative sector performance in the equity market. Relative sector or industry performance will drive benchmark carbon intensity without underlying economic changes. A small number of technology companies have driven much of the massive increase in China's contribution to emerging markets. In the USA, technology stocks have substantially outperformed energy and utilities for the past several years. Technology companies tend toward lower emissions. The larger technology slice of the equity pie relative to the past does not mean the carbon intensity of the economy has improved. We can only conclude that the market value of lower CI companies has increased faster than, or relative to, high CI companies.

In Fig. 2.2, we add the CI measures for equal-weighted portfolios. A typical equity index, and those shown in Fig. 2.1, weight companies in the index based on their market capitalization: large companies contribute greater weight to the index. The equal-weighted measure tells us CI for the average company in the index, rather than changing the weights through time based on the market value of each company. While not a perfect measure, it removes the variation due entirely to relative valuation changes. Notice the equal weight intensity is substantially higher: the carbon intensity of the average company in the index far exceeds the capitalization-weighted intensity. The equal-weighted measures show somewhat more stability over time. We note the significant drop off for 2020, likely due to the economic contraction as a result of COVID-19.

For the three indices MSCI USA, MSCI Emerging Markets and MSCI All Country World Index excluding USA, the figure plots carbon intensity, as measured by Scope 1 and Scope 2 tons of carbon emitted per $1 million sales, at each year end. The figure also reports carbon intensity for an equal weight portfolio of index constituents. MSCI Inc. provided the index and emissions data.

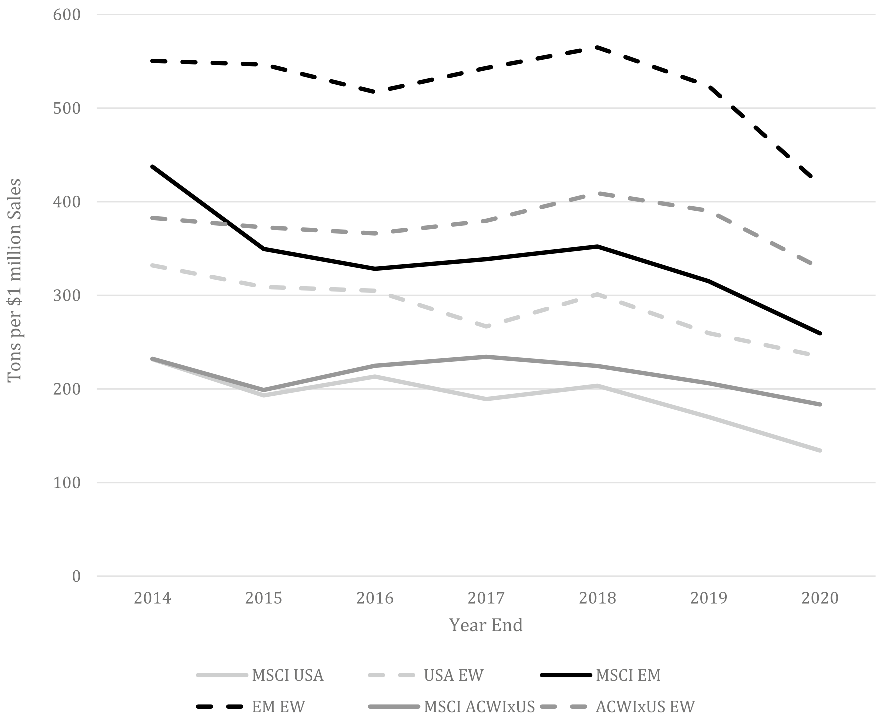

Fig. 2.2 Capitalization-weighted and equal-weighted index carbon intensity, 2014–2020 (*Data Source* MSCI ESG Research LLC and MSCI Inc)

As a final example, consider how relative commodity prices might impact intensity. (Think of this as a special case of the relative sector performance issue above.) Consider a stylized example close to home: coal drops out of favor as an energy source, natural gas fills the gap. Coal consumption falls, gas consumption rises. But what about prices of gas and coal? That's hard to predict. Suppose falling coal prices bankrupt highest cost miners, and their mines shut down. Many coal consumers cannot substitute gas and their power contracts allow them to earn fixed returns on capital. These coal consumers are indifferent to coal price changes. That makes the remaining coal miners potentially more profitable with less competition, so their stock price rises relative to gas companies. Predicting stock returns is hard. One can expect a similar indeterminate result as renewable power substitutes for fossil fuels.

In summary, while we could choose different metrics, or develop better ones, we cannot avoid the problem that even with mandated, audited, and verified data, our ability to evaluate, or ideally drive, real economy impacts through portfolio decisions remains challenging.

Modeling Climate Risk

Few investment products attempt to reconcile data and product design with a model of climate risks and associated mechanism that impact the real economy. In this section, we consider a general framework for climate-driven risk, and how such risks flow through to asset prices. We discuss performance implications of these models.

Green Strategies and Performance Intuition

Climate-driven products appeal to investors through a combination of preferences and performance. Preference-driven products, often couched in the more general category of environmental, social, and governance (ESG), presume an investor directly values the goals or characteristics embodied in a portfolio that meets some set of criteria. While intuitively appealing, economists dislike this approach because adding arbitrary characteristics to utility functions has no limit—any outcome could be explained by modifying preferences.[6]

Performance approaches benefit from the basic principle that investors want to maximize returns. They appeal to the idea that "doing good" means investors will do well. Several studies have examined this question as well, finding conflicting results. Literature surveys, often considering ESG criteria, show the results vary by time, market, and evaluation method.

ESG enthusiasts may find this result disappointing. However, one must distinguish between running businesses better and generating persistent excess returns. Consider a simple example: the new CEO discloses best-in-class carbon exposures reflecting her deep concern about climate risks to planet and her company. She commits to continued disclosures and paths to decreasing risks. The stock market integrates this "surprise" information immediately, pushing the stock price up. New information generated excess return immediately. The next time the CEO discloses updated information and progress, analysts will have forecast expected changes under a new disclosure regime, and the stock will only move based on surprises relative to those forecasts. Neither good nor bad news surprises should be forecastable.[7]

Take the example one step further. Suppose an asset manager chose to own companies that fail to disclose or acknowledge climate risks. Those companies likely have the most upside to reforming their ways and raising their stock price. We might be bothered by these companies, but this strategy probably works better for an outperformance motivated investor.

Any performance-driven strategy likely runs out of steam. Something must give, eventually. The rising tide of carbon disclosures and climate risks may lift all boats, but that does not mean outperformance persists. Pick your favorite cliché—trees don't grow to the sky. Not everyone can outperform by adopting climate-driven strategies. If green investors bid up prices on green companies today, yes, they realize higher returns in the current period, but prospective returns must be lower. In fact, if green investors sell holdings in high GHG emitters, then prospective returns to climate indifferent investors rise.[8]

As preferences and performance fail to provide a clear answer, we turn to formalized models of economic dynamics. In an excellent survey, Giglio et al. (2020) provide a framework to describe the interactions between climate risk, real economic activity, consumption, and asset prices.[9] They model aggregate consumption growth, subject to a shock. This shock may follow two pathways, describing two classes of climate dynamics that ultimately drive asset prices and investor returns.

In the first formulation, they model the shock as a low probability climate disaster, or tipping point, impacting consumption growth directly.[10] The key model uncertainty is the timing of a disaster. We could imagine this shock as a permanent change in weather systems that dramatically reduces agricultural output, for example.

In their second approach, they link economic activity and climate risk, more along the lines of the feedback mechanics of integrated assessment models. In this formulation, economic growth directly impacts future climate damage. Larger climate damage strikes when consumption has been relatively high because of the links tying consumption growth with harm. Giglio et al. note COVID-19 provides an excellent example of this sort of shock: economic activity seized up, reducing greenhouse gas emissions. Of course, our concerns lie in the other direction, for example, as emerging economies wealth grows, GHG emissions rise, leading to more harm.

Both approaches have intuitive appeal. In fact, reality may combine the two effects. In the first case, assets that hedge climate risk (i.e., pay off when the disaster strikes) have lower expected returns because they pay off exactly when the economy takes a hit. Think of these securities like insurance. Insurance has a negative expected return, but pays off in the case of a loss. In the second case, assets that hedge climate risk pay off when consumption is relatively high, because the worst of the impacts only accumulate after sustained economic growth and consumers have more wealth. Such payoffs require *higher* returns because marginal gains matter less to investors with more wealth.

In this section, we attempt to provide some basic intuition as to why green investing should not obviously drive superior performance. We raise the more technical climate risk modeling to both point to climate impact transmission ambiguity, but also to note that our management approach in this chapter is indifferent to the details. In the next section, we will dig into asset pricing and portfolio construction in greater detail, developing portfolios and risk management tools that will work regardless of underlying model uncertainty.

Asset Pricing: Theory to Implementation

The approach this section takes to hedging climate risk depends on the concepts of modern portfolio theory, asset pricing models, and quantitative portfolio construction. We will attempt to provide a non-expert reader with a useful overview of the history and development of these concepts, and their applications as used in the asset management business.

Theory: Capital Asset Pricing (Mis)modeling

Modern portfolio theory begins with Markowitz (1952). His "brilliant insight", according to Rubinstein (2002), "[was] that while diversification would reduce risk, it would not generally eliminate it" and therefore investors should seek to maximize expected returns, while minimizing risk.

Markowitz showed that for any collection of assets, with associated expected returns, and covariances among the assets, an investor could construct a unique set of portfolios that would have the lowest level of risk at each achievable level of portfolio return. Furthermore, an investor would select *only* from this set of portfolios since any portfolio not on this "mean–variance frontier" (MVF) could be improved upon, with an expected lower risk for the same return.[11]

In Fig. 2.3, we plot a hypothetical MVF based on the characteristics of a collection of assets.[12] Indifference curves describe the preferences of our investor. These curves are upward sloping and convex—she always prefers more return and less risk.[13] As her risk increases, she demands ever increasing returns to compensate for marginal risk. A rational investor holds a utility maximizing portfolio where her indifference curve is tangent to the MVF.[14]

In Fig. 2.4, we extend to a case where a riskless asset exists. This is not as far-fetched as it sounds, and it provides some particularly useful results. For example, bank deposits, subject to FDIC limits in the United States, are essentially riskless. Similarly, US Treasury bills have a known return with

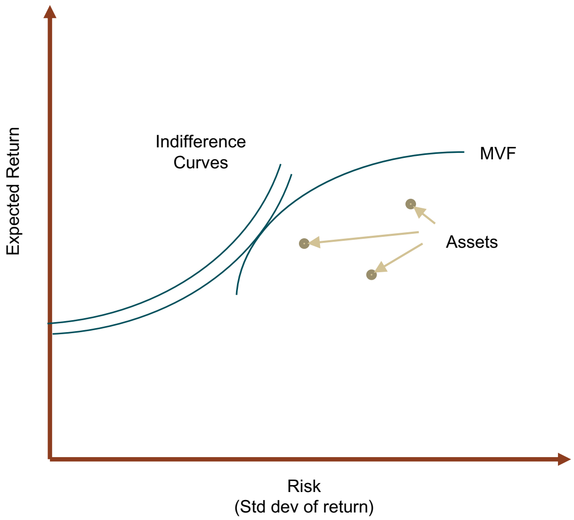

Fig. 2.3 Mean–variance frontier with investor preferences

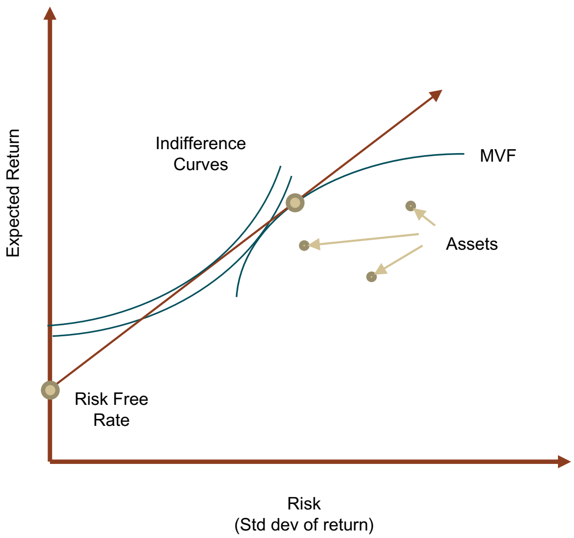

Fig. 2.4 Mean–variance frontier with riskless asset

extremely remote risk of default. We plot the riskless asset on the vertical axis of the plot: some expected return, with a zero standard deviation. If we draw the highest sloped line from the riskless asset to the MVF, (the *security market line,*) we call that tangent point the *mean–variance efficient* (MVE) portfolio. We call the slope of that line the Sharpe ratio, after (Sharpe 1967).

The Sharpe ratio tells us the highest expected return per unit of risk available to our investor.

Without a riskless asset, in Fig. 2.3 we see that based on investor preferences (i.e., shape of the indifference curves,) investors would hold various portfolios on the MVF. With the addition of the riskless asset, and the security market line, we can show that all investors will hold *only* a combination of the MVE portfolio and the riskless asset. First, we know that our investor could choose to hold only the MVE portfolio, (even though, based on her indifference curves, it would not be her optimal choice on the MVF.) She could also hold only the riskless asset. Therefore, by choosing any combination of the MVE portfolio and the riskless asset, she could hold any portfolio on the *security market line*. In fact, if she can borrow at the risk-free rate, she can hold any position on the security market line that extends beyond the MVE portfolio.[15]

Notice that by holding a mix of the riskless asset and the MVE portfolio, our investor can always reach an indifference curve of higher return and/or lower risk than holding any other portfolio of risky assets. This will hold for any investor utility function.[16] Markowitz's core result implies that all investors should hold only the riskless asset and the MVE portfolio, regardless of their preferences.

Shortly thereafter, Sharpe (1964) and Lintner (1965) burst onto the scene. They built upon Markowitz, with the first and most widely known model of asset pricing: the *capital asset pricing model*, or CAPM. (For an excellent presentation of CAPM, see Cochrane (2009), particularly Chapters 6 and 10, or Ang (2014) for a less mathematically formal presentation.) CAPM builds on Markowitz's MVE portfolio and demonstrates that asset prices and returns depend only on an asset's covariance with the MVE portfolio, but the collection of assets includes *all* assets.[17]

CAPM took the finance world by storm. Business schools around the country shifted much of their traditional stock analyst training toward teaching the modern, analytical approach based on CAPM. Everything investors needed to know about asset pricing and returns flowed from the MVE portfolio that all investors ought to hold. Applying modern portfolio theory and CAPM to investment decisions holds significant appeal. Analytical models replaced intuition and judgment. Systematic methods allowed for empirical rigor.

Implementation: Good Benchmarks vs. Cheap Indices

Here we take a brief historical sidetrack to link theory, that demands a portfolio of all assets, and practice, that uses a collection of traded assets. In US markets, for example, investors seem to behave as if the Standard & Poor's 500 Index is the *right* benchmark to evaluate their portfolio. An historical accident led to its supremacy and letting go of this may reduce one of many impediments to managing climate risk.

In a rarely cited paper, Armstrong (1960) set out to show that the nascent investment vehicle, mutual funds, made good investments. He compared performance of several funds to the Dow Jones Industrial Average, using cumulative returns and a measure of relative risk. As a practitioner, he did not yet have the newly developing tools of modern portfolio theory, nor yet-to-be-developed asset pricing models at his disposal.

Armstrong discussed the tradeoffs of different indices noting "[i]t is often said that the Dow Jones Industrial Average (DJIA) is 'unmanaged.' Few statements could be more misleading." He further explained convoluted calculation mechanics for a price-weighted index such as the Dow. He observed "one-half of its weight is in the 10 higher-priced stocks, with the other half in the 20 lower-priced stocks." In passing, he noted that "Standard and Poor Indices give the largest amount of weight to stocks with the largest aggregate market value."

We might restate Armstrong's conclusion in the context of modern portfolio theory: Armstrong sought a benchmark, something like a return on the total wealth portfolio of CAPM, he could use as a basis for evaluating mutual funds. He chose the DJIA. The formality of CAPM would explain why, over the next several years, investors would recognize his poor choice: a capitalization-weighted benchmark like the S&P500, while not reflecting the true "wealth portfolio", at least came closer to an equilibrium portfolio that could be held by all investors.

Samuelson (1974) challenged the practitioners of finance with the newly developing theory. He looked to the field of financial economists of the time, and noted none could identify superior performance by asset managers, writing that "[t]he only honest conclusion is to agree that a loose version of the 'efficient market' or 'random walk' hypothesis accords with the facts of life." He further explained transaction costs in a zero-sum game of beating the market would drag down performance. Samuelson directly contradicted Armstrong's result that mutual funds should outperform. He challenged the asset management world to track the S&P500 index. Samuelson most certainly thought of this as a practical equity market substitute for the theoretical MVE portfolio.

John Bogle, the founder of Vanguard, credited Samuelson (1974) as his inspiration for launching Vanguard's famous index fund the next year, even though he dismissed knowledge of CAPM and efficient markets.[18] However, even a casual reader would see Samuelson's connection with efficient markets and asset pricing theory. In a 2013 exchange, Bogle denied knowledge of these theories until decades after Vanguard's launch, while at the same time Bogle challenged Armstrong head on, changing benchmarks and trying to dispel the myth of outperformance. This wouldn't be particularly surprising, until one realizes that Bogle wrote the Amstrong paper under a pen name.

Once Bogle provided the S&P500 index as an easily implemented equilibrium portfolio available to any investor, practitioners seemed to have lost track of the fact that CAPM's market portfolio contains all assets, and the S&P500 simply serves as an acceptable, but far from perfect alternative. We'll discuss some implications of this imperfect solution when we turn to implementation.

Theory Meets Implementation: ICAPM, APT, and Alpha

CAPM elegance and intuition notwithstanding, researchers and practitioners have found many weaknesses. Merton (1973) and Ross (1976) developed two closely related models to generalize CAPM, termed the *intertemporal capital asset pricing model* (ICAPM) and *arbitrage pricing theory* (APT), respectively. These models extend the single factor in CAPM (where an asset's covariance with the market portfolio explains returns) into a multi-factor framework, where any number state variables (including the market portfolio return) may drive asset returns.

Asset owners and asset managers strive for superior returns. Identifying a clear definition of superior returns remains elusive and complicated. Typical approaches involve linear regressions of asset returns on at least a market portfolio, and potentially other constructed risks (or factors) that might describe return variation. Measures of "value", "momentum" or "small cap effects" are different factors used to describe returns. We also hear the term "alpha" and "beta" in the context of evaluating managers. In a linear regression of manager returns on the market, alpha and beta correspond to the intercept and slope terms, respectively. A positive alpha means a strategy generates return in excess of that predicted by CAPM. For example, an S&P500 index fund will have a beta very close to one, and an alpha of very close to zero.[19] A manager consistently beating a benchmark has positive alpha.

When asset managers and asset owners use factor models to evaluate risk and returns relative to benchmarks, evaluate managers, and attribute performance, they seek positive alphas that have lower *tracking error*, defined as standard deviation of the difference between a strategy return and the benchmark return.

A manager seeking to generate alpha presumes to have some sort of information that allows her to construct a "private" MVF that differs from the market.[20] We would expect this information to have decreasing marginal value, i.e., the more of this information she uses, the less value it adds. Maybe her information edge applies only to a selection of smaller stocks; or, as she trades more, her information leaks into the market. In any case, analogous to the concave MVF in Fig. 2.3, her excess return per unit of tracking error falls as her tracking error increases, as shown in Fig. 2.5.

She could manage any one of various portfolios at a target expected excess return, or target expected tracking error. She might define products for her clients based on expected "information ratio"—the ratio of excess return to tracking error.[21] A high information ratio strategy more reliably generates excess returns than a lower information ratio strategy.[22] The figure shows three such strategies, with increasing excess returns, but falling information ratios.

Investor preferences, like Fig. 2.4 indifference curves, determine preferences over information ratios, and underly a decision to deviate from a benchmark, and by how much. For typical preferences, we can draw two

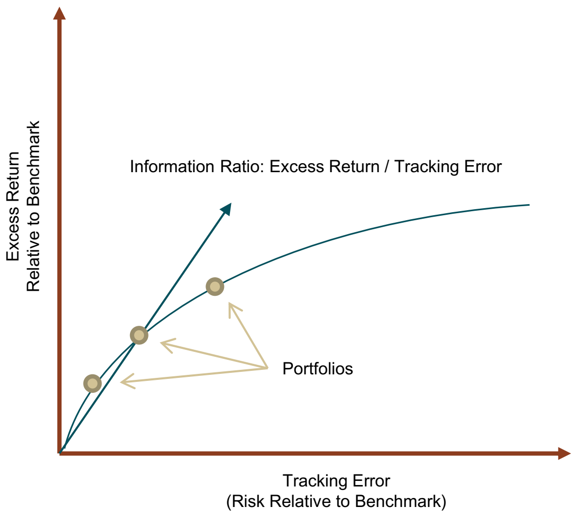

Fig. 2.5 Manager's possible information ratios

conclusions. First, as tracking error approaches zero, information ratios may be quite high, and under many models of manager private information, the confidence in that information ratio increases as well. Therefore, unless an investor has absolute intolerance for any tracking error, an investor would rationally choose to take some risk.[23] Second, as wealth increases, investors become more tolerant of risk, particularly small risks. We will return to these preference implications in our conclusions.

Portfolio Optimization

In this section, we turn from theoretical to practical. We build portfolios. More specifically, we set out to capture the risk implicit in greenhouse gas emissions. As we discussed in the previous section on modeling climate risk, we do not know how GHG emissions will impact the real economy, nor when we might hit a tipping point, or even what a tipping point might mean. We can reasonably expect that policy changes, investor sentiment, or even investors' acceptance that CO_2 emissions contribute to market uncertainty will play out through companies based on their carbon intensity. Carbon intensity serves as our conditioning information. We expect companies with high-carbon intensity have greater exposure to this probable, but uncertain risk.

Our theoretical portfolio manager seeks to minimize tracking error—something investors dislike—for a target level of excess return—something investors like. In the same way, we seek to minimize tracking error subject to a target level of *carbon intensity reduction*—something investors might value. Specifically, we construct portfolios that reduce carbon intensity by percentages, e.g., if the benchmark has a CI of 250 tons/$sales, a 20% benchmark relative portfolio would have a CI of 50 tons/$sales, or an 80% reduction. We have a slightly different objective, but we reach it using the same methodology.

We need a factor model to execute on our optimization. We use the MSCI Barra Global Equity Model, one of several widely accepted, commercially available models. This model uses 16 common factors and 44 industry factors to describe risks of any stock. Portfolio risk aggregates the exposures to risk factors for every position. The factor exposure difference between a portfolio and a benchmark provides a forecast of tracking error. Note that the optimization process will not simply eliminate exposures to industry factors (at least initially) because excluding industries would have material impacts on forecast tracking error.

In Fig. 2.6, we plot the curve that describes portfolios reducing bench-

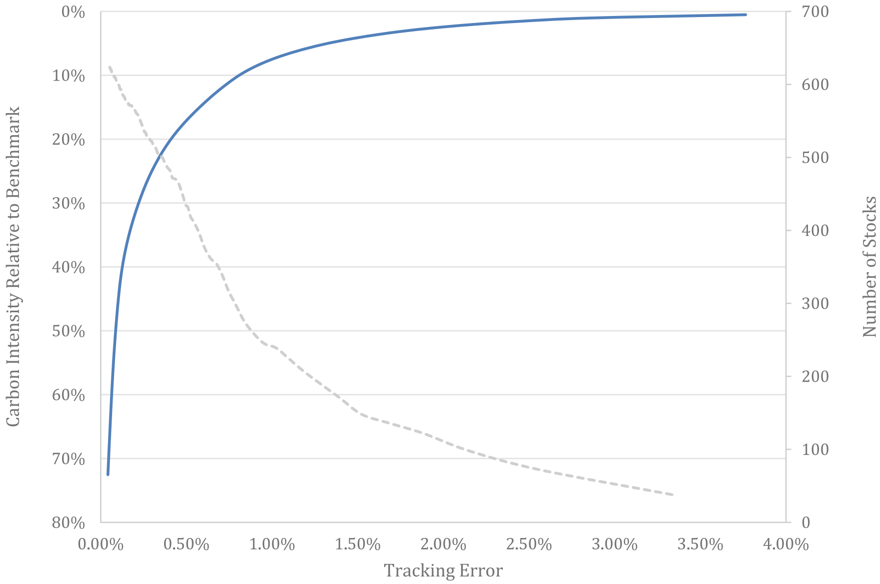

Fig. 2.6 Carbon intensity frontier, MSCI USA index, year-end 2015 (*Data Source* MSCI ESG Research LLC, MSCI Inc., Barra Global Equity Model, and Barra Portfolio Manager [Barra, LLC])

mark relative carbon intensity for the MSCI USA Index for year-end 2015. We call this the *carbon intensity frontier*. Notice we can dramatically reduce carbon intensity with modest tracking error: 50% CI reduction results in less than 0.20% tracking error. A 90% reduction in CI, i.e., 10% of the index level, results in less than 1% tracking error. To put these numbers in context, tightly constrained institutional enhanced index strategies may have 1% tracking error or more. Discretionary retail mutual funds may have several percent tracking error. In other words, meaningful reductions are almost unnoticeable. Dramatic reductions introduce some tracking error.

On the right-hand axis, we plot the number of positions in the portfolio. We might be concerned that reducing CI so dramatically would result in a poorly diversified portfolio. However, even the 50% reduction portfolio has more than 260 positions. This gives us some degree of confidence that our tracking error estimates reflect reasonable diversification of stock-specific risks. Remember, the way the Barra model works, our portfolios continue to manage against 44 industry-specific risks. Our optimization does not simply exclude oil and gas extractors, at least not until extreme CI reductions.

What is an investor to do with this knowledge? Following our information ratio discussion, an investor has preferences over carbon reduction and tracking error. Those preferences may depend on the underlying model of risk, or on investor-specific preferences to reduce carbon exposure. Recall our previous two observations: (a) the curve steepness at very small relative reductions means virtually any investor would willingly reduce carbon exposure by some amount even if they aren't particularly engaged with or concerned about climate issues; (b) even at substantial reductions, the tracking error cost remains low and idiosyncratic, so wealthy investors, particularly universal owners, should be indifferent to this risk; (c) an investor confident that carbon intensity risk is real, yet uncertain about when it might hit, might choose dramatic reductions, noting a 90% reduction only adds a little more than 1% tracking error.

Recall earlier, we saw that carbon intensity of a portfolio may shift through time because of equity market movements. In Fig. 2.7, we present the shift in the carbon intensity frontier over time. The trend over time follows a positive pattern: an investor with a fixed tracking error budget may, over time, reduce carbon intensity by more.

While this approach does an excellent job at reducing carbon exposures for an equity portfolio, it has some important limitations. First, this approach cannot provide Net Zero exposure for a portfolio. Second, by extension, this approach cannot provide for potential offsets for non-public equity exposures.

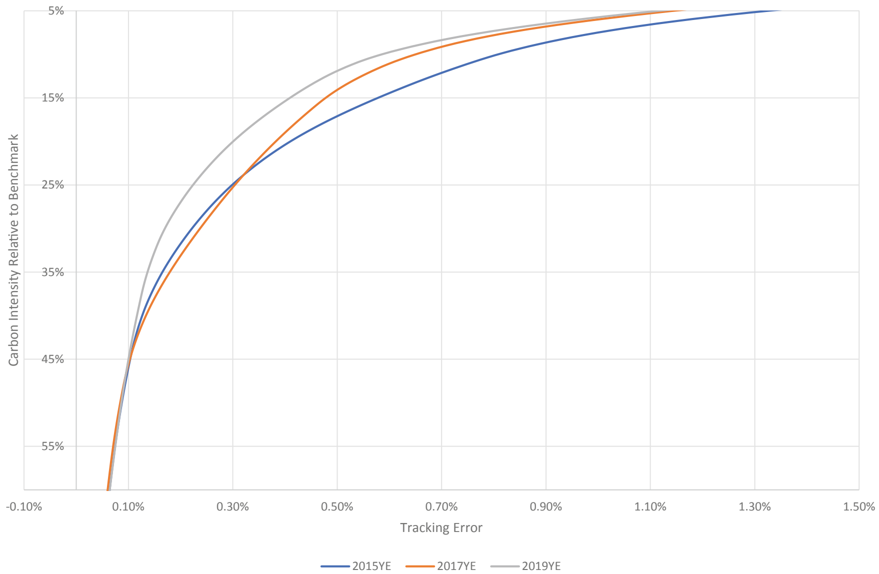

Fig. 2.7 Carbon intensity frontier, 2015–2019 (*Data Source* Barra Global Equity Model and Barra Portfolio Manager [Barra, LLC])

Option Replication and Long/Short Portfolios

Some asset managers, particularly hedge funds, construct long/short portfolios. These are equity portfolios that balance exposures long and short. In theory, they have zero cost. How does this work and what does this portfolio do for an investor in our context?

Suppose an investor with $100, buys the 20% carbon intensity portfolio. At the same time, she sells short $100 of the index by borrowing the stocks in the index and selling the borrowed shares. The resulting portfolio consists of a $100 portfolio of stocks she owns, $100 portfolio of stocks she borrowed and sold short, and the $100 of cash proceeds from her sale of borrowed shares. This portfolio has zero net equity exposure, $100 of cash, and she owns the performance differential between the low-carbon intensity portfolio and the index. In theory, this portfolio has zero cost. She started with $100, and after a bunch of trades, she still has $100, but also a bunch of risk.

How much risk? From Fig. 2.6, we can deduce that the long/short portfolio has about 0.5% total risk. (The short portfolio, index risk, offsets the long portfolio risk, leaving only the tracking error as the total risk.) Moreover, the arithmetic works if she buys $200 of long positions, and shorts $200, only now her long/short portfolio has about 1% risk because she has twice the gross portfolio exposure.

What do we know about this risk? We know this risk captures whatever might happen that drives return differences related to carbon intensity. She holds long positions in low intensity stocks, and she has short positions in high intensity stocks. If high-carbon intensity *hurts* asset prices, her long portfolio should perform much better than her short portfolio. Of course, the reverse holds if high-carbon intensity helps prices. She need not concern herself with the exact dynamics underlying climate risk.

Does she capture this risk for free? This seems too good to be true. Turn back to our ICAPM/APT discussion and consider two views of our investor's portfolio. On the one hand, we recall that under a MVE framework, an investor maximizes her utility by holding the MVE portfolio. If our investor owns the MVE portfolio and adds to it the long/short portfolio, she no longer holds "only" the MVE portfolio, therefore, she must pay a price. In this setting, she pays a price to hedge a risk that the asset pricing model says is uncompensated. On the other hand, in an APT setting, we have simply constructed a portfolio that replicates the payoff of the factor risk. However we decide to describe it, the conclusion remains the same: if carbon intensity risk impacts the market, she is hedged. If it does not, she pays a very small price in terms of tracking error, or risk that she underperforms the market.

Conclusions

We set out to help investors understand ways they might integrate improved climate data into investment portfolios. While accurate, audited data makes this process more effective, we have shown that even if we assume perfect data, the results are not obvious. Relative commodity prices and relative market performance may confuse our results, nonetheless.

However, our most important message to asset owners and asset managers is that they should let go of the outperformance promise, and instead focus on carbon and climate risks. They will have greater success implementing risk management methods that may capture the effects of climate risks in robust ways, indifferent to models and economic mechanisms. These strategies may be implemented efficiently, at low cost.

Practically, where should an investor start? First, worry less about benchmarks. The MSCI USA, or the S&P500, are both perfectly good benchmarks. Any benchmark you buy falls short of what theory demands. In practice, an index serves as an adequate substitute for a theoretically correct portfolio, and as a cheap substitute for discretionary portfolio construction by well-paid asset managers. Any well-diversified portfolio that you can hold at low cost fills the bill. The range of carbon intensity reduction portfolios we modeled also fills the bill. Therefore, investors should consider alternative, lower carbon portfolio strategies that may be implemented cheaply. Spend time convincing investment committees and boards of trustees to switch benchmarks.

Second, the minimal tracking error resulting from small reductions in carbon intensity means that virtually any investor should be willing to reduce carbon intensity by some amount. So, you should take that minimal risk. For universal owners, or very large investors, we can take it one step further: even if you have low confidence in a risk-based approach to climate investing, you are indifferent to idiosyncratic risks that don't have (material) costs, so take some. It may hurt short-run performance a little.[24] It might, on the margin, lead others to shift as well.

Third, long/short strategies can be used to dramatically reduce your carbon intensity. For example, by reducing long exposure, and adding long/short exposure, you could remove carbon intensity risk from equities entirely. By expanding further, you could offset carbon intensity risk in private equity, or other parts of your portfolio as well.

Fourth, equity portfolio carbon intensity serves only as one example of climate risk proxies (see the Conclusion for more discussion on the conflation of emissions accounting and risk management.) You may find your portfolio has other climate-related risks of concern. Flood risks threaten many company assets. While companies insure these risks today, a risk appetite shift by insurance companies due to their own climate risk concerns might leave assets uninsurable. A long/short strategy might capture this variation of physical risk. Similarly, physical risks have been used by some managers as inputs into municipal bond valuations. Using the methods outlined here, you could manage risk exposure with municipal bonds, or even amplify it.

Public markets provide some of the most flexible environments for strategic implementation of investment ideas and risk management tools. Climate risk applications abound. Even if direct impacts on the real economy lie beyond reach, applying these tools has the potential to change perceptions and influence other investors while also enhancing risk management.

Key Takeaways:

- Focus less on marginal performance gains, and more on meaningful risk reduction. Chasing performance generally fails. Implementing strategies that substantially reduce exposures to climate risks are more reliable and verifiable.
- Asset class benchmarks are not carved in stone. Asset owners and managers should adopt modified benchmarks more closely aligned with Net Zero initiatives.
- Climate risk hedging translates across assets. Public markets can provide investors tools to hedge their total portfolio exposure to climate risks in flexible, inexpensive ways, even for asset classes difficult to manage or trade.
- Recognize limitations. Public markets have limited impact on the real economy.

Notes

1. Significant complications arise calculating Scope 3, as discussed in Chapter 4.
2. The data used throughout this paper has been generously provided by MSCI, Inc. and its affiliates. Carbon intensity results used in Figs. 2.1, 2.2, and 2.6 have been derived from MSCI ESG Research LLC data. Index results used in Figs. 2.1, 2.2, and 2.6 have been derived from MSCI Inc. data.
3. Using GDP has another set of concerns. Why use GDP when carbon impacts the globe, for example. Or, we could consider impacts to GDP per capita. Any measure we choose will have implicit and explicit biases.

4. This concern has particular relevance to the highest emitters. Energy companies typically carry substantial debt, and use complex capital structures and off-balance sheet entities confusing such calculations.
5. For more details on index construction methods, see https://www.msci.com/our-solutions/indexes. The particular index choices in this paper reflect general familiarity with markets and products. We note that the ACWIxUS does overlap with the EM index. The Barra Global Equity Model and Barra Portfolio Manager (Barra, LLC) were used for index construction and analysis, as well as for producing Figs. 2.6 and 2.7.
6. The approach taken by Pedersen, Fitzgibbons, and Pomorski (2019) follows this strategy in a formal way, deriving interesting results with novel modifications to investor preferences. Still, they find indeterminate results depending on underlying assumptions about relative frequency of investor preference types.
7. An extensive academic literature exists around excess return persistence. Most depend on forecasting biases by stock analysts. To the degree climate risk disclosures or strategies may link to persistent excess returns, the mechanism probably ties to similar models of forecast errors.
8. Selling positions in dirty companies may reach a threshold such that increasing cost of capital strands dirty assets. More on this topic later.
9. As we discuss in the next section, asset prices and returns must tie back to consumption models.
10. Mathematically, a climate disaster follows a Poisson process. We have some expectation of the likelihood of the event in any given period, but we do not know exactly when the event may happen.
11. Although we use the term "mean–variance frontier" based on an optimization problem that maximizes mean return subject to a penalty for variance, the conventional graphical presentation uses mean returns and standard deviation of returns.
12. The complete MVF, in fact, follows a hyperbola. For simplicity, we ignore the lower half of the curve. These are portfolios with minimum returns for a given level of risk—not something generally of interest to actual investors!
13. Technically, the indifference curves may be linear. They cannot be concave. Concave indifference curves would imply an investor would accept more risk without compensation, and at an increasing rate.
14. We could imagine different investor preferences, where indifference curves have a different shape, and therefore have a tangent point to the MVF at a different location.
15. Think of this as a short position in the riskless asset, otherwise known as borrowing at the riskless rate. The idea that any investor may borrow and lend any amount at the riskless rate makes for nice mathematical results and intuition. Obviously, it lacks practicality.
16. Subject to endnote 13, however.

17. "All assets" is a rather expansive term, as Cochrane (2001) notes: "not only all stocks, but all bonds, real estate, privately held capital, publicly held capital (roads, parks, etc.), and human capital—a nice word for 'people'."
18. Bogle letter to *The Wall Street Journal*, October 18, 2013. https://www.wsj.com/articles/SB10001424052702303680404579139530872119634.
19. Index fund fees look like small negative alpha. Due to fee rebates, securities lending, and other features of market microstructure some index funds may not show negative alphas.
20. An interesting theoretical result from Hansen and Jaganathan (1997), shows that there always exists a pricing model that correctly prices securities—in other words that alpha does not exist, at least ex post. However, ex ante, we reasonably assume conditioning information could exist. This is not inconsistent with weak forms of market efficiency.
21. The information ratio is similar to the Sharpe ratio. A Sharpe ratio measures the tradeoff between return and risk relative to a riskless payoff, versus the information ratio that measures the tradeoff between excess return and risk relative to a risky benchmark.
22. The statistical details for the distributions of Sharpe ratios and information ratios are complex.
23. We must keep in mind that this argument assumes we are observing net of fees excess returns. If fees or trading expenses would eat all the excess returns, this conclusion would not hold.
24. In fact, mathematically an investor may add value to a portfolio through this risk, carefully managed, under many modeling assumptions.

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3

Carbonwashing: ESG Data Greenwashing in a Post-Paris World

Soh Young In and Kim Schumacher

Editorial Note

As regulation and governance of climate action has moved from centralized governments to distributed regimes, the number of actors engaged in the practice (and marketing) of emissions reductions has increased to include financial institutions, corporates, and other non-state actors. With a multiplication of actors comes critical coordination challenges. This chapter focuses on one such problem—"carbonwashing," a term the authors define to name instances of misleading information about the carbon-related impacts and actions of a company or its products.

In the period since Paris, we see three key evolutions in carbon disclosure and reporting driving the issue of carbonwashing to greater prominence: (1) an

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increasing importance of the futurity of data; (2) a shifting focus from "what are your own emissions?" to "what are the emissions of everyone in your value chain?"; and (3) a growing recognition of the difference between measuring risk instead of emissions alone. This chapter outlines the complex ecology of actors involved in carbonwashing, as well as the evolution of Net Zero reporting and disclosure in practice. While evolution is often presumed to be good, the editors challenge the reader to consider whether the direction of current practice presages emissions reductions in the real economy.

In recent years there has been a wave of announcements, pledges, statements, declarations, initiatives, calls, and various other forms of public messaging regarding the corporate implementation of decarbonization strategies. The most notable example revolves around the concept of "Net Zero" emissions commitments. The majority of these commitments, which currently cover about two-thirds of the global economy, set 2050 as the target date for (net) zero greenhouse gas (GHG) emissions.

Yet, there exists a significant disconnect between stated ambitions and observed management practices, which might include: GHG monitoring, actionable reduction strategies, efficient governance, and capital allocation toward achieving these self-declared targets. For example, a recent study by the Oxford Net Zero initiative revealed that only 20% of these targets currently meet quality tests (Black et al. 2021). Furthermore, a report by the Climate Action 100+ initiative stated that among the world's largest corporate GHG emitters, "only six companies explicitly commit to aligning their future capital expenditures with their long-term emissions reduction target(s), and none of these companies has committed to aligning future capital expenditure with the goal of limiting temperature rise to 1.5°C" (Climate Action 100+ 2021).

This massive degree of corporate impact frontloading in the form of climate change mitigation-related public relations (PR) does not seem to be matched with similar ambition in terms of tangible measurement, reporting, and verification (MRV) of GHG emissions. As such, these efforts could be seen as a form of "greenwashing," a term that refers to the practice of marketing a product as "green" or "sustainable" when, in fact, it does not meet basic environmental standards (European Commission 2019). To address issues of greenwashing, climate-related risk disclosure has been gaining immense momentum through initiatives, frameworks, and associations such as the Task Force on Climate-related Financial Disclosures (TCFD), the Carbon Disclosure Project (CDP), the Science-based Target Initiative (SBTi), the Net Zero Asset Owner Alliance, the Glasgow Financial Alliance for Net Zero (GFANZ), the RE100, and the UN Climate Change Conference

(COP)-affiliated "Race to Net Zero." In this context, given the overwhelming role that carbon data plays, we introduce the term "carbonwashing" as a unique classification of carbon-related greenwashing instances.

These climate-related initiatives exert significant pressure, both regulatory and reputational, on firms to reduce their carbon footprint and create reputational incentives for companies to transition to climate-neutral business models and low-carbon supply chains. Financial institutions are similarly under increasing scrutiny to decarbonize their investment portfolios, as well as refrain from providing financing or underwriting to carbon-intensive projects, activities, or assets (PAAs). Meanwhile, companies and financial institutions continue to struggle with proper reporting of environmental, social, and governance (ESG)-related data, and carbon data in particular. At the same time, these actors have incentive to take advantage of systemic inconsistencies, such as regulatory gaps or lack of standardized disclosure frameworks, to realize the benefits provided by positive climate-related PR. These benefits include being able to communicate strong decarbonization efforts, direct positive impacts on corporate ESG ratings and score, and alignment with investor-level or regulatory carbon benchmarks. Given these reputational incentives, regulatory pressures, and methodological shortcomings, the proliferation of future-oriented Net Zero promises may outstrip the pace of a concrete system-wide low-carbon transition.

This chapter aims to illuminate the space of carbon data disclosure to better account for the burgeoning interest in global public and private decarbonization efforts. The first section grounds the discussion by mapping the carbon data ecosystem and providing an overview of its constituent actors. The second section offers a list and subsequent discussion of the different forms that carbonwashing can take within these entities. The final section posits and traces the evolution of several factors that drive the risk of carbonwashing throughout the carbon data system.

The Carbon Data Ecosystem

Green finance tools rely on objective and accurate carbon data to distinguish high-carbon performers from low-carbon performers. Kolk et al. (2008) describe how the effectiveness of carbon disclosure, as a tool for determining sustainable investment allocation, depends on its reliability and usefulness, which, in turn, incites investors to pressure additional firms to disclose and improve their carbon performance. To better ground the discussion of where and how instances of carbonwashing may occur, this section traces the progression from firm-level carbon disclosure to investor action, providing a brief overview of the key players in this process.

Firms: Suppliers of Carbon Data

As most available information or disclosed data about carbon performance is currently not subject to regulation, the vast majority of carbon data takes the form of self-disclosed firm-level environmental communication (Guo et al. 2020). In other words, firms are currently the primary generators of available carbon data.

The TCFD encourages firms to disclose the carbon footprint and low-carbon transition pathways of their activities, as well as additional information regarding carbon-related governance, strategy, risk management, reduction targets, and accounting metrics. Firms may also include investments they are making toward carbon reduction as a forward-looking measure, including "carbon–neutral," "Net Zero" or "carbon-negative" targets. Over 800 firms have committed to science-based targets (SBTs), which aim to align firm-level climate mitigation strategies with common climate models, including those by the International Energy Agency (IEA), to meet the Paris Agreement's 2°C emissions target (Newell 2020; Walenta 2020). This uptake has in large part been driven by the SBTi, a collaboration of non-profits working to help companies set science-based emissions reduction targets. Large firms, such as Microsoft and Unilever, have also implemented internal carbon prices as a form of self-regulation, though the efficacy of such tools has been debated (Addicot et al. 2019; Bento and Gianfrate 2020).

Firms communicate their carbon performance to stakeholders through a variety of channels (In et al. 2019). Firm-specific sources include corporate social responsibility (CSR) reports, annual filings, and information posted on company Web sites. In addition, firms can adhere to or fall under carbon emissions disclosure regimes, which can be divided into two broad categories. Mandatory regimes, such as the European Union (EU) Emissions Trading System (ETS), require firms to disclose some portion of their emissions to a government agency to determine the amount of required carbon credits. These schemes are characterized by their focus on a firm's direct emissions and their strict accounting requirements. The second regime category consists of voluntary reporting initiatives, which exist to encourage firm-level transparency about carbon emissions and to provide diverse groups of stakeholders with access to this information. The CDP is the largest and most comprehensive of these frameworks (Kolk et al. 2008). The CDP collects its data via a detailed annual questionnaire sent to firms, which covers emissions metrics, strategy, governance, and climate risk management. Voluntary schemes are usually less strict about their accounting practices and more flexible regarding the applicable accounting frameworks than mandatory regimes, particularly regarding the type of emissions firms are encouraged to report. As a result, there often exist significant discrepancies with regard to the types of emissions firms track and disclose.

Rating Agencies: Aggregators of Carbon Data

Once a firm discloses its carbon performance, the data is often aggregated and analyzed by third-party rating agencies. These agencies act as intermediaries between company disclosures and investors looking to access and use that data in a publicly accessible format or centralized database. In addition, rating agencies create indicators and metrics based on data provided by firms with the aim of increasing data comparability and ultimately distinguishing high-carbon from low-carbon performers. Sectoral benchmarks, which place corporate climate mitigation performance into a financial context, are based on how well firms carry out their carbon data MRV processes. These are then often utilized to determine the makeup of ESG or climate-aligned investment portfolios.

Investors: Users of Carbon Data

In recent years, investors have become interested in carbon data for a number of reasons. First, as the profile of climate change has increased in the public consciousness, there is significant retail demand for products with a link to the low-carbon transition (Deloitte 2020). This has led to competitive pressures around green products, as well as pressure for decarbonization of standard product offerings (Benz et al. 2020). Industry advocacy groups have also played an important role in raising the profile of green finance, one the earliest being the United Nations Environmental Program Finance Initiative (UNEP FI), created in 1992, following the Earth Summit in Rio de Janeiro. In particular, the Principles for Responsible Investing (PRI) and the TCFD are two high-profile initiatives advocating for investors to integrate ESG data through transparent risk assessment. Second, there are legal requirements in some countries to pursue decarbonization and disclosure around it, such as the French Energy Transition Law that requires investors to report on their CO_2 reduction strategy and climate risk management under its Article 173. Third, climate risk assessments have increased practitioner interest in managing those risks. Climate risks are grouped into physical risks and transition risks, wherein physical risks relate to the impact of climate change's physical effects on a firm's operations, and transition risks concern the policy, societal, and market-based risks associated with a low-carbon transition, such as the implementation of a carbon price or Net Zero targets. Transition risks particularly increase present-day pressure on firms since there is an increasing likelihood of regulatory actions limiting their carbon emissions (Monasterolo et al. 2017; Andersson et al. 2016). Finally, investment portfolios can also be evaluated based on their carbon footprint, comparing the average portfolio-level carbon emissions of firms. As a result, the use of carbon data is no longer confined to targeted ESG funds but is instead increasingly considered in the policies of traditional products (Barzuza et al. 2020).

Carbon-oriented index funds generally fall into two broad categories—exclusionary models focusing on divestment from high emitters and "pure-play" models focusing on driving impact in a green sector such as clean energy. This choice between exclusion and impact is mirrored across the broader asset management business, where managers have the option of creating new ESG product offerings or removing carbon-intensive stocks from existing funds. In practice, the former strategy is currently preferred, either via thematic or exclusionary low-carbon funds (Jahnke 2019). Prominent funds focusing on the exclusionary decarbonization strategy include the MSCI Global Low Carbon Leaders Index product family, which is based on existing indices but excludes the worst performers based on carbon intensity and fossil fuel reserves. Similar strategies are pursued by the S&P 500 Carbon Efficient Index product family or the iShares MSCI ACWI Low Carbon Target ETF. Many index families offer a variety of options depending on investor preference for decarbonization methods. For example, the S&P 500 Carbon Efficient Index weights companies based on carbon intensity, while their Carbon Efficient Select Index weights based on firms' overall carbon footprint. Notably, the Amundi Equity Global Low Carbon index tempers the exclusionary strategy by reducing the representation of carbon-emitting companies rather than excluding them entirely (see Chapter 2 for further discussion of low-carbon equity strategies).

The more impact-driven model of product construction features a greater diversity of approaches. The Low Carbon Risk Index from Morningstar uses data from Sustainalytics, a prominent ESG rating agency, in choosing stocks with a lower carbon risk score, resulting in high exposure to tech and healthcare with low exposure to energy and utilities. A different strategy is employed by two S&P Indices, the S&P Eurozone Large MidCap Paris-Aligned Index and the Climate Transition Index. In each, companies are selected and weighted based on their compatibility with a 1.5°C global warming climate scenario. In terms of data used to construct these two broad types of products, carbon intensity remains a common choice, either relative to sales or market capitalization. However, firms often employ other emissions-based metrics, such as ETHO Capital's Scope 4 emissions that consider the emissions reductions produced by a firm or its products. Investors use both historical and forward-looking carbon information in determining firm-level carbon performance, in line with the practices of third-party rating agencies. This growth and diversification in the climate-related index product segment have also caught the attention of lawmakers and regulators. For example, the EU has recently adopted a series of legislative and regulatory acts around climate and ESG benchmarks and disclosures to address the risk of greenwashing to improve transparency and comparability of information (European Commission 2020c). Through the introduction of an EU Climate Transition Benchmark (EU CTB) and an EU Paris-Aligned Benchmark (EU PAB), the EU tries to streamline minimal standards for carbon-related benchmarks that are rooted in the latest climate science by requiring year-on-year self-decarbonization of at least 7% on average per annum, in line with or beyond the decarbonization trajectories of the Intergovernmental Panel on Climate Change (IPCC) 1.5°C scenario (State Street Global Advisors 2020).

Debt Markets: Issuers of ESG-Related Fixed-Income Instruments

In response to investor interest, firms have increasingly started to offer financial products highlighting current or projected carbon performance, particularly in the debt markets. Flammer (2020) defines green bonds as instruments whose proceeds are committed to financing low-carbon projects. Tolliver et al. (2019) examined publicly reported green bond proceeds allocations from 53 organizations to projects and assets throughout 96 countries from 2008 to 2017. They found that their study sample projects and assets were associated with over 108 million tons of carbon dioxide equivalent (tCO2e) in GHG reductions and over 1500 gigawatts in renewable energy capacity. Moreover, a green bond has become a representative designation for a large variety of ESG-related fixed-income instruments that support a wide range of ESG-related projects or activities (Schumacher 2020a).

For example, in recent years, the expansion gave rise to products such as sustainability-linked bonds (focused on other ESG metrics), transition bonds (for carbon-intensive firms), and climate bonds (specifically focused on developing climate resiliency). These tools are widely seen as a critical part of the economic transition and have been successful in helping firms to market their environmental credentials and communicate their goals. While there is some self-regulation, such as the Green Bond Principles and certification regimes, there is still a great deal of ambiguity as to the precise definition of what constitutes an eligible green project (Schumacher 2020b). The EU, for example, proposes a currently voluntary "EU-wide standard to encourage market participants to issue and invest in EU green bonds and improve the effectiveness, transparency, comparability, and credibility of the market" (European Commission 2020d). The proliferation of green bonds has also led to thematic ETFs focused on green bond investments, such as the VanEck Green Bond ETF and the BlackRock iShares Global Green Bond ETF (See Chapter 8 for further discussion on transition and climate-related bonds).

Forms of Carbonwashing: What Does It Look Like?

Following this outline of the carbon data ecosystem and pipeline, we turn to a discussion on specific examples of where within this ecosystem carbonwashing can be observed. Below, we propose a list of ten potential scenarios that enable or incentivize misrepresentation of carbon-related data. This structure offers the advantage of allowing relevant stakeholders to properly map climate-related disclosure based on factors likely to influence the quantity and quality of carbon data.

1. *Disproportionate share of largely unsubstantiated decarbonization plans*, which often comprises carbon data-related announcements, including Net Zero targets, carbon reduction pledges, and other forms of overly ambitious or ill-documented carbon management plans that are not met with an equal level of ambition in implementation-level MRV messaging.
2. *Immaterial virtue signaling*, such as announcements of limited tree planting efforts to display carbon awareness while constituting an immaterial component in overall carbon footprint.
3. *Insufficient, incomplete, or inconsistent measurement*, which comprises lack of material data collection across business-related projects, activities, and assets across supply chains

4. *Ill-defined and obscure carbon metrics*, illustrated by the use of vague, poorly defined, or methodologically opaque carbon measurement metrics.
5. *Overreliance on carbon offsets*, which describes the practice of formulating carbon reduction plans that rely to large extents on the use of carbon offsets; thus, any carbon reduction targets remain mostly speculative.
6. *Insufficient, incomplete, or inconsistent reporting*, of the results of lack of material data disclosure, frequent or material data gaps, or the use of different disclosure methods, formats, or units.
7. *Selective disclosure,* often underpinned by the divergent reporting of material data depending on the progress expectations or reputational influence of respective data users.
8. *Fragmented disclosure*, which constitutes the practice of spreading out material group-level carbon data throughout several reports and other means of disclosure like Web sites or blogs.
9. *Insufficient, incomplete, or inconsistent internal verification*, meaning the lack of internal governance and data assurance mechanisms to verify collected and calculated carbon emissions.
10. *Insufficient, incomplete, or inconsistent external verification*, meaning the lack of genuine independent external carbon data verification by qualified and accredited assurers.

Examples in Practice: Net Zero Target Announcements

The accelerating pace of Net Zero carbon announcements serves as a timely example of the structural mechanisms that incentivize carbonwashing and facilitate its perpetuation. Directing our focus on the various climate alliances and the corresponding pledges, declarations, and commitments to achieve Net Zero carbon emissions by 2050 enables us to illustrate imminent and emerging carbonwashing risks. If left unaddressed, these bear significant potential to only generate short-term reputational benefits for its authors and consequently undermine more meaningful and tangible long-term climate mitigation progress.

To explore how carbon data is processed and to what extent it is currently being measured, reported, and verified, it is useful to have a look at current practices around Net Zero carbon announcements and the associated carbonwashing risks surrounding their exponential growth. Specific scrutiny should also be paid to the various initiatives and alliances that promote the adoption of Net Zero carbon targets because they serve as platforms for investors and corporates to amplify their messages of self-declared climate action. Moreover, several of them also act as gatekeepers and monitors to assure compliance with any commitments, pledges, or targets set under the frameworks of the respective organizations.

An in-depth examination of the primary voluntary target validation and progress monitoring platforms, SBTi, GFANZ, and the UNFCCC "Race to Zero" campaign, outlines potential risk elements that could facilitate carbonwashing (Science-Based Targets Initiative 2021b; Climate Action 100+ 2021). The first analysis centers on the target setting and data tracking processes of the SBTi, one of the earliest and currently the largest climate reporting and carbon reduction target setting framework. This aims to procure additional transparency regarding its most recent progress report, which serves as a key global source in tracking current Net Zero target-related carbon data processing practices and how carbon data influences market sentiment (Science-Based Targets Initiative 2020; Science-Based Targets Initiative 2021b). It should be noted that as of April 2021, the SBTi Net Zero criteria are in development, and the SBTi has not yet approved any robust Net Zero targets under these criteria (Carbon Disclosure Project 2021). The SBTi utilizes many data sources, including public and private CDP disclosure data, information retrieved from company sustainability reports and Web sites, other publicly available data related to global emissions figures and market capitalization, and data collected by the SBTi (Science-Based Targets Initiative 2021a). The SBTi states that their MRV protocol, which is currently under development, will provide further guidance for companies on target achievement assessments and claims. In the report, they caution that significant portions of the progress data are presented as reported publicly by the companies themselves, and therefore such data presented should not be interpreted as confirmation or validation of a company's apparent progress toward or achievement of targets. This is a key indicator pointing toward the often highly endogenous and insufficiently verified nature of most voluntarily reported corporate carbon data.

This situation raises numerous ethical and procedural questions, as the SBTi depends on public trust supported mostly by the fact that it is being "backed by four of the most prestigious environmental organizations," which indicate that they "conduct a comprehensive, independent quality assessment of the targets against the latest climate science and provide multiple opportunities to showcase approved targets" (Science-Based Targets Initiative 2021b). However, the SBTi's methods have recently been viewed in an increasingly critical light, as there is little transparency around what specific scientific criteria are used as the basis to determine which science-based targets methods are eligible through the SBTi (Farand 2021; Bjørn et al. 2021). Given the strong reliance on the SBTi performance figures to measure corporate decarbonization efforts, it is important to note that the SBTi target validation process is not conducted in line with best practice in terms of publication of scientific results, such as an independent double-blind peer review process (McNutt et al. 2018; Allen et al. 2019; COPE 2021). It is carried out entirely internally by the initiative's technical partner organizations, the CDP, the World Resources Institute (WRI), or the World Wild Fund for Nature (WWF), and neither the internal reviews, review discussions, or the final approval are publicly disclosed (Carbon Disclosure Project 2021).

Key Drivers of Carbonwashing: Why Does It Happen?

As alluded to in the introduction of this chapter, carbonwashing can be viewed as a byproduct of general regulatory uncertainty, lack of overall standardization between reporting frameworks, ongoing data gaps, and reputational incentives. In this context, it often remains unclear how MRV of carbon emission mitigation can be carried out in the most transparent and efficient ways, and according to what standards, to prevent or reduce carbonwashing. This section summarizes and delves more deeply into each of these drivers to explore the origins and evolution of, and suggest potential remedies for, the aforementioned instances of carbonwashing.

Lack of Standardized Carbon Accounting Practices

There persists considerable ambiguity in the carbon accounting process. The latitude in measurement and evaluation of carbon performance leaves room for firms to overstate or present misleading accounts on their capabilities and carbon-use reduction efforts. For instance, Scope 3 emissions are generally optional under voluntary regimes, and the share of reporting firms only accounted for around 22% of their full Scope 3 emissions on average (Blanco et al. 2016). This lack of reporting, combined with the fact that for many firms, Scope 3 emissions represent a significant portion of their total footprint, creates the potential for firms to present an inaccurate account of their true carbon performance (Mercereau et al. 2020). Concerns have been raised that firms may outsource their carbon emissions to their supply chain, reducing reported emissions while maintaining or increasing the overall emissions generated in connection with their PAAs (In et al. 2019; Blanco et al.

2016; Bowen and Aragon-Correa 2014) (See Chapter 4 for further discussion on Scope 3 emissions).

Inconsistent and Unaudited Disclosure and Reporting

Within this disclosure environment, concerns have been raised about the inconsistency of firm-originating carbon data and the exacerbated assymetry of information. Disclosure under voluntary regimes such as the CDP remains unaudited in large part, and firms have been found to employ a variety of methods for disclosing both direct and indirect emissions, potentially rendering this information unreliable (Stanny 2018; Andrew and Cortese 2011). Furthermore, other studies have shown that many companies from carbon-intensive sectors do not disclose climate-related data at all. For example, in Japan, only a few listed companies from sectors with the highest transition risks reported their emissions under the CDP disclosure framework (Schumacher et al. 2020). This situation increases the risk that firm-level carbon data continues to display low levels of transparency and will remain largely dependent on voluntary disclosure.

Even mandatory reporting requirements are often ineffective at increasing data comparability (Matisoff 2013). Although the TCFD recommends that firms communicate information in financial filings, it is common practice for firms to place this information in largely unaudited sustainability reports (Eccles and Krzus 2018). As a result, there arises significant ambiguity about the methods employed with these reports (Dragomir 2012). Severe divergences regarding the rating methodologies of ESG raters and service providers means that the problem of inconsistent carbon data is compounded by ambiguity about how this data should be used (In et al. 2021). Rating agencies are themselves inconsistent, choosing different dimensions, metrics, and weights when evaluating firm-level ESG performance (Berg et al. 2020). This has led to low convergence between ratings, even when corrected for explicitly named differences in rating construction (Chatterji et al. 2016).

For example, evaluations can be based on firm-level processes or process-level outcomes and the different dimensions impacting firm-level performance (Delmas et al. 2013). It is difficult to determine whether ratings and indicators are meant to illuminate past behavior or provide forward-looking estimates (In et al. 2021; Chatterji et al. 2009). Rating agencies also attempt to generate forward-looking information, but these have questionable predictive power (Kalesnik et al. 2020). Forward-looking information is demanded by investors seeking to assess firm-level performance regarding risks and opportunities, but without clarification on how ratings are constructed, it will remain difficult to distinguish between high-performing and low-performing firms (Benz et al. 2020).

These issues are exacerbated by the continued absence of ESG rating agencies and service provider regulations. The chair of the European Securities and Markets Authority (ESMA) has stated that the "lack of clarity on the methodologies underpinning those scoring mechanisms and their diversity does not contribute to enabling investors to effectively compare investments which are marketed as sustainable, thus contributing to the risk of greenwashing" (ESMA 2020). In response, ESMA and the European Fund and Asset Management Association (EFAMA) have called for appropriate regulatory requirements to ensure the quality and reliability of ESG ratings and other assessment tools. Supervisory capacity gaps, however, pose the key barrier to implementing these recommendations (ESMA 2020; EFAMA 2020). The same applies to the creation of a centralized EU data register that would increase comparability and transparency of, as well as accessibility to ESG data, which faces both logistical, data privacy, and proprietary data hurdles (European Banking Federation 2020). In the US, as of the writing of this chapter, the Securities and Exchange Commission was in the process of evaluating comments it requested regarding climate and ESG disclosure. A rulemaking process was anticipated to follow.

Reputational Incentives

In light of this lack of formalized accountability mechanisms, firms have substantial incentives to publicly highlight their climate mitigation activities or ambitions as more progressive than they actually are. For example, firms generally experience improvements in stock price valuation in response to green bond issuance, thus suggesting concrete, high incentives to impression management (Flammer 2020). Furthermore, Li et al. (2019) showed that even if firms engage in symbolic instead of substantive CSR, markets view this mostly immaterial engagement positively following a corporate controversy, hence providing strong incentives for virtue signaling and unsubstantiated ex-ante ESG performance claims. Communication strategies, such as disclosing unaudited data or unsubstantiated self-reporting, are highly problematic due to the future-oriented nature of risks. Suppose one can exhibit a higher return for reporting misleading or wrong information. In that case, the disproportionate risk-reward ratio provides a strong incentive for corporates and investors to engage in inadvertently or intentionally dishonest disclosure practices. An examination of greenwashing theory and its intersection with the current state of firm-level carbon disclosure are therefore critical in understanding the incentives behind such instances of corporate carbon performance misrepresentation, all the while outlining ways in which said disingenuous or negligent practices can be tracked.

As such, users of ESG data, including carbon data, should be cautious. Schumacher et al. (2021) found early stage evidence that the majority of seemingly unbiased business news eligible for consideration under several ESG scoring methodologies are still indirectly reproducing significant portions of direct company messaging on material ESG issues. These findings are of high relevance in terms of adequately evaluating corporate ESG performance evaluations. They signify that in the presence of a fragmented and still largely unregulated ESG regulatory environment and the absence of centralized, widely accessible, and transparent ESG data platforms, companies find themselves in a position in which engaging in greenwashing becomes advantageous. Through specific forms of selective ESG disclosure, they can theoretically engage in ESG sentiment engineering, which again feeds directly into common industry ESG ratings and scores (Schumacher et al. 2021). This partially explains the more frequent usage of targeted messaging in the area of climate-related corporate virtue signaling. Common words associated with climate action and carbon data include: climate, carbon–neutral, climate-neutral, TCFD, Net Zero (and its variations), Paris-aligned, CO_2, carbon-free, decarbonization, carbon-capture, carbon clean, carbon removal, tree planting (and its variations), carbon/CO_2/GHG emissions, RE100, SBTi, science-based, low-carbon, emissions, SDG, and transition.

These instances of PR-motivated carbonwashing will flourish without strong regulatory oversight capacities to address the lack of standardization, absence of central ESG data registers, and significant rewards for showcasing numerous ex-ante decarbonization ambitions or strong but self-reported ex-post carbon data. Instances of potential carbonwashing become most apparent in observing corporate communication of climate action, where announcements, statements, pledges, joint initiatives, or target setting represent instances of firm-level impact frontloading. In most instances, this corporate inaction is not penalized by the market since many of these climate-related announcements are either too vague or have long-term target horizons, besides a lack of broad industry-wide ex-post impact monitoring.

Lack of Consensus on What Is "Green"

Finally, even with the best intentions, a lack of clarity on what constitutes a "green" project or activity will ultimately result in carbonwashing. The EU has been one of the most active entities to provide proper regulatory framing of what PAAs can be considered green by contributing to sustainable development or environmental objectives. Building on the recommendations of the European Commission's 2018 Action Plan on Financing Sustainable Growth, the EU has been adopting a range of legal texts and regulations (European Commission 2020b). Clear frameworks and standards are required, especially regarding climate-related carbon data, since many respondents from a research study commissioned by the European Commission stated that the "E" pillar related to climate change was flagged as the one with the most "insufficient information, requiring some improvement or strong improvement" (European Commission 2020a), meant to provide a definition of "environmentally sustainable" economic activities.

Conclusion

The surge in climate pledges and Net Zero carbon reduction targets has brought a lot of attention to the reliability of carbon data. Demand for and spending on carbon data have been particularly acute within sustainable finance and ESG investing, which consist of various financial products, strategies, and initiatives that take carbon mitigation into account, ensuring investment in "green," "sustainable," or "ESG-aligned" firms (Chasan 2020). Nonetheless, current carbon reporting standards and related regulations are not sufficiently inclusive in driving companies toward mobilizing more effectively behind low-carbon energy transition and Net Zero-related economic goals. Companies engage in various decarbonization efforts, both regionally and globally, but most of them have not been fully incorporated into current carbon reporting frameworks or climate-aligned evaluation strategies. These incomplete impact criteria are not providing adequate incentives for companies to align their capital expenditures (CAPEX) and operational expenses (OPEX) with long-term sustainable growth objectives or become active beyond their own business activities.

As evidenced by the many frameworks, studies, and drivers discussed in this chapter, the evaluation of corporate carbon performance constitutes a complex undertaking. Due to the diverse ways that firms can communicate their performance, it can be challenging to differentiate carbonwashing from genuinely sincere and material environmental communication. The central problem identified in this chapter pertains to the mostly anticipatory nature of the majority of carbon data reporting, meaning that the focus of most climate-related disclosure has shifted from actual measured action to theoretical promises of achieving performance goals in the future. For instance, companies used to report their carbon emissions reductions versus an established baseline, but now they are more vocal about promoting carbon reduction targets. The gap between corporate decarbonization claims and tangible action has widened. As of writing this chapter, the majority of corporate capital markets still rely primarily on unaudited, unverified, and largely self-reported data to bridge these information gaps. Due to the absence of rigorous validation processes, the incentives to pursue misinformation-related "low-risk/high-return" strategies have not substantially subsided.

Carbonwashing represents a systemic market-level disclosure failure and negative externality that impacts firms, stakeholders, and society at large in materially significant ways. By proposing new language to describe and frame carbon data-related misinformation incidents, this chapter outlines various avenues for lawmakers, regulators, and sustainability reporting framework organizations to classify carbonwashing as a distinct branch of greenwashing. This diagnosis facilitates an understanding of the evolution of the carbon data landscape and where the most acute risks are situated.

Throughout this chapter, we document the benefits that financial institutions and corporates derive directly and indirectly from presenting themselves as leaders in the area of climate mitigation. Moreover, carbon data has emerged as the primary currency to validate and communicate said action in the public sphere. As a result, we see the number of incidents of carbonwashing expanding, both in terms of quantity and quality. The spread of misleading information or unsubstantiated claims occurs in every phase of the carbon data lifecycle (In and Schumacher 2021), becoming highly embedded in the general carbon disclosure process and hence even more challenging to eliminate. Without proper checks in place, facilitated by mandatory, structurally solid, and science-based MRV frameworks, carbonwashing could transform into one of the most severe and material risks to meaningful and broad climate action. Carbon data based on mostly theoretical "impact frontloading" as opposed to concrete achieved carbon reductions would render the modeling of informed Paris-aligned transition pathways highly unreliable.

Key Takeaways:

- The growing materiality of carbon-related greenwashing (i.e., carbonwashing) requires a new taxonomical framing.
- An increase in the quality and quantity of carbonwashing is prominent throughout the entire carbon data lifecycle.

- Net Zero announcements represent a strong contemporary case of carbonwashing.
- The majority of carbonwashing scenarios seem to be facilitated by the absence of mandatory reporting frameworks.

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4

The Road from Scope 3 to Net Zero

Marc Roston

Editorial Note

In recent years, Scope 3 has moved from the margins of climate accounting to its center. This shift prompts several questions. If, by definition, Scope 3 emissions are the primary responsibility of someone else, why should anyone be focused on measuring and managing them? Once Scope 3 emissions are disclosed, what is the disclosing firm supposed to do about them? How should the lines of Scope 3 be drawn, and who gets to decide? What happens when firms pursue management of Scope 3 emissions across state boundaries? While practitioners are grappling with these higher-level questions, technical experts also are belaboring the unsettled nuances of Scope 3 calculations, further complicating the situation.

In this chapter, Roston covers a brief history of greenhouse gas emissions protocols and frameworks to help explain why and how Scope 3 has drawn significant attention in the race to Net Zero. He lays out the challenges Scope 3 accounting including data reliability, comparability, and traceability. In the end, Roston cautions that reliance on Scope 3 accounting portends a bumpy ride to Net Zero.

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Twenty years ago, The World Resources Institute and the World Business Council for Sustainable Development published the first edition of The Greenhouse Gas Protocol ("GHG Protocol," "Protocol") with the ambitious goal to "develop and promote internationally acceptable greenhouse gas accounting and reporting standards through an open and inclusive process" (WRI and WBCSD 2001). The introductory comments around emission scopes concludes: "The GHG Protocol recommends that companies account for and report Scopes 1 and 2 at a minimum."

Scope 1 covers direct GHG emissions from corporate owned or controlled sources, including fleets.[1] Scope 2 includes purchased power, where emissions occur off-site, outside direct corporate control.[2] Finally, Scope 3 "allows for the treatment of other indirect emissions that are a consequence of the activities of the reporting company" (WRI and WBCSD 2001).

In retrospect, the GHG Protocol may be seen in the optimistic context of the early 2000s: C-suite executives must understand the risks to their companies in light of impending shocks to carbon prices, whether from domestic legislation or multinational treaties, resulting in taxes or cap-and-trade mechanisms. Two decades on, the GHG Protocol remains front-and-center, but the nexus has shifted from Scopes 1 and 2 to Scope 3. Climate activism has shifted from top-down, government-led policy to bottom-up, Net Zero emissions targets, led by private action and corporate policies, leveraging a small(ish) number of companies' influence on and control over their supply chains.

In the Net Zero era, industry leading CEOs use their market position to impact their Scope 3 emissions by influencing their supply chain while climate activists may force laggards to take similar actions. Both groups seek to impact capital allocation in a positive way, imposing costs that change corporate decisions and drive down real emissions.

In this chapter, we consider the path from GHG Protocol circa 2001 to the *Strategic Framework for Paris Alignment*, issued on 2021 by the Partnership for Carbon Accounting Financials (PCAF). Along the way, Scope 3 migrated from the ensemble to center stage. As a leading figure of Net Zero accounting, we examine some details of Scope 3 that ought to raise warnings and point towards paths for clarity and improvement.

The Road Thus Far

Cataloging Scope 3 began as "nice to have," but hard-to-collect, data on a company's risk management path, in response to expected state action that would soon price carbon. Two decades later, Scope 3 seems to have become the central focus of climate action. How did we arrive here? Why the focus on Scope 3, or even 2, when all GHG emissions are *someone's* Scope 1? The power plant that supplies electricity to the auto manufacturer (the manufacturer's Scope 2) is owned by some entity that can measure and manage its own Scope 1. Similarly, the driver who buys a car, and pumps gasoline into that car, ought to be held accountable for her emissions, rather than the oil extractor, pipeline operator, oil refiner, gasoline retailer, auto manufacturer, or even financial institution that loaned her the money to buy the car, each of whom owns the Scope 3 emissions for the same gasoline pumped into the same auto. Even more confusing, the gasoline retailer's Scope 3 enters the auto manufacturer's Scope 3, and vice versa.

To begin, imagine taking a step back to 2001 after the release of GHG Protocol. The introductory paragraphs, in retrospect, read almost naively optimistic, "Many governments are taking steps to reduce GHG emissions through national policies. These include the introduction of permit trading systems; voluntary reduction and reporting programs; carbon or energy taxes; and regulations and standards on energy efficiency and emissions" (WRI and WBCSD 2001). The Protocol introduction continues, "Increasingly, companies will need to understand and manage their GHG risks in order to maintain their license to operate, to ensure long-term success in a competitive business environment, and to comply with national or regional policies aimed at reducing corporate GHG emissions" (WRI and WBCSD 2001).

Protocol stakeholders expected that in the not-too-distant future, governments would impose a carbon price, directly or indirectly. A carbon price would propagate through the economy quickly and efficiently, raising costs of Scope 1 emissions to corporations, organizations, even households.

Based on those expectations, corporate managers had the obligation to evaluate and minimize carbon pricing risks to their operations and profits. According to the logic implicit in the Protocol, forecasting that potential impact split into the three scopes—useful but imperfect measures of how GHG emissions posed risk to corporate performance. In the introduction to the concept of scopes, "the GHG Protocol recommends that companies account for and report Scopes 1 and 2 at a minimum." Scope 3 impacts, under a carbon pricing mechanism, become secondary concerns, likely smaller, and most certainly indirect, as customers and suppliers adjust internal operations independently. Rather than forecasting supply chain responses, companies would simply adjust to a new equilibrium price. The Protocol doesn't ignore Scope 3—it says worry first about Scopes 1 and 2 because the largest risks to the reporting company will flow from Scopes 1 and 2.

As the previously expected government action failed to deliver a carbon price, stakeholders adjusted their focus. Protocol advocates shifted from encouraging risk management in response to presumed government action, towards pressure by private actors on emitters pushing towards Net Zero. Without a price, climate activists sought out tools to encourage private action on emissions. Years of intense pressure on the energy sector made some significant inroads. Activism halted the Keystone pipeline—more than once. ExxonMobil has altered strategy, somewhat improved disclosures, and now has new directors. Royal Dutch Shell must reduce emissions faster than management planned under a recent Dutch court decision.

On the other hand, high-profile, top emitters have few alternatives to literally power the global economy. Divestment has often meant pushing the worst offending Scope 1 companies and assets out of the public spotlight, owned and controlled by opaque (and less accountable) private companies. Moreover, many utilities and power generators benefit from regulatory protections to their return on capital. Meaning they are largely immune to non-government pressure. In short, activism applied to the energy sector re-arranges capital and hides the ball rather than reallocating capital and changing the rules of the game.

In parallel with divestment in the energy sector, technology companies took the lead on climate action early. Whether led by Google's *Don't Be Evil* motto translated into climate action, Apple's early adoption of voluntary disclosures not long after the GHG Protocol, or simply commercial reality in competitive labor and product markets where young tech employees and tech savvy consumers want to work for and buy products from better corporate citizens, technology companies have generally pushed further, faster than their "old economy" peers.

Climate activists jumped at the opportunity to leverage technology company leadership and insight. These companies provide services. Apple's famous "Designed by Apple in California" nods to the fact that Apple creates very little stuff—their suppliers, in the context of climate, do most of the dirty work. Hence, Scope 3 jumped to the forefront. Concern for electricity devouring data centers (Scope 2) spread to indirect demand for more efficient manufacturing of semiconductors (Scope 3.)

At the same time, climate activists saw a chokepoint: financial institutions. Banks, insurance companies, and asset managers financed *everything*, but in particular the capital-intensive fossil fuel-driven energy complex.

Technology and finance also happened to share two important features: high profits and coveted brand names, making them good targets for public pressure.

The seemingly innocuous description of Scope 3 emissions in the GHG Protocol may have worked for an aspirational measure for the particularly engaged corporate risk manager going the extra mile. But it could not fill the expanded role as the primary tool for fighting emissions absent government action. In trying to stretch Scope 3 into this larger role, advocates and NGOs worked to elucidate Scope 3 in a myriad of ways that would impress any academic scholar. In 2011, ten years after release of GHG Protocol, effort by hundreds of contributors produced WRI and WBCSD's *Corporate Value Chain (Scope 3) Accounting and Reporting Standard* ("Scope 3 Standard"), a manual of requirements and guidance for companies seeking to prepare and report their Scope 3 emissions.

Technology companies smoothly expanded their reach into well-defined and well-optimized supply chains. Scope 3 expanded their efforts almost out of momentum. Financial institutions faced a more complex problem. The Scope 3 Standard identified 15 Scope 3 categories. The final covered "investments" in just four pages with little detail. Clarifying that Scope 3 category required almost another decade. In 2020, the Partnership for Carbon Accounting Financials (PCAF) released the 134-page opus *The Global GHG Accounting & Reporting Standard for the Financial Industry*. The report set out detailed methodologies covering six different asset classes of "financed emissions" covered under investments in the Scope 3 Standard. Many gaps remain.

Return to 2021: Technology companies and financial institutions stand at the leading edge of climate activists' attempts to reduce greenhouse gas emissions by monitoring and managing their Scope 3 emissions through a combination of leadership and grassroots pressure.

Potholes

Economists see prices as information signals. Price movements communicate information unambiguously, and the information contained in prices propagates through markets. In the absence of prices and following two decades of Scope 3 developments from the GHG Protocol to PCAF, stakeholders have embraced Scope 3 as the next-best alternative source of information to guide a path to Net Zero. In this section, we consider several shortcomings of this next-best alternative with the intention of highlighting some areas for caution and improvement.

Old Problems

In a recent working paper, Gireesh Shrimali, a contributor to this book and colleague at Stanford's Sustainable Finance Initiative, provides an accounting of the documented challenges of measurement and management of Scope 3 faced by corporate managers. Assembling Scope 3 data requires aggregating across sources of varied quality and confidence. The Scope 3 Standard and PCAF additionally provide recommended criteria and targets for data specificity, sources, and assembly methods. PCAF proposes objective scoring for five categories of data reliability based on confidence in the data collection methods, which allows for reliability normalization. However useful, this approach cannot easily account for variation arising from underlying emissions models, scenarios that determine up- or down-stream emissions assumptions, or other parametric inputs to calculations.[3]

In a risk forecasting context circa 2001, these sorts of potential errors mattered less. As long as Scope 3 remained optional, and estimation errors decreased over time, managers understood risks well enough. However, using Scope 3 to inform investment decisions means volatility in those estimates carries direct cost. Methodological changes in data collection could materially change costly, irreversible investment decisions. A single company's procedural shift could propagate through its supply chain. Previously smart, clean, and efficient investments could be made obsolete by another party's data collection and reporting.

Early on, the GHG Protocol identified emissions double counting as a potential problem, but dismissed any impacts, noting that carefully constructed boundaries and methods for calculating Scopes 1 and 2 precluded double counting across scopes for a given company. The Protocol stated that "Double counting needs to be avoided when compiling national inventories under the Kyoto Protocol, but these are usually compiled via a top-down exercise…for GHG risk management and voluntary reporting double counting is less important" (WRI and WBCSD 2001).[4]

The 2004 revision to the Protocol addressed several novel double counting situations: merchant energy trading, recycling energy costs, and offsets, for example (WBCSD and WRI 2004). When describing double counting third-party transportation services between a manufacturer and a retailer, however, the Scope 3 Standard notes, "this type of double counting is an inherent part of Scope 3 accounting" (WBCSD and WRI 2020).

The assumption that double counting is less important makes sense in the context of tracking a single company across time—that is, for setting internal goals and evaluating results. If the board of directors wants to measure evolving risks over time, consistent measurement techniques and level changes through time matter more than avoidance of double counting. But as directors and executives, at the behest of climate activists or on their own, use Scope 3 to drive capital allocation decisions, double counting may have real, negative impact on the economy. If a supply chain manager does not understand details underlying her suppliers' Scope 3 emissions, whether through lack of high-quality data, transparency, or ambiguous boundaries, she could make poor allocation decisions when terminating existing, or seeking lower emission suppliers.

More generally, Scope 3 calculations are not invariant to corporate mergers and acquisitions. Consider the manufacturer-transportation-retailer example.[5] Company A manufactures widgets sold by Company B, transported from A to B by Company C. Company C's emissions enter as Scope 3 for A and B. If Company B buys A, the "consolidated" B no longer double counts C's emissions, meaning total Scope 3 has fallen, but no actual emissions changed.

In response, the Scope 3 Standard says "because of this type of double counting, scope 3 emissions should not be aggregated" (WBCSD and WRI 2020)—much easier said than done. Banks and investment firms provide financing up and down the supply chain of virtually all sectors of the economy. It is impossible to avoid aggregation when calculating Scope 3, category 15 "investments" for financial institutions, following PCAF methods.[6]

Boundary Problems

The GHG Protocol seeks to carefully define scope boundaries, essential to both completeness at a point in time, and consistency through time, for a given reporting entity. Well defined boundaries for Scopes 1 and 2, when applied correctly, maintain complete coverage avoiding gaps and double counting.

Scope 3 boundaries add substantial complexity. It is useful to distinguish between internal and external boundary problems. Internal boundary problems stem from the iterative nature of Scope 3 emissions: how many scope layers must a company track? Any company's supply chain Scopes 1 and 2 obviously enter their Scope 3, but does a company include its supply chain's Scope 3? If the company does not, then perverse incentives will insert a layer of distance between a company and its supply chain to push emissions just out of range.

The Scope 3 Standard proposes criteria for identifying *relevant* Scope 3 activities that a company ought to include[7]: size, ability to influence change, risk to the company, stakeholder interests, outsourced activities, significant by sector guidance, or other relevant criteria. The Scope 3 Standard leaves drawing these lines and explaining limits to the reporting company. Again, this approach works for good faith actors, particularly in a risk identification context. In a leverage to Net Zero context, self-reporting provides an enormous range of possible results, even for good faith actors. Climate activists certainly prefer a much broader interpretation of Scope 3, and wider use of corporate strength.

External boundaries pose a different problem. For the purposes of this chapter, we define external boundaries as limitations on a company's ability to act on Scope 3 because those actions overstep the limits of a company's size or influence, typically in conflict with a government actor. Consider the US auto industry's actions during the summer of 2019. At the risk of unreasonable simplification, a group of auto makers agreed with the state of California to self-impose tighter emissions standards than those endorsed by the federal government. The auto makers wanted to reduce their Scope 3 in California in a manner consistent with California politicians' preferences. However, they ran into an external boundary when they tried to impose their reductions on the entire nation, against the desires of the federal government, by suggesting they would only produce California compliant autos. The federal government threatened anti-trust action against the auto makers for colluding to foist California preferences on 49 other states.

Financial Engineering Offsets

Offsets as a means for reducing Scope 3 emissions receive ample coverage in the Revised GHG Protocol describing, for example, the need for additionality, quantification of effects, risk of reversibility, and double counting cautions. Similarly, the Scope 3 Standard instructs companies to report the use of offsets. PCAF currently has little to add regarding offsets in an investment portfolio. Therefore, we present some cautionary notes as PCAF and others work to clarify guidance.

Chapter 2 of this book presents a method to hedge climate risk by taking long and short positions in a portfolio that may have negative net exposures to emissions. This approach might be used as a method to, in effect, construct offsets: an auto manufacturer implements the strategy to hedge risk and offset end-user emissions for their vehicles. PCAF has only a single mention of shorting securities, "Green bonds, sovereign bonds, and derivative financial products…are not covered by [listed equity and corporate debt]. The same holds for short and long positions…Guidance on such financial products are still under development" (PCAF 2020).

Certainly, we would argue that a portfolio designed to deliver offsets by shorting stock does not likely meet the additionality criteria. However, consider paired holdings. Imagine an investor identifies a cheap, high-emissions company with attractive expected returns. She might pair that investment with a direct air carbon capture venture investment. Treatment of those paired net investment emissions may not be as clear.

Off-Balance Sheet Emissions

A large international consulting firm produces a detailed disclosure report for their emissions, closely following the GHG Protocol, including full estimates of Scope 3 emissions. They detail globally distributed spending in emerging economies in support of the United Nations Sustainable Development Goals to offset tens of thousands of hotel rooms and millions of miles of air travel. They disclose nothing about consulting services provided to OPEC nations, fossil fuel producers or other clients who presumably have massive GHG emissions. The only mention of advisory services in any of the relevant guidance appears in the Scope 3 Standard optional approach to Category 15 for financial firms (WBCSD and WRI 2020). While all of a company's Scope 3 falls off-balance sheet in a technical sense, this type of undisclosed exposure pervades many businesses (Roston 2021).

Similarly, the phrase "off-balance sheet" appears in PCAF exactly twice. Once to explain that off-balance sheet loans do not factor into the Scope 3 emissions for business loans and unlisted equity.[8] The second notes that off-balance sheet mortgages might be reported. Financial firms specialize in moving risks off-balance sheet.[9] Roughly speaking, a bank moves a transaction off-balance sheet when they have customers on both sides of a transaction, and they serve as an intermediary. Yes, that means a bank can push virtually any activity off-balance sheet. Off-balance sheet emissions float in a cloud of obscurity, beyond the reach of even the most earnest or aggressive accounting for Scope 3 under current guidance.

The Road Ahead

Twenty years ago, those driving the adoption of the GHG Protocol expected imminent carbon pricing. Unfortunately, that did not come to pass. Not only that, but a uniform, global approach to managing Scope 1 emissions remains elusive. Today, the most attractive option for progress on emissions reductions depends on stakeholder pressure, voluntary reporting, and corporate leadership driving change through Scope 3. However laudable these efforts may appear, substantial progress requires changes to capital allocation and corporate investment. Securities markets may re-arrange risk (see Chapter 2). The asset management business may respond to evolving demands for capital to finance a transition (see Chapter 5). But neither of those approaches drives or directs real corporate decision-making.

CDP recently reported that 226 of the world's largest 500 companies by market capitalization set an internal price on carbon, with half of the companies surveyed disclosing a shadow price for carbon covering Scope 1 emissions. While these results show promise, massive gaps remain. Few companies apply pricing to Scope 3. Too many companies claim they expect to take climate action, yet do not assign a price to carbon (CDP 2021). It is difficult to imagine an executive making strategic decisions without even an estimate of costs. How do they trade off costs and risks? How can stakeholders take them seriously without a carbon price to inform decisions? Internal carbon pricing should no longer be accepted as optional, and must be applied to each Scope.

CDP also reports significant variability in price. While price competition would typically be encouraged, in the case of pricing carbon, a problem arises because the lowest price generates the greatest value to the emitter and cost to society. Uniform and systematically rising prices pushed through each Scope may effectively drive real emissions reductions that will persist.

Uniform pricing high enough to have material impact may be beyond the reach of non-government actors, but minimally enters uncharted legal territory. First, private companies setting a carbon price, even in response to overwhelming public demand, risk running afoul of anti-trust regulators. In the dust-up between California, the auto makers, and the federal government, the auto makers had some cover that they were simply complying with California regulations. In the alternative, if the auto makers agreed to impose a \$200/ton shadow price for CO_2 emissions on themselves and their suppliers, harmed suppliers might shout collusion and price fixing.

Second, the external boundaries discussed in the previous section might lead to diplomatic conflict, if not outright trade disputes. While domestically the auto makers may claim "good climate stewardship," foreign suppliers facing shadow carbon prices that exceed their domestic government prices might see US auto manufacturers' carbon price more like tariff.

Finally, in an ironic twist, activists may have conflicting interests around flexing corporate muscle to accomplish public climate goals. Activists cannot, on the one hand, demand that companies use their heft to force carbon prices and, on the other hand, push for a break-up of mega companies viewed as too powerful.

Scope 3 as path to Net Zero has potential—but the road ahead remains bumpy.

Notes

1. Scope measurements may apply to non-corporate entities as well. In the context of this chapter, we focus almost exclusively on commercial entities.
2. Purchased energy generally includes electricity, steam, heating, and cooling. Subsequent clarifications also excluded energy purchased for resale from Scope 2.
3. See Shrimali (2021) Section 3.2, for a detailed review.
4. As one indication of evolving importance, the phrase "double counting" appears seven times in the 2001 GHG Protocol, versus 53 times in the 2004 revision.
5. This example is based on a modification of the example presented in Fig. 9.1 in Scope 3 Standard.
6. Shrimali and others attempt to sort through some aspects of these problems, e.g., Section 6.2 (Shrimali 2021).
7. Table 7.1 in (WBCSD and WRI 2020).
8. "Business loans and unlisted equity" is one of the specific asset classes defined in PCAF.
9. See Chapter 5 for a discussion of how financial firms have developed such techniques over decades.

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5

Fixing the Plumbing: Asset Management, Clean Energy Technology, and the Valley of Death

Richard L. Kauffman and Marc Roston

Editorial Note

As of the writing of this book, the United States has been in a bull market for approximately a decade. In response to these conditions, markets have achieved long periods of growth via *specialization and intermediation. This state of play, however, creates a number of problems when trying to rapidly innovate and scale climate technologies. In this chapter, Kauffman and Roston further our conversation of finance's limits in addressing climate change by describing the evolution of a siloed asset management industry, from venture capital to private equity to project finance. Due to the incentives motivating its various actors, this industry has achieved growth largely by incremental improvements and fit-to-purpose vehicles. This chapter explores the impact that this fragmentation, inertia, and accretional growth has had on the trajectory of climate innovations.*

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This discussion urges readers to consider—can radical climate action come in the form of a pure market solution? We'd argue the authors' discussion would suggest that this is unlikely. Rather, in the absence of government or philanthropic actors prodding and disturbing the market, deep time lags will likely continue before we see increasing innovation at-scale within existing financing structures.

The United Nation's Intergovernmental Panel on Climate Change (IPCC) calculated that limiting temperature rise to 1.5°C will require an annual investment of $2.4 trillion until 2035 in the energy system alone. We are falling short. Explanations abound: low returns and high-risk impede clean energy capital raising; fossil fuel subsidies distort capital allocation; politicians lack the will to price carbon; policy uncertainty compounds risk. This chapter focuses on the role asset management—the business of capital allocation—plays in meeting our collective climate goals.

Much has been written about the challenges facing clean energy technology (CET) companies crossing the "Valley of Death"—the time when a company transitions from a developing idea into a commercially viable enterprise. For CET, this period may extend from a promising laboratory project to deployment of a utility scale plant. What might take several quarters for a software company extends to several years for CET.

This chapter argues that specialization in asset management, developed to finance the economy of the twentieth century, has adapted poorly to CET. The first section offers context for understanding the business of asset management: the roles played by different actors in the business, and their sometimes-conflicted incentives that have real impact on capital allocation. We argue that the business of asset management encouraged diversification and specialization that may have gone too far.

The second section considers the challenges bridging across the Valley of Death in a stylized case study of a venture we will call SolRX, which has a "new prescription for solar power." We walk through the lifecycle of SolRX, beginning as an idea out of a university material sciences lab that has identified a promising innovation that materially improves efficiency, but uses technology requiring a completely new manufacturing process. We follow this technology from venture capital investors who fund the company's launch to project finance investors who deploy the first grid attached utility scale installation, to growth investors who scale manufacturing and deployment. These three steps provide concrete examples of specialization, and associated twists and turns that inhibit the flow of capital in the asset management business.

In the third section, we provide a survey of existing tools and strategies, ranging from financial structures, to investor strategies, to climate reporting that offer promising approaches to enhancing the flow of capital into CET.

The asset management business has succeeded by developing products to match real economy needs for capital with demand from financial markets to deploy capital. This feedback process works. To reach our targets for greening the economy, policymakers and financial markets must work in concert to speed the process. The financial pipes, as they currently exist, are narrow, twisted, and clogged. We need wider, straighter, cleaner financial pipes to facilitate the flow of capital to reach our collective climate goals.

Building the Pipes: A Brief History of Asset Management

In introductory economics, we learn that people save to transfer today's wealth into the future. They invest, taking risk, to generate greater wealth in the future, either because of uncertain liabilities, or aspirations for greater consumption. An individual may invest to fund a child's college education, or retirement. A pension fund or an insurance company takes investment risk to generate returns so as to avoid fully funding today their future liabilities, whether known or unknown. In theory, investments provide capital to fund activities that generate real returns in excess of the cost of capital. In so doing, the capital stock increases, creating more societal wealth.

Financial markets saw little innovation from the 1620 IPO of the Dutch East India Company to the latter half of the twentieth century. Companies borrowed money, mostly through bank loans, sometimes through bonds, and they issued stock to shareholders. Individuals, particularly in the United States, saved in banks, invested in their homes, and eventually received pensions from their employers. Banks provided one-stop financial services shopping.

The confluence of several events conspired to completely upend long standing relationships in investing, risk taking, capital allocation, and oversight. We highlight several of these shifts. First, innovations in finance theory drove changes to asset management practice. Mainstreaming of modern portfolio theory (discussed in more detail in Chapter 2,) drove asset class proliferation. Fifty years ago, a pension fund or endowment would allocate 60% of its portfolio to US stocks with the remainder in bonds (PEW Trusts 2014). Then, diversification took over. Stocks became large, small, and foreign. Bonds split apart too. By the early 2000s, alternative investing made bespoke securities into asset classes: catastrophe bonds, PIPEs, CLO equity, and royalties earned "asset class" labels. Theory says diversification smooths the ups and downs of a portfolio. Logic says specialization by investment professionals will improve performance. These mutually reinforcing trends continue, seemingly without limits. The pattern starts with large, sophisticated investors taking innovative, well-compensated risks. Asset managers, however, have every incentive to grow their business, expand distribution, and, as a result, dilute investor returns. Diversification and specialization work in concert with the highly scalable asset management business model.

Second, with the passage of Employee Retirement Income Security Act of 1974 ("ERISA"), companies had license to shift pension risk to employees. Employees needed investment products. Asset managers rushed into the gap.

Third, global turbulence and stagflation in the 1970s focused management on lean operations, efficient capital allocation, and shareholder value, ushering in 1980s high-risk lending, leveraged buyouts, and corporate raiders. At the same time, rising interest rates, and outdated banking regulations led to money market funds upending bank financing.

Almost a half century of asset managers supplanting banks has left banks generally leaner, and asset managers in control of enormous amounts of capital. What began as bank trust departments has ballooned into the *business* of asset management.

In parallel with asset manager growth, asset owners grew in complexity. Circa 1970, the pension CIO oversaw the bank trust department relationship, or maybe a handful of managers. By 2020, even the moderate sized endowment CIO oversaw an investment staff, who in turn, managed a dozen or more asset managers each. Fiduciary oversight expanded, and fiduciary services blossomed. Consultants provided customized asset allocation, manager selection, due diligence, and monitoring.

On the one hand, specialization within investment teams at asset owners allows experts to make better decisions, just like at the asset manager, leading to better outcomes. On the other hand, another layer of principal–agent problems[1] clouds decision-making, distorts incentives, and reinforces herding. An endowment investment committee straying too far from their consultant's asset allocation guidelines takes reputational risk, not just investment risk. The same holds for the head of private equity investing at the endowment. If she strays too far from peer endowment private equity decisions, she risks career ending outcomes.

Systematic performance evaluation and benchmarking helps fiduciaries better understand how managers seek to add value, but risks pushing groupthink down another level in decision-making. A particular manager, knowing how clients will benchmark her performance, fears straying too far from peers, and losing her client.

The clear upside to careful monitoring and evaluation has been the general recognition that outperformance in liquid public markets faces high hurdles. The rise of indexing, and quantitative strategies, both executed at relatively low cost, has probably made asset owners better off. However, this also pushed asset owners to dedicate greater resources to areas they believe more promising for value add. Hence, the rise of alternative investments and the "endowment model," closely associated with David Swensen and Yale University. The endowment model assumes that deep research and expert execution in non-standard asset classes has greater opportunity to add significant value to a portfolio.[2]

This model has high direct and indirect costs. Expert internal investment teams make illiquid allocations to specialist managers charging substantially higher fees, typically based on performance. If specialist managers deliver extraordinary results without taking outsized risks, this model works fine. If the managers deliver mediocre results, charging performance fees on risks asset owners could obtain cheaply, the model, in execution, falls short.

As we noted earlier, asset class proliferation and manager specialization bring some gains but, asset management remains a business. Asset management firm owners face pressures of their own to grow and diversify revenue. Mature, liquid strategies, where excess returns are fleeting at best, require scale, leaving managers to compete on price. Alternative asset strategies of all shapes, sizes, and products, carry higher management fees and performance fees where managers can earn high margins on diversified revenue streams.

Without sounding too cynical about the asset management business, the forces of diversification by asset classes, competition reducing fees in liquid markets, and specialization by asset owners and asset managers, combined with substantial expected values from performance-fee driven products, conspire to balkanize asset management into silos that do not serve CET investment.

A very long bull market in bonds and equities has covered over the sins of underperformance, high fees, and misalignment between asset managers and asset owners. Maybe the prospect of lower returns changes the asset management business. Until then, clean energy financing must fit the siloed ecosystem that has grown for nearly 50 years.

Adapting the Pipes: Clean Energy Technology Lifecycle

We separate the path through the Valley of Death into three phases following the fictional case of SolRX. Most authors describe two valleys, drawing a distinction between technology development and commercial deployment. We prefer a wider, deeper valley. First, a company crossing only one still fails. Second, investment specialization and the distinction between two valleys, or parts of a larger valley, unfortunately, mutually reinforce each other, making the traverse harder. These three phases do not match reality for all companies, but they provide a simple framework for our discussion. SolRX begins as an experiment with promising results. A venture capital investor provides enough support to move from the lab to a handful of working panels. A project developer partners with SolRX to build a utility scale installation operating under real world conditions. If the project succeeds, growth investors take the handoff from the venture investors. They scale manufacturing, and bring in more project developers, rolling out SolRX technology across the grid and around the world.[3]

Phase 1: Venture Capital (VC)

Venture capital began slowly during the post-WW2 boom. Venture capitalists financed Fairchild Semiconductor, their first major deal, in 1959 (Gupta 2000) Over the next two decades, the venture capital industry, while still small, developed several key features that continue to this day. First, independent, specialized firms, structured as general partnerships with capital provided by limited partners, spread along Sand Hill Road in the heart of California's Silicon Valley. They (likely) modeled their fee structures after the first hedge funds—the so-called "Jones Model"—collecting management fees to fund operations, and hefty performance fees to incentivize the general partners. Finally, they limited fund size to reflect limited opportunities and high risks.

By the late 1990s, venture capital had grown up and gone mainstream. A typical endowment today holds venture capital within their private equity portfolio. However, the high risk/high reward of the scrappy newcomer remains. Conventional wisdom says one out of ten VC deals hits a "home run" justifying (or burying) otherwise failed investments.

VC funds remain small—the median fund manages $100 million (Rowley 2019). VC partners' path to wealth depends on big performance fee payouts, but that also encourages multiple funds rather than large funds. The performance fee to the General Partner (GP) amounts to an option on the portfolio: If the portfolio return exceeds 8%, the GP takes 20% of the gains. Each of those GPs learned in business school that the value of a basket of options on individual risks exceeds the value of an option on the basket of those risks. Therefore, their performance fee on a series of small funds has greater expected value than the performance fee on a single, larger fund making the same investments.[4]

The Limited Partners (LPs) have the opposing view. Larger funds with more deals diversify risks across deals and through time, reducing the expected performance fees they must eventually pay. This is another principal–agent problem where asset owner and asset manager have conflicting interests.

The period known as "CleanTech 1.0" from 2006 to 2011 cost US venture capital investors more than $10 billion (Gaddy et al. 2016). CleanTech 1.0 highlighted the mismatch between the experience and skills of VC investors, and the business of bringing CET across the Valley of Death. First, VCs lacked the capital to finance CET investments through the wider, deeper Valley. With a typical $100 million fund, a GP may have allocated $5 to $10 million (Statista 2020) to any one investment like SolRX. That may be plenty of cash to fund a management team and additional research as the project moves from lab to rooftop. But SolRX is not a software company. Deploying SolRX technology at a first utility project could easily require another $50 to $100 million and a couple of years. VCs do not typically commit that kind of funding or have that level of patience.

Second, the GP has every incentive to get out quickly to (a) monetize at the steepest point of growth to capture the highest performance fee potential, (b) potentially recycle capital in the fund to get another bite at the venture investing apple before the investment period runs out, and (c) raise assets for the next fund off the earliest signs of success.

Other typical asset management challenges plague VC as well. Even innovative VC managers herd around investment trends. The next big idea may have many players on whom they bet, with the hope of backing the winner. VCs fight for investor dollars on a relative performance basis, so herding provides some level of safety for VCs too. The "winner's curse" plagues VC investing more powerfully than other areas simply because high risk exacerbates the mechanics. The investor who makes the biggest error in forecasting wins the deal—but they want the hottest new deal, so they push their forecast. When GPs review deals for likely winners and losers, the deal that failed to deliver goes out with the trash. The VC model leaves little room for error correction.

Phase 2: Project Finance

Project finance developed in the mid-twentieth century for highly capitalized natural resource-based companies to develop infrastructure from ports to pipelines to power plants. Companies engaged in bespoke project finance to manage capital and isolate risk for large scale development of what were ultimately low-risk projects. Capital markets have tried to adapt this tool to CET, with mixed results.

The first project for SolaRX has the most risk. It looks, in many ways, like a self-contained venture exercise. In theory, the cost of capital falls on subsequent projects: The technology track record builds after the first project operates, and project execution teams build experience. In practice, project finance using novel CET has nearly insurmountable risk. The only source of cash to compensate investors will arrive after SolaRX delivers power to a customer, potentially years in the future. Different specialist asset managers provide different forms of capital, with varied return expectations. Projects may change hands multiple times even before completion.

We start with the debt, often the largest capital source, and typically provided by a large non-US bank (Müllner 2017). Project debt most often remains on bank balance sheets, with limited secondary markets, and relatively high regulatory capital requirements. In fact, given the limited market for this debt, few competitors compound pricing challenges, and regulatory capital may be proportionally greater for smaller deals. Banks have little risk tolerance in these transactions. Risk of cost overruns, timing delays, and technology defects all impact lender decisions about "bankability." Non-bankable deals do not make it through the Valley.

Tax equity falls below the debt in the capital stack for project finance. Project financiers source this capital from profitable firms that can use tax credits generated by the project to compensate the capital providers.[5] Tax equity also faces capacity constraints: few large corporate investors have known future tax liabilities to offset, and they prefer the lowest risk, most certain projects where they can deploy the most capital. Often smaller, innovative projects cannot find takers for their tax equity because of capital provider preferences.

Project equity, the last tranche of capital, has its own challenges. Project equity splits into development and construction. Development equity carries almost VC-like risk. This capital funds securing a site; performing environmental and engineering studies; obtaining approvals and permits; negotiating terms from suppliers and builders; obtaining offtake agreements and renewable certifications. Modest dollars with huge payoffs sound similar to venture capital, but the participants in this market are completely different.

Construction equity carries minimal risk. The developer has locked in project economics for as long as 20 years. While technically equity, returns to investors look more bond-like, meaning different investors. Many large institutions simply exclude development and construction risks from their portfolios. Some investors specialize in these securities, knowing they can flip them for handsome gains upon project completion. Still, a capital provider bottleneck slows the process.

Phase 3: Growth Equity

A successful venture capital investor hands off to growth investors. Growth investors avoid technology risk and most go-to-market risk (the specialties of venture capital.) Growth investors expand production, reduce costs, raise margins, and beat out competitors. They may be strategic or financial; public or private. To date, CET has struggled with the transition from VC to growth because the project finance stage complicates a smooth hand-off. VCs cannot or will not carry their companies far enough, and growth investors will not step in early enough.

Biotechnology growth funds prove exceptional. The time scale, capital, and risk for a biotech company to proceed from promising lab insight to commercial manufacturing is similar to what it might take for SolRX.

How do biotech companies survive the Valley of Death? Biotech investors have greater risk appetite because payoffs have greater upside, conditional on intermediate stage success. If an innovative drug works, it saves lives. The healthcare market pays well to save lives. Biotech also benefits from greater diversification, both to predict outcomes and share risk. The industry has massive amounts of data about probabilities of advancing through drug development trials, conditional on success at each step. CET has no such history, or near-term diversification prospects.

SolRX, successfully deployed, just produces electrons. We have many ways to produce electrons—cheaply, especially with carbon, by heavily regulated incumbents. Lessons learned from electric vehicles can help us improve SolRX's chances. EVs benefit from government and private action. Fuel economy standards and targeted subsidies by governments tilt the scales towards EV success. Equally importantly, consumer concerns over gasoline prices, GHG emissions and even virtue signaling contribute to the easier path for EVs. In the next section, we will discuss ways to support CET development and deployment notwithstanding the challenges posed by the asset management business.

Unclogging the Pipes

Financial services provide the plumbing that connect consumers, savers, and investors to products and businesses requiring capital. In the first sections of this chapter, we discussed ways the asset management business shifted from a single straight pipe (banks) to twisting, interconnected, oftentimes partially clogged pipes (specialist investors, non-bank lenders, and the lifecycle of CET.) In this section, we survey attempts to speed efficient deployment of CET—methods to straighten and clean out the pipes. We roughly divide these strategies into financial market innovation versus government action. However, in two highly regulated markets, financial services and energy, we cannot draw perfect demarcation lines.

Financial Innovation

YieldCos

Renewable energy requires substantial capital that generates stable cash flows over a long life. They share these features with conventional energy infrastructure and real estate. However, conventional energy and real estate benefit from tax advantaged legal structures: Master Limited Partnerships (MLPs), and Real Estate Investment Trusts (REITs), respectively. While structurally different, REITs and MLPs share the feature that they are disregarded for tax purposes if they pay out 80% of their cash flow as dividends. Only investors owe tax on their earnings. Investors value them based on current and anticipated dividends.

Unfortunately, MLPs and REITs effectively exclude renewables. For MLPs, the statute explicitly excludes renewables. Legislative efforts have failed to remedy the exclusion.

Renewable energy REITs show more promise. REIT statutes distinguish between "real" and "personal" property. Favorable tax treatment for REITs applies to real property. To a non-tax attorney, land and buildings qualify as "real" property. Anything on or in the building—property an owner might move—counts as "personal" property. REIT-eligible real property has expanded over the past decade. Refrigeration equipment essential to cold storage, railroad tracks, and cellphone towers have become REIT eligible. Most promising, LED billboards—a glass panel with wires and electricity running through it—became eligible. Reversing the flow of the power ought to be fine. However, the Obama Treasury failed to follow through with this change.

To overcome MLP/REIT limitations, bankers developed a structure called a "YieldCo." These public companies owned renewable assets, and would pay out their cash flow via shareholder dividends. They expected renewable energy tax advantages would offset corporate taxes, leaving shareholders roughly in line with MLPs or REITs on an after-tax basis.

YieldCos were wildly successful instruments—at least for a while—significantly reducing the cost of capital for their sponsors. In fact, their initial success probably contributed to their downfall. Suppose SolRX deploys a project that a private investor will hold for a 12% yield. A YieldCo, with liquidity and wider ownership interest, might buy that SolRX project at an 8% yield, giving the private investor a 50% capital gain.[6] At the same time, as investors forecast the YieldCo dividend growth, the price of the YieldCo shares rose further, driving yields below 5%.[7]

Additionally, this re-valuation and cost of capital reduction created massive value for the YieldCo sponsor. To address principal–agent concerns between sponsor and YieldCo, bankers required the sponsor to retain 50% of the assets contributed to YieldCo. Therefore, YieldCo price jumps translated into large sponsor equity gains.

The result for a SolRX project would be exactly what we want, in theory. With a ready market of low cost of capital retail holders of YieldCo securities, YieldCos would pay higher prices to project holders. Project holders, with a ready market of YieldCos would develop more projects, demanding lower yields. SolRX obtains lower cost project financing.

In practice, the spread compression between project developer buyer prices and YieldCo buyer prices, combined with too-rosy forecasts about the sustainability of YieldCo dividend growth, (which depended on a high spread,) and a modest move up in interest rates demanded by YieldCo holders, brought the system down.

One early issuer of YieldCos, SunEdison—a mix of silicon manufacturing, renewable solar development, and owner of solar projects—lost 95% of its market value in a year and subsequently filed for bankruptcy (Hals and Groom 2016).

Creating a publicly traded stock that would efficiently price renewable energy assets remains a good idea. YieldCos stand as a cautionary tale: *Because* *the market had been inefficiently pricing assets, the structure generated early, unsustainable gains, inflated expectations, and ultimately contributed to their failure.*

Benchmarking and Performance Fees

Traditional public investments have well-established frameworks for benchmarking and performance evaluation based on formal models.[8] Alternative investments, from venture capital and private equity to infrastructure and project finance, developed as asset classes lacking formal rigor for benchmarking or performance fees. Somehow managers and investors anchored to the return hurdles of those early funds. This anchoring clogs the financial pipes.

Consider the purchase of a completed project finance deal. A 10-year investment with an expected 10% return in 1990 would earn about 1.5% more than a 10-year investment in US Treasury bonds, which at the time yielded about 8.5%. In 2020, that same 10% forecast return exceeds Treasury bonds by about 8.5%. In both scenarios, a manager with an 8% hurdle has the same expected performance fee.

We find it inconceivable that the 2020 investor has so much more skill than the 1990 investor. We more easily believe the reverse holds: with 30 years of financial innovation and increased competition, combined with a low interest rate environment, we should expect lower spreads. We logically conclude the 2020 investor must be taking more risk, if not actually engaging in a completely different strategy.

The confusion in our simple project finance deal in 1990 versus 2020 broadly applies across time and asset classes for many investments. In our example, we specifically compared completed energy infrastructure project deals. An asset owner, or even many asset managers with "opportunistic" mandates make the problem almost unsurmountable. It's no surprise that an investor cannot figure out the "right" or even a reasonable rate of return for a particular investment when the only thing consistent through time and across asset classes is that the manager will make an investment to beat a hurdle rate.

No perfect solution exists. However, risk-based benchmarks and performance hurdles that vary will make goals clearer and facilitate more efficient capital allocation—an essential step towards CET deployment.

Venture Capital Expansion

In our discussion of the investment lifecycle, we noted that the combined effects of risk appetite, fund size, and incentives to general partners, impose certain investment dynamics on venture funds that do not serve CET particularly well. VC investors would do well to expand their investment mandate to include, minimally, a first project deployment.

Project development generates high returns, often not too far from venture. Moreover, deploying a first project leverages the return on the VC investment itself. The venture investor backing SolRX enhances the prospective exit value on the operating company, at the same time they deploy additional capital into a high returning project. The traditional VC model just doesn't have the financial capacity to do this.

One path, attractive to many limited partners, depends on co-investments. Co-investments provide investment capital outside the structure of the core venture fund. Often at reduced fees, limited partners appreciate the net reduction in average fees on deployed capital. Venture firms would need to add expertise in project deployment. However, project experience would be additive to their core investment decisions because the GP would better understand the path to real economy development of their venture companies.

Alternatively, larger funds that may invest more in each deal, and across the lifecycle, would be better suited to bridging the Valley of Death. For example, Generation Investment Management launched a $1 billion Climate Solutions Fund with a focus on later stage VC and private equity growth; Brookfield has announced a $7.5 billion Climate Transition Fund which will invest in renewable power and investments that will reduce carbon emissions.

Neither approach will change the asset management business overnight. However, incremental changes that encourage flexibility across silos will move investors in the right direction.

Securitization

If one weakness of project finance stems from its origins in large, bespoke transactions, securitization offers an alternative, and one particularly useful for small projects. Securitization allows a bank to bundle similar loans together onto a single balance sheet, carve up various parts of the cashflows into different securities, and sell those securities to investors. Securitization facilitates free flowing credit in otherwise sub-scale, difficult to trade markets. The Great Recession taught markets difficult lessons around complex risks in securitizations, but this tool continues to finance everything from home loans to automobiles to credit cards.

The solar industry has been the only bright spot for CET securitization, issuing about $2 billion of asset backed securities (ABS) annually since 2016 (Finsight 2020). ABS issuance requires high-quality historical data to satisfy ratings agencies, and standardized contracts to efficiently package loans. Beyond solar, few other CETs can satisfy these requirements today. As different technologies roll out smaller projects in volume, securitization likely expands. EV charging stations, distributed storage, and community solar may offer opportunities.

Special Purpose Acquisition Companies

Special purpose acquisition companies (SPACs) have potential to complement the growth equity investor. SPACs, a 1990s innovation, are public companies that raise a pile of cash in an IPO to merge or "de-SPAC" with a private company. They have raised incredible sums in the second half of 2020, and into 2021. SPAC managers thus far seem willing to take on earlier stage risk—companies traditionally not-quite-ready for an IPO. Investors see them as a path to owning earlier stage growth equity businesses traditionally only available to institutional investors.

At this stage, CET and other green strategies appear particularly attractive to SPAC managers and investors. They have the potential to take on more risk than traditional growth equity investors, and they have deeper pockets to fund growth and greater access to public market capital. Time will tell if SPACs offer a successful path forward.

Green Bonds

The market for green bonds exceeds $ 1 trillion (Haggerty 2020). Green bond issuers promise to dedicate new capital to green projects in compliance with various standards. The evidence that issuance leads to incremental project funding is mixed. In a study for the Bank of International Settlements, Ehlers, Mojon and Packer (2020) conclude that green bond issuers are less carbon intensive than average. Flammer (2021) suggests that corporate green bonds have signaling value about future carbon reductions. Issuers may gain attention for otherwise unnoticed projects. Finally, demand from ESG investors may marginally impact cost of capital for issuers. However, research shows limited evidence that green bonds have unlocked otherwise unavailable financing for green projects.

With continued development of the green bond market, we may yet find approaches that have material, durable impact on the real economy.

Investor Pledges

As of spring 2021, 30 of the world's largest asset owners with combined assets of $5 trillion[9] and 30 of the largest asset managers with $9 trillion under management[10] have committed to Paris Agreement-level "Net Zero" decarbonization targets for their portfolios. Initiatives such as Ceres[11]—which organizes an Investor Network of over 200 institutional investors with more than $47 trillion in assets under management—have made progress in reporting and advocacy, but changing the underlying investment architecture likely lies beyond the reach of NGOs.

As pledges expand, markets will develop better monitoring and auditing tools for the companies in which they invest. Asset owners and managers alike should support data reporting that facilitates independent evaluation and monitoring, as well as compliance monitoring by those making the pledges. (More discussion on this can be found in the book's Conclusion.)

However, as the asset management *business* encourages this process because vendors want to sell data and processed analysis of data, asset owners and managers must remain vigilant: turning over responsibility to the inevitable rating agency specialist too frequently absolves investors of responsibility. Investor reliance on third party ratings can go very wrong—mortgage investors learned this lesson in the Great Recession. We cannot afford the same mistakes as we address climate change.

Public Action

Environmental Policy Stability/Price Signals/Procurement

Raising the cost of carbon and providing price signals to financial markets clearly has the greatest possible impact. To clarify, we mean raising the cost using a wide variety of tools. A carbon tax, obviously, would explicitly force markets to respond. A "shadow" carbon tax imposed in federal procurement processes would push markets to respond to the demands of an enormous buyer of goods and services.

The presidential election of 2020 has put US policy back on a potentially better path. However, federal policy can change each election cycle. State level actions prove more durable. Similarly, non-US governments have more stable policy. Policy stability, whether fuel standards, commitments to Scope 1, 2, and 3 emissions, or mandated reporting each provide incentives that make CET solutions more valuable when they are deployed.

Investors dislike volatility. Policy that consistently raises direct and indirect carbon prices reduces the ultimate risk for CET investments. Inconsistency raises risks as investors discount good outcomes. Signals to venture, project finance, and growth equity investors that incrementally push towards higher ultimate returns make investors' jobs easier. Government policy plays a key role.

Tax

MLPS and REITs have proven their effectiveness. Investors have insatiable demand for yielding assets. Capital intensive markets desperately need efficient solutions. Climate driven asset owners and asset managers must continue to push for consistent tax advantages for CET deployment.

In the interim, might investors' appetite for YieldCos return? SPACs have gone through several cycles since the first issuances in the 1990s. Potentially a YieldCo 2.0 with improved discipline based on past errors would be more successful.

Green Banks

Government-sponsored green banks accelerate CET financing. These organizations have both capital available to lend and deep expertise at fitting CET into existing investment architecture. Instead of traditional subsidies that may just offset inflated costs, the New York Green Bank uses domain expertise to offer credit to quality project developers unable to source capital.

Public Pensions

In the United States, public pension plans hold most of the largest asset pools. They depend extensively on outside managers. They seek to find the best managers in individual asset classes, exemplifying the specialization and disjointed approach developed in the first section of this chapter.

By mandate, these entities have long investment horizons, that must balance the interests of their employee beneficiaries and the taxpayers obligated to fund the programs. For example, CalPERS, the largest public pension in the country, describes their long-term investment beliefs in the context of broad views of risks to the economy, taxpayers, and beneficiaries. CalPERS also acknowledges their constraints as a public sector entity, specifically with respect to compensation, which reinforces the need to use outside managers.[12]

In contrast, Canadian counterparts to US public pensions take a much different approach. Over the past two decades, various Canadian pension plans have internalized much of their investment decision-making, building organizations that look more like asset management firms than typical public pension capital allocators. With this structure, the Canadians more easily structure investments within their organizations that fit long-term needs of the companies in which they invest, and cross investment silos or asset classes with fewer frictions. The cost to these entities may, in fact, be lower by financial metrics: They have large staffs of relatively highly paid investment professionals around the world, likely paid less than their private asset management counterparts would otherwise collect in management and performance fees, but significantly more than most government employees.

Disclosure

Financial disclosure standards for both public and private firms developed over decades, beginning after the Great Depression. Financial reporting continues to adapt to novel business models and growing financial complexity.

In a similar fashion, we are only at the beginning of climate disclosures. Several initiatives seek to standardize and mandate climate impact and risk disclosures. Today, most climate disclosure relies on voluntary reporting and compliance. Moreover, commercial vendors collecting this data obtain it for free, and attempt to process reported data into value-added products, often keeping raw data confidential. Consider the likely result of voluntary financial reporting, in secret, with only processed results for outputs.

Investors need mandatory disclosure requirements, verified by independent auditors, probably paid for by the companies themselves, and reported uniformly with meaningful data standards.

Where Do We Go from Here?

Our history of asset management focused on weaknesses endemic to financial services. We need to appreciate the incredible results achieved by this imperfect system. The gains for consumers and the real economy have been nothing short of phenomenal. Forty years ago, buying a car required cash or repeated back-and-forth negotiations between a dealership, buyer, and lender. Today, because of technological and financial innovations, most consumers can walk into a car dealer with little more than a driver's license and drive out a few hours later in a car they can afford to drive, that cost more to buy than they might make in a year. Neither financial nor technological innovation moves people or makes cars. Financial innovation carves up the risks of manufacturing, buying, and selling cars to make the cars less expensive for end users. Technological innovations collect and move data across the disparate financial pipes, helping capital flow freely.

To meet ambitious Net Zero mandates, markets need auto-industry levels of financing efficiency across a broad range of innovative CET deployments. Where sufficient scale exists, asset managers will continue to adapt incumbent structures to bring energy innovations to market. Today, customers can lease electric vehicles as easily as for traditional autos. As residential solar has tapped securitization markets, expect the same for other moderate cost, high volume products: distributed wind, battery, or fuel cell projects.

To be clear, fitting CET into investing pipes built for other purposes is a mixed blessing. Projects that "fit" will benefit from rapid capital formation: markets will quickly recognize financial and structural similarities for a subset of clean energy assets. Those projects that don't fit can face a capital drought. Projects that use innovative technologies will not flow smoothly through existing pipes. Straightening and clearing the financial pipes can only do so much. Asset management will not lead the CET industry. But once policymakers, companies and consumers provide clear signals that end markets will buy CET innovations, asset managers will quickly mobilize capital.

Key Takeaways:

- Over the last few decades, the asset management industry has created specialized silos of investing. These investing silos represent the sources of financing.
- Clean energy has faced the challenges of trying to fit into these silos that have been developed to finance other sectors in the economy. As a consequence, clean energy financing can be expensive or, in some cases, simply

not available. Breaking down these silos will improve the flow of funds to clean energy.

- The asset management industry is a business and has acted rationally to invest in areas where there a large opportunities to earn attractive returns. Government policy stimulating clean energy deployment and corporate buying commitments for clean energy will be much more important in improving the flow of capital than any effort at financial innovation.
- Financing follows the real side of the economy; only at the margin does it create demand.

Notes

1. A principal-agent problem in this context arises because asset owner and asset manager interests only partially align. Similarly, conflicts exist between the board of trustees of an endowment, the chief investment officer, and the investment staff.
2. This is only one aspect of the endowment model. For a full description see David Swensen's *Pioneering Portfolio Management.*
3. In some situations, the growth equity and project equity may reverse, or happen contemporaneously.
4. This result holds for private equity funds too. However, VC funds have significantly higher volatility than PE funds. The value of the performance fee option rises with volatility.
5. Tax equity investors, legally equity investors, earn returns much closer to debt investors. The federal tax credits to the investor substitute for interest payments that would otherwise be owed from the project cash flows once operating.
6. This is straightforward bond arithmetic: A $100 security with a 12% dividend that sells at an 8% yield has a price of $150.
7. Investors forecast dividend growth because they were seeing YieldCos buying 8% yielding projects, when the YieldCo investor would hold < 5% yielding securities. Any acquisition with a positive spread would cause dividend growth.
8. See Chapter 2, for example.
9. See the Net-Zero Asset Owner Alliance, convened by the United Nations, for more information. (unepfi.org, accessed March 12, 2021).
10. See the Net Zero Asset Managers Initiative for more information https://netzeroassetmanagers.org (access March 12, 2021).
11. See Ceres Investor Network for more details http://ceres.org/networks/ceres-investor-network (access March 12, 2021).
12. See CalPERS' Mission and Vision to learn more: https://www.calpers.ca.gov/page/about/organization/calpers-story/our-mission-vision (accessed May 1, 2021).

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Part II

Beyond Net Zero: States, Markets, and Transition

6

Blended Finance for State-Led Decarbonization

Esther Choi and Soh Young In

Editorial Note

Previous chapters in this volume address the challenges of accounting for climate through private financial markets. In the West, as infrastructure finance has moved from state budgets to market structures, limitations across the innovation value chain and cycle have emerged (Chapter 5). Our focus on private markets thus far, however, is not meant to suggest that the world has converged on a common approach to climate action. In fact, quite the opposite is true, as is highlighted in this chapter.

Here, the authors explore the development and use of blended finance for green investments in Korea. As a state-driven society, Korea is representative of much of the world, where political and economic structures organize climate-intensive sectors differently from market-driven economies. Through this chapter, the authors explore the key question of what a state must do to deliver the public part of blended finance. Along the way, they detail a learning process

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taking place in Korea as the country continues to develop its approach to green finance, highlighting changes and adaptations in the Korean public financial system.

Why Blended Finance? Why State-led?

Effectively decarbonizing the global economy and putting it on a sustainable growth path will require a major shift in investment patterns and a focus on catalyzing diverse sources of financing. Accordingly, there is noticeable movement in the traditional roles of the public and private sector in addressing climate change and supporting the clean energy transition. In particular, the question of how public interventions—through policies and finance—can help direct private finance towards green investments has become central in the current climate policy debate (Corrocher and Cappa 2020; Choi and Seiger 2020; Meckling 2019; Polzin et al. 2015). This is because public actors, who are willing to accept a higher degree of risk than private investors, play a significant role as enablers for new technologies and systems (Mazzucato and Semieniuk 2018; IRENA and CPI 2020). In this context, blended finance, a structuring mechanism that strategically uses public and/or philanthropic capital to catalyze additional private capital and increase private investment, has emerged as a promising solution to facilitate low-carbon transition, help deliver the goals of the Paris Agreement, and achieve the Sustainable Development Goals (SDGs) (African Development Bank et al. 2015; OECD 2018). In blended finance mechanisms, public and philanthropic investors can improve an investment's risk-return profile with their catalytic capital and familiarity with the market, thereby lowering perceived and real risks associated with climate technologies and projects. In the national context, blended finance can be considered as an effective financing scheme for the state, and for the public sector in undertaking a transition towards a more sustainable and low-carbon economy.

This chapter identifies major actors and financial mechanisms for national decarbonization efforts and determines whether the public sector demonstrates learning, innovation, and a systemic approach to blended finance. Specifically, we investigate roles that the public sector plays to mobilize private capital for climate impact in context of a specific country, identify factors that should be considered for effective deployment of blended finance, and draw implications for other economies with similar political structures and climate ambitions. We provide a qualitative case study because the nature of our topic requires an in-depth understanding of the dynamics of the country-specific landscape. Especially in the post-COVID period, reassessing the role of public finance and public financial institutions will be critical in "building back better."

We focus on the Republic of Korea, whose interpretation and application of blended finance contribute to the knowledge and practice of climate and blended finance in several key ways. First, this case sheds light on the structure, incentives, and empirical behavior of the state-driven finance regimes in Asia. These finance regimes provide the bulk of resources to renewable energy and infrastructure projects, and thus play a critical role in building and transforming national energy infrastructures. Second, blended finance transactions have often crossed national borders, flowing from the developed to the developing parts of the world as part of the former's development and climate strategy. Focusing on domestic activities and transactions, as we do here, can provide a complementary assessment for the internal, or local, practice of blended finance. Finally, the Korean case addresses the "how" question of blended finance. As of 2021, the country is undergoing the second wave of significant institutional and financial innovations with its state-led green initiative. Assessing how the government strategizes and deploys its capital to mobilize private investment for climate impact can provide important lessons on the approach to blended finance in this specific context.

Korea's development history and trajectory offers a complementary lens to understand the role of the public sector in leading economic and social development, especially as compared to the market-driven approaches of other countries. Similar to other "developmental states" in East Asia, the practice of the policymaking elite strategically intervening in the economy in pursuit of national development goals is accepted as necessary and desirable. In this context, Korea has instituted export-led growth strategies that rely far more heavily on state direction (Fukuyama et al. 2019; Haggard 2018; Kim and Thurborn 2015). Strong state leadership with centralized bureaucratic structures has played a crucial role in achieving rapid industrialization in spite of limited capabilities and social infrastructure (Lee et al. 2019). While the increasing technological sophistication of the private sector has precipitated a shift towards a more decentralized governance structure, the government remains the leader in driving industrial restructuring and technological upgrading.

Similarly, Korea's climate goals and agenda have been set and driven by the government. The government introduced two major initiatives for the climate agenda: Low-Carbon, Green Growth (LCGG) (2008–2013) and the Green New Deal as part of the Korean New Deal (KND) (2020–2025).[1]

Both represent major top-down attempts by the government to trigger a "fundamental transformation" that would change the basic economic model to a decarbonized green economy. Through LCGG, Korea became a vocal champion of green growth, a concept that integrates environmental sustainability into economic growth. Korea's green growth agenda stood out for its ambition, investment scale, speed of deployment, and systematic design, embodying the modality that has defined Korea's approach to techno-industrial transformation since the 1960s. Korea's prioritization of green growth under LCGG also reflected the reimagining of the relationship between the economy and the environment on the part of the policymaking elite (Kim and Thurborn 2015). The Green New Deal, launched in 2020, embodied the revival of this relationship in response to a major exogenous shock caused by the COVID-19 pandemic, reopening old decisions and realigning interest groups and choices related to policy design. These two initiatives display notable differences, however, in their approach to finance in terms of the level of public sector involvement, the emphasis on private financing, and the degree of institutionalization. While the LCGG era put its emphasis on state-led investment and public institutionalization, the Green New Deal showed a marked shift towards long-term private involvement for green financing.

An essential characteristic of Korea's approach is that, regardless of political party affiliation, it views climate change as a growth opportunity, not a cost. Korea has formulated its green growth strategy in terms of investments and their anticipated economic benefits—e.g., new engines of growth, job creation, exports—rather than in terms of costs and internalizing negative externalities. The idea that economic growth will not be compromised by the goal of environmental protection is firmly entrenched, and green measures have always been viewed through the lens of economic growth and national interest. Policymakers perceive "growing" and "greening" the economy as complementary goals that can be simultaneously advanced by developing, commercializing, producing, and exporting green technologies, products, and processes (Kim and Thurborn 2015). Therefore, Korea's focus on green growth and the Green New Deal is fundamentally an industrial upgrading strategy. The Korean government did not design its green policies as a response to climate change, despite the predominant positioning of climate objectives. Perhaps this explains why there was no specific roadmap for decarbonization or plans for significant greenhouse gas (GHG) emission reduction for both initiatives. Still, in a world where many countries are being held back in their efforts to adopt green strategies because of the focus on the costs and the need to regulate the negative effects of fossil fuel production and consumption (Meckling 2019; Cullenward and Victor 2020), Korea represents a unique example of the state taking leadership and materializing the economic benefits of transitioning into green economy.

The Korean case also provides a clear example of how blended finance can be applied in an emerging economy where domestic financial markets have sufficient liquidity, yet institutional and market failures are preventing active involvement of the private sector in climate-relevant sectors. Despite the traction and diverse applications of blended finance for climate and sustainable development that have been observed globally, there has remained a certain level of ambiguity around the actual practice of blended finance. This ambiguity is derived from several factors, including: (1) the multitude of actors, forms of financing, and objectives that make it difficult to measure effectiveness; (2) complex governance structures that discourage private and local actors from participating; (3) monitoring and evaluation (M&E) is rarely conducted in a transparent and effective manner; (4) the implications and value for money of investing public capital in blended finance are not fully understood; and (5) many blended finance operations do not take local context and dynamics enough into consideration.

Despite the significant improvement in the collective understanding of the concept and principles of blended finance in recent years, there remains a lack of systematic guidance on the approach and strategies for blended finance in specific contexts. By setting a geographical and jurisdictional boundary, this chapter sheds light on the role of public actors in designing incentives and institutions to manage risks and catalyze private capital for domestic decarbonization.

Blended Finance for Decarbonization in the State-driven Finance Regime: Context and the Two Waves of Green Finance

A Brief History of Korea's Climate-related Economics and Policies

Before delving into Korea's blended finance landscape for decarbonization, it is necessary to understand the context and overview of the economy. Korea is the seventh largest national CO_2 emitter and one of the OECD countries with the fastest-growing GHG emissions. In 2017, Korea's GHG emissions had increased by 143% from 1990s levels, with most of the increase coming from the energy sector (IEA 2020). While Korea's exposure to physical climate change is relatively low given its geographical conditions, the Korean economy is highly exposed to transition risks of climate change (In and Park 2020). Since the Korean economy relies heavily on manufacturing exports, it is vulnerable to external shocks that result from the global transition to a low-carbon economy. Despite these impending risks, the private sector remains reluctant to make significant changes to its business—and investment—as usual behavior.

Korea's developmental success was driven by an extreme version of the fossil fuel-dependent industrial economy. The country's economy was built from the ashes of civil war to produce the most rapid economic growth in modern history, until China's rise in the late 1990s (Kong 2000). With the country's meager market share and weak technical infrastructure, the government considered cheap energy to be vital to creating price competitiveness of Korean products in the international market. As such, the 1960s and 1970s saw a major effort by the public sector to secure reliable energy for industry. Korea's energy policy traditionally focused on subsidizing the energy-intensive heavy and chemical industries with low retail electricity prices, maintained through state-led investment in nuclear and coal-fired power stations (Song et al. 2018). These developments, in turn, encouraged rapid growth in energy demand while preventing unsubsidized energy options from entering the market (Boo et al. 2013). As a result, Korea went from one of the lowest energy-using countries to one of the largest consumers in the world.

The country, however, produces neither oil nor high-quality coal and only 1.5% of the natural gas it requires, importing over 95% of its energy supply (Mah et al. 2012). The country's geographic location means Korea has no inter-country electricity and gas connections, posing an added challenge to energy security. Securing a stable energy supply has been therefore a primary national energy policy goal, and the energy security and reduced import costs serve as important co-benefits of climate mitigation (Mah et al. 2012; IEA 2020). Yet, the share of renewable energy supply remains significantly low. By the time the LCGG agenda was launched in 2008, renewable energy accounted for only 1.4% of energy inputs (Mathews 2012). By multiple accounts, Korea had the lowest share of energy from renewable sources among all countries surveyed by the International Energy Agency (IEA) and was far below average for OECD members (IEA 2020).

The Renewable Portfolio Standard (RPS), which replaced a feed-in-tariff (FIT) scheme in 2012, is the main policy instrument to promote renewable energy. The RPS scheme requires major electric utilities to increase their renewable and "new energy" share in the electricity mix to 10% by

2023. Through the third Energy Master Plan adopted in 2019, the government aims to increase the share of renewable electricity to 20% by 2030 and to 30%–35% by 2040, up from 3% in 2017. The current administration also aims to gradually phase-out coal and nuclear from the energy mix while significantly improving energy efficiency and fostering the country's nascent hydrogen industry (IEA 2020). Reaching these ambitious targets will require Korea to substantially enhance decarbonization efforts across all energy sectors, address regulatory and institutional barriers, make use of the country's advanced technologies and innovative capacity, and introduce a resilient and flexible electricity system that is capable of accommodating the growing share of variable and decentralized renewables (IEA 2020). Private sector finance and participation is central to achieving these goals.

Development of Public and Private Sectors and Their Interface for Inclusive and Sustainable Economic Growth

During the country's rapid industrialization in the 1960s and 1970s, the Korean government employed a top-down approach that relied heavily on state-owned enterprises (e.g., Korea Electric Power Corporation, Korea Gas Corporation) and family-owned conglomerates, or chaebols (e.g., Samsung, Hyundai, Daewoo, LG), with particular focus on capital-intensive industries like steel, shipbuilding, and manufacturing (Lim 2013). In order to quickly grow the national economy, large-scale capital was needed to support domestic companies. Korea has been an astute user of finance in its decades-long industrial development trajectory, utilizing debt finance to a much greater degree than other countries in catch-up mode. State-owned banks such as Korea Development Bank (KDB), Export–Import Bank of Korea (KEXIM), and the Industrial Bank of Korea (IBK) were established during this period and played a central role in providing stable capital at an affordable rate and serving the real sector. They raised investment capital from the market using sovereign credit and provided low-interest-rate debt to domestic companies.

The 1997 Asian Financial Crisis, however, hit Korea particularly hard because Korea's corporate and financial sectors had a high level of liquidity risk exposure due to large short-term foreign currency-dominated borrowings, especially in USD, and an increase of foreign equity participation. The shock was aggravated because the securities market was underdeveloped, and corporates heavily relied on debt capital (Kwon 1998). In response to the 1997 Asian Financial Crisis and the 2008 Global Financial Crisis, the government structurally improved the domestic financial system and made it more resilient to future financial turmoil (Lee 2017). In particular, the Korean government restructured the financial system and strengthened the domestic private banking sector.[2] For instance, it attempted to fully or partially privatize state-owned banks such as Korea Exchange Bank, Kookmin Bank, Woori Financial Group, IBK, and KDB. Also, private and public banks diversified their domestic investment portfolios. As a result, assets under the management of privately placed funds, derivatives-linked securities and products such as equity-linked securities grew rapidly, amounting to about KRW 500 trillion, or roughly 30% of GDP (IMF 2020).

The Korean government considers the low-carbon and clean energy transition as the next phase of the national economic growth following its industrialization. Just as the government played a pivotal role in the country's rapid industrialization, it now looks to lead the energy transition. But the low-carbon transition differs from past industrial revolutions in that the government provides the majority of capital demand while the private sector and its financial system are weakly responsive. The low-carbon transition requires both long-term capital to scale and sustain energy projects as well as risk capital to seed innovative energy projects, both of which the private sector have potential to provide. Despite the deep and mature status of the private financial market, it is still pervasive in domestic capital markets to see green initiatives as public policy and not as business opportunities. As a result, while the Korean capital market has been highly liquid as it goes through the COVID-19 pandemic and quantitative easing, the increased capital is not flowing into sectors and businesses that can facilitate a low-carbon transition. Blended finance can serve as an effective means to mobilize public and private funds and achieve climate impact, but only with the proper buy-in from the private sector.

From the market perspective, green finance and investment are perceived as high risk mainly due to (1) closed energy and utility markets, (2) absence of financial intermediation and relevant infrastructure, and (3) heavily regulated capital markets. First, the Korean electricity market is vertically integrated and not open to competitive suppliers because the government has been subsidizing energy-intensive industries to expedite industrialization. The generation, transmission, distribution, and retail supply sectors are separate. The generation sector, while nominally liberalized, is still run by six wholly owned subsidiaries of a state-owned utility, Korea Electric Power Corporation (KEPCO), which exclusively runs the other sectors of the electricity market (Park and Dooley 2019). That is, the electricity market price is determined by the government, and not through a pure market mechanism. The current market structure further increases the sector's exposure to political risks and investment uncertainty. This, in turn, poses significant challenges to mobilizing private capital for renewable energy projects. In 2021, the Electric Utility Act Enforcement Decree Amendment was proposed, which would allow consumers to enter into renewable power purchase agreements (PPAs). Still, KEPCO is expected to act as an intermediary between the seller and the buyer under this amendment. Second, the Korean capital market is dominated by institutional investors such as the national pension service (NPS), whose investment strategies are relatively conservative. They remain reluctant to diversify their revenue stream even though new energy policies and planning have forced them to do so. Part of the reason is that the financial market is not equipped with financial instruments such as loans, equity, and guarantees that meet the diverse interests of investors and infrastructure that can create access points for a large pool of the private sector. And finally, the Korean financial services industry is highly regulated at the state level. Financial intermediation processes and diverse investment instruments can encourage capital mobilization, yet stringent and inflexible regulations may discourage both. In January 2021, commercial banks convened and requested to ease the regulations on banks' capital adequacy ratios so that the private sector can extend loans and investments to support the real economy. They also requested to provide tax incentives to attract long-term investments in the relevant sectors.

The current landscape of the public sector through which the Korean government deploys investment capital for green projects and businesses is shown in Fig. 6.1. A wide array of financial institutions and financial instruments are available, and they are affiliated with various government entities. For example, the Financial Services Commission (FSC) controls KDB and IBK, which provide full commercial banking services (e.g., loans, interest subsidy financing, securities, guarantee, securitization of credit risk, financial advisory) to support national economic growth. Two more financial institutions provide credit guarantees: the Korea Credit Guarantee Fund under the control of FSC covers the liabilities of promising small and medium-sized enterprises (SMEs) that lack tangible collateral, and the Korea Technology Finance Corporation under the control of the Ministry of SMEs and Startups provides credit guarantees based on technology appraisals. Additionally, there are financial institutions specialized in early-stage equity investing. The Korea Growth Investment Corporation (K-Growth) is an independent fund-of-funds (FoFs) investment firm under the supervision of FSC, specializing in stage-specific venture capital and private equity investments. The Korea SMEs and Startups Agency (KOSME) is a non-profit, government-funded organization under the control of the Ministry of SMEs and Startups,

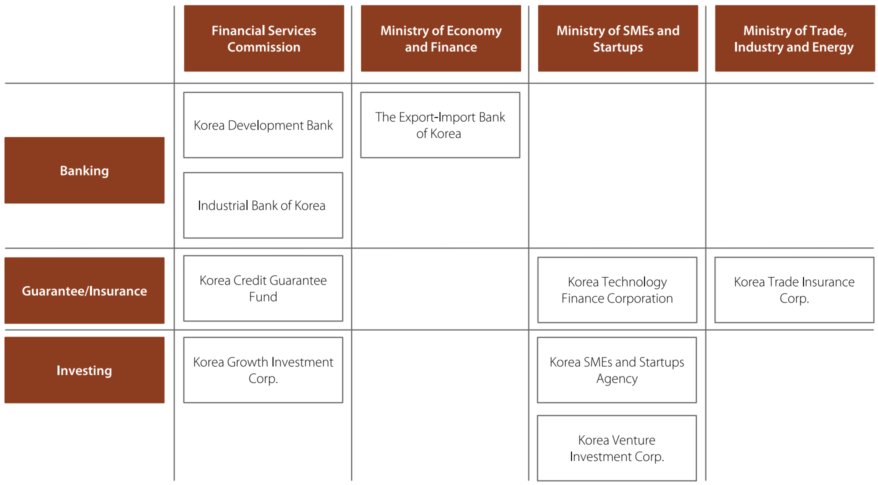

Fig. 6.1 Map of relevant state-owned actors and financial instruments in Korea's green finance landscape

providing financing and other advisory services (e.g., consulting, training, marketing). The Ministry of SMEs and Startups also controls the Korea Venture Investment Corporations, which is also a FoF investment firm promoting the development of Korean venture capital and private equity fund industry. As these examples demonstrate, state-controlled institutions often have duplicative roles in the capital market, raising concerns about fragmentation, ineffective use of public resources, and potentially crowding out the private sector.

The First Wave of Green Finance in the Grand Low-Carbon, Green Growth Scheme

In 2008, the LCGG agenda was announced by the Korean government in a presidential speech celebrating the 60th anniversary of the founding of the Korean Republic. The first sixty years of Korea's development that saw spectacular improvements in per capita income powered by fossil fuels were contrasted with the next sixty years with LCGG as a new vision for the economy. While Korea's strategy is not the only attempt to foster greener growth worldwide, it certainly represents the first, largest, and most organized policy approach to green growth thus far (Kamal-Chaoui et al. 2011). It was also unexpected, because prior to 2008, efforts towards "greening" at home and abroad were lackluster, with limited attempts by the Korean government to address environmental issues in regional forums in the 2000s (Kim and

Thurborn 2015). The focused efforts by the top leadership and the political elite at the executive level enabled rapid legal and policy measures for green growth, including those for green finance. The subsequent sections examine how the LCGG top-down approach triggered various legal and policy measures that serve as a basis for state-driven actions, with a particular focus on the first Green New Deal and blended finance vehicles in the form of state-backed green funds.

In January 2009, the first green stimulus package was introduced to Korea in the form of a Green New Deal to respond to the 2008 Global Financial Crisis and to advance the LCGG agenda. With the Financial Crisis significantly affecting the export-market oriented Korean economy, a green stimulus could be implemented quickly, and its aim was to specifically respond to economic shocks while contributing to environmental benefits (ILO 2016). Korea's Green New Deal was the largest package among the OECD member countries adopting explicit crisis-driven stimulus programs (Barbier 2010; OECD 2011). From 2009 to 2012, 80% of the total amount—US$30.7 billion—was allocated to green measures, including renewable energy, energy efficient buildings, low-carbon vehicles, rails, and water and waste management (UNEP 2009; Mundaca and Damen 2015).

In July 2009, the Korean government expanded the Green New Deal into a comprehensive mid-term plan called the Five-Year Plan for Green Growth (2009–2013), which was the centerpiece of the government's development strategy. Under this plan, public expenditure of US$83.6 billion was committed in the area of climate change and energy, sustainable transportation, and the development of green technologies. The Five-Year Plan, which also served as a means to turn the National Strategy for Green Growth (2009–2050) into a concrete and operational policy initiative, had designs to trigger private investment from chaebols and increase involvement of SMEs in the green tech sector. A year after the release of the Five-Year Plan, thirty major Korean corporates committed themselves to investments in green sectors amounting to KRW 22.4 trillion (or around US$20 billion)—not as large as anticipated, but substantial nonetheless (Lee 2010; Mathews 2012).

As part of the Green New Deal and the Five-Year Plan, the government did focus on encouraging private investment, but the scope was largely limited to one-off infrastructure investments. For projects such as road and railway construction and river restoration, the Korean government introduced several incentives for private sector partners to form public–private partnerships. The incentives included simplified public procurement procedures with the length of the procurement period shortened from 79–90 days to 20–38 days, increased liquidity for the private sector, private investors receiving loans at the interest rate of government bonds, and accelerated evaluation of the environmental impact of projects (OECD 2011).

The LCGG era also introduced the term “green finance” to Korea for the first time. For example, the Plan for Facilitating the Inflow of Funds to Promote Green Investment announced in July 2009 presented a specific roadmap for green finance and investment. To implement this measure, the government provided tax incentives to expand voluntary participation of individual investors in green finance products. Furthermore, Article 28 of the Framework Act on Low-Carbon, Green Growth (FALCGG), enacted in June 2010 to lay the foundation to implement the National Strategy, provided legal basis for government support for green finance, including raising financial resources to support green industries, developing new green financial products, encouraging private investment in green projects, reinforcing the public disclosure system for green management, and establishing a carbon market (Office of Government Policy Coordination 2010). At the practitioner level, public and private investors instituted some degree of institutionalization for green finance through the establishment of the Green Finance Council. The Council, launched by the Financial Services Commission and the Financial Supervisory Service in 2009, included fifty representatives from the government and major actors in the banking, brokerage, and insurance industries,including the Korea Federation of Banks, the Korea Financial Investment Association, the General Insurance Association of Korea, the Korea Life Insurance Association, and the Credit Finance Association. The Council’s task was to develop a key finance agenda and establish a network linking businesses and finance. An array of green funds subsequently emerged, contributing to the establishment of the “green growth fund” as a theme in the investment community.

Various government agencies launched green investment products in the form of policy funds, or also known as state-controlled funds, to implement the national agenda. These funds used public finance to guarantee the principal and offer returns higher than the market rates. Despite the significant use of public finance, these funds have not been properly accounted for and monitored systematically. A survey conducted by a member of the National Assembly showed that the majority (64%) of the fundraising amount came from the government, with the leveraged amount of private investment varying significantly across the funds, ranging from a dollar of public capital mobilizing 0.06 to 3 dollars of private capital (Kang 2020). None of these blended funds had ex-post evaluations.

We observe two major developments that took place under LCGG with respect to green finance for blending. **First, the efficient top-down**

approach facilitated rapid disbursement of public funds, but the partnerships with the private investors were largely limited to one-off infrastructure projects lacking scalability. Whole-of-government coordination, with efficient top-down governance as shown in the case of Korea, allowed the government to quickly set up and implement a debt-financed stimulus package (Agrawala et al. 2020). The distribution of the green stimulus was especially speedy—almost 20% of the funds were disbursed by mid-2009, compared to 3% for most countries (Strand and Toman 2010). Despite this rapid deployment of public funds, it remains uncertain whether this stimulus package represents an effective blending of public and private capital. First, public incentives for private partners were offered on a case-by-case basis, and the resulting infrastructure public–private partnerships did not lead to sector development or transformation, as is the goal of blended finance. Second, in an effort to increase the speed of disbursement, the plans of some projects were not reviewed sufficiently, and the focus shifted to short-term projects directed by central government ministries (OECD 2011).

Second, the investment community received a strong signal from the government for the first time about green finance and financial products. The signal, however, remained one-way, resulting in a weak form of institutionalization for green finance with limited governance function and passive embrace by private investors. On the one hand, the Korean government successfully set-up legal, institutional, and international foundations in the form of the FALCGG, the Presidential Committee on Green Growth (PCGG), and the Global Green Growth Institute (GGGI)[3] in order to rapidly yield tangible outcomes to legitimize the by-then unfamiliar concept of green growth and trigger path dependency of institutions both domestically and internationally. Green finance, on the other hand, received relatively little attention and the interface between the public and private investors was short-lived. The LCGG era introduced the term green finance, established the Green Finance Council to serve as a legitimate channel for cooperation between private and public investors, and launched state-controlled "green" funds. Yet, the government's attempt to engage and mobilize private capital for green industries was limited to state-controlled funds, voluntary commitments from chaebols, and a handful of green funds in the investment community that altogether did not create a self-sufficient market for private investors. The private sector remained largely reactive to government initiatives and the hype quickly died with the administrative change.

Korea's top-down approach for green finance, therefore, did not generate enough collective understanding and support from the private sector. It was successful in setting up the basis for green and blended finance, with the introduction of relevant concepts, products, and institutions. However, the lack of strong coalition and support around green finance resulted in a fragile domestic foundation, which quickly dissolved after the change in administration. Legal and institutional measures remained largely in place, but the political rhetoric, power, and interests dissipated. The Green Finance Council's 7th and last meeting was held in April 2012 and exists only in name. The state-controlled green funds and financial products quickly lost their profitability mainly due to their politicized nature. These developments, in turn, led to limited climate impact. An ex-post assessment of the Green New Deal under LCGG found that while the green stimulus program was successful in creating jobs and boosting economic growth, climate-related indicators such as the energy intensity of GDP, the CO_2 intensity of energy, and the share of renewable energy were not significantly improved (Agrawala et al. 2020; Mundaca and Damen 2015; Sonnenschein and Mundaca 2015).

A Second Wave of Green Finance, with Renewed Focus on Private Investment

The second wave of green finance was initiated in the midst of the COVID-19 pandemic. In July 2020, the Korean government announced an economic stimulus package called the Korean New Deal (KND) to invest US$ 133 billion (KRW 160 trillion) by 2025. The KND focused on creating 1.9 million jobs and invigorating the pandemic-hit economy through economic, environmental, and social reforms. The KND has three key objectives—(a) creating jobs in both traditional and newly emerging digital and green sectors, (b) building necessary infrastructure that will facilitate a transition to a digital and green economy, and (c) transforming the Korean economy from a fast follower to a first mover economy in the post-COVID-19 era. Accordingly, it has three main themes: (1) the Digital New Deal to transition towards a digital economy with investments focusing on the integration of data, network, and artificial intelligence, (2) the Green New Deal for climate change, green infrastructure, renewable energy, and green industries, and (3) the overarching theme of strengthening the employment and social safety net to increase resilience against economic uncertainties. Of the total KRW 160 trillion, KRW 73.4 trillion (KRW 42.7 trillion as government expenditure and the remaining KRW 30.7 trillion from local governments and the private sector) is allocated to the Green New Deal, which has three focus areas: Green Transition of Infrastructure (zero-energy public facilities, ecosystem recovery, clean water management), Low-Carbon and Decentralized Energy

Supply (smart grid, renewable energy, electric and hydrogen vehicles), and Innovation in the Green Industry (green industrial complexes, R&D).

There are many differences between the first and second Green New Deals, including the context, timing, scope, and allocated budget. Yet, one of the most distinctive characteristics about the second Green New Deal is that there is a much more explicit and strategic focus on finance and mobilizing private capital. There is a strong recognition that in order to maintain the investment impact led by the government, it is necessary to build an "autonomous and self-sustaining New Deal ecosystem" driven by private investment (Ministry of Economy and Finance 2020a). President Moon has also emphasized that the success of the Korean New Deal would only come with the support and active participation of the private sector and investors (Kim and Do 2020), rhetoric that was not explicit in the previous Green New Deal under LCGG.

Accordingly, there are notable institutional developments to materialize the government's revamped focus on green finance. The Korean New Deal Fund was announced in 2020 to serve as the main financing mechanism to invest in digital and green industries. The Fund consists of three tiers: the Policy Fund, the Infrastructure Fund, and the Private Sector Fund (Fig. 6.2). The Policy Fund, which will have catalytic capital from the government and

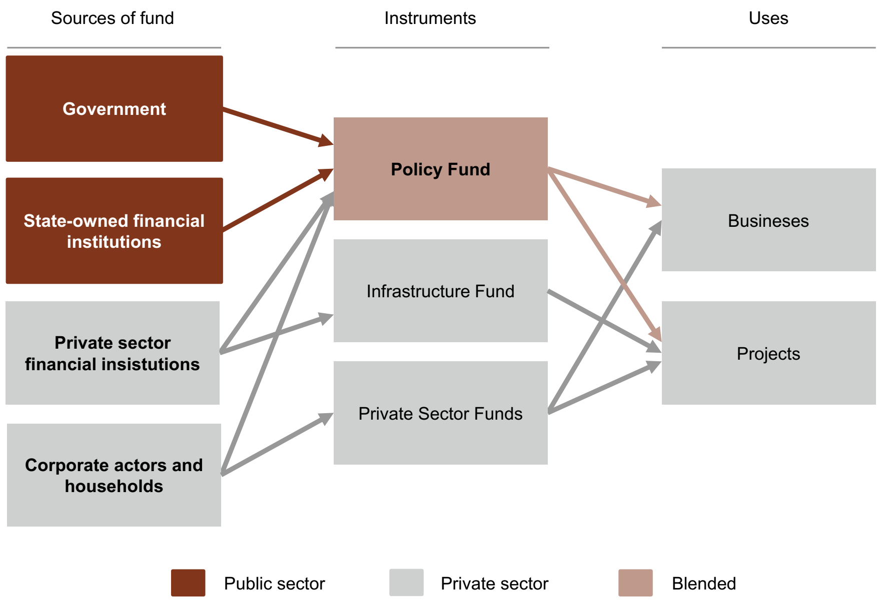

Fig. 6.2 Overview of the Korean New Deal Fund, consisting of three types of funds: a Policy Fund, an Infrastructure Fund, and Private Sector Funds (*Data Source* Authors' construct based on Ministry of Economy and Finance [2020b])

state-owned financial institutions to attract private investment, is essentially a blended finance vehicle and hence the focus of this section.[4] The government's rationale for the Fund is that investing in the New Deal areas involves a high level of uncertainty and a long investment horizon, making it difficult for private capital and investment to come in without the involvement of public investment lowering the risk.

To be established in early 2021 and financed over the period of five years (2021–2025), the KRW 20 trillion Policy Fund blends diverse sources of capital to create a fund-of-funds structure (Fig. 6.3). The KRW 7 trillion master fund is to be made first with contributions from the government (KRW 3 trillion) and state-owned financial institutions (KRW 4 trillion from institutions such as KDB and the Growth Ladder Fund[5]). Once the master fund is established, an asset manager will be selected to run the Policy Fund. A unique aspect of the Policy Fund that distinguishes it from other state-controlled funds is that this asset manager can propose key fund-related elements such as investment areas, size of the funds, proportion of public contributions, and hurdle rate depending on investment strategy. Feeder funds under the master fund will then be formed, with additional matching contributions of KRW 13 trillion from private financial institutions, pension funds, and the general public (Financial Services Commission 2020). The feeder funds, in turn, will invest in New Deal-related businesses and projects.

There were several notable incentives that the New Deal Fund has instituted to attract private capital. First, in the feeder funds, contributions from the public sector took a subordinated position to absorb losses first, lessening investment risks of private investors. The investment-return structure also offered private investors priority on reflows, with private investors getting

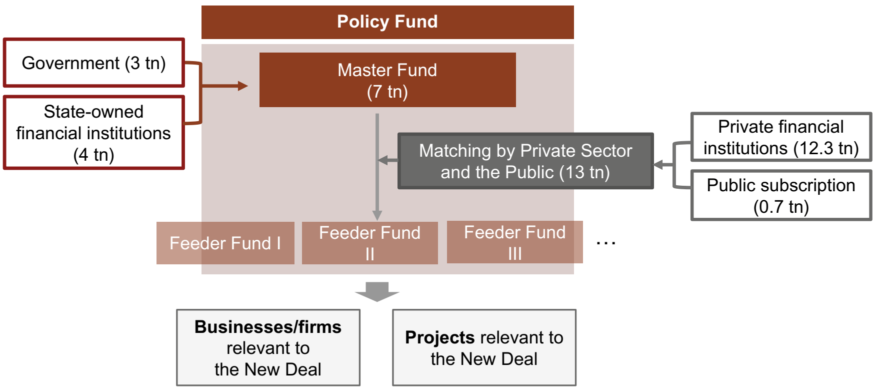

Fig. 6.3 Structure of the Policy Fund (*Data Source* Authors' construct based on Ministry of Economy and Finance [2020b], unit: KRW)

repaid first in the case of excess revenue. Private investors also had a choice of the call option to purchase a portion of public contributions during the investment period. Second, the Fund allowed funds that invest in immature industries a longer operating period of 10–20 years, compared to the average period of 7–8 years. Third, there was a preferential treatment for fund managers that invest in New Deal areas with high investment risk. For example, the public portion of the stack could increase to maximum of 45% thereby increasing the buffer for private investors and lower the hurdle rate.

Another significant institutional development for green and blended finance in Korea was a proposal for the Green Finance Corporation as a state-run financial institution to manage the Green New Deal. In November 2020, the ruling party tabled the Bill for the Special Act on the Promotion of Green Finance in Response to Climate Crises, which proposed the definition of green finance and the establishment of an institutional base in which the public sector leads and the private sector actively participates. Under this proposal, the Green Finance Corporation would be established under the Financial Services Commission, the government's top financial regulator, with an initial capitalization of KRW 5 trillion (USD 4.5 billion). This public corporation would essentially act as the country's first green bank, with functions such as identifying demand, providing funding, mitigating credit risks related to green industries, and providing services such as loans, interest subsidy financing, securities, guarantee, securitization of credit risk, financial advisory, and insurance for green industry firms. The second wave, therefore, came with the establishment of and proposal for dedicated institutional measures to engage and catalyze private capital, displaying a marked departure from the previous government-driven wave of green finance.

At the core of both first and second green waves, a stimulus package emerged as a direct response to the economic disruptions caused by the Global Financial Crisis and the COVID-19 pandemic. These stimulus packages themselves underwent a major makeover. The first one under LCGG transformed into a systematic Five-Year Plan that focused on state-led planning and implementation, and the second one under the Korean New Deal resulted in a New Deal Fund to stimulate and sustain private investments into the identified areas of Green and Digital New Deals.

LCGG's emphases were on setting the targets and laying legal foundations to trigger institutional path dependency and utilize the "stickiness" of institutions. Initial policy choices constrain what is possible in the future because major policies and commitments are hard to unwind once in place. For example, the FALCGG and GHG emissions reduction commitments were deliberately designed to ensure the endurance of green growth following a change in political leadership. Korea's first major state-led decarbonization effort illustrates the public sector's firm acknowledgement for the stickiness of institutions—be they legal, policy, or organizational. This effort, however, did not prioritize the strategic use of private capital and the operationalization of green finance to the scale needed to materialize the government's goal and ambition. The combination of a relatively weak level of institutionalization and the lack of a strong coalition of domestic actors around green finance, particularly among the private investors, led to limited momentum and impact.

The second green wave demonstrated a continued inclination for, and dedication to, the traditional top-down institutionalist approach that relied on legal and policy measures. The second wave showed a significant departure is in its focused effort on institutionalizing green finance, particularly with the goal of engaging and mobilizing private capital to sustain momentum and impact. With a renewed recognition that only the proper engagement of private capital and investors can create self-sustaining markets, the second wave marked the beginning of proper legal and institutional developments that could facilitate durable deployment of blended finance. In response, domestic investors increasingly embraced green finance, and the public and private sectors actively created dedicated teams to ESG and green finance. Therefore, while remaining faithful to the top-down and institutionalist approach, the Korean government's tactics showed evidence of lessons learned and an evolved strategy towards private investment to achieve climate goals, instituting incentives for private interests and market opportunities and acknowledging stakeholders' heterogeneous needs.

Conditions for Successful Blended Finance Application

Drawing from the structural and financial barriers to mobilizing private capital for decarbonization and how the public sector has shifted its strategy to address them, we propose necessary conditions for successful blended finance application. **First, streamline green finance into policy design and focus on consensus building and stakeholder engagement to mitigate political risks.** Green transition by Korea and most other Asian countries is much less reliant on bottom-up action from the private sector compared to that in the US and Europe. Therefore, policy and institutional arrangements have an important role to play in building private sector confidence. Explicitly incorporating, streamlining, and implementing "climate" or "green" finance into the policy objective or national agenda can provide a strong signal to the investment community and support its green finance activities. However, this means that climate or green finance tends to be associated with political risks, with national priorities changing with administrative change. For example, the term "green" was essentially removed from all government initiatives in Korea when the administration changed in 2013. The political nature of state-controlled green funds meant that the funds lived and died with the administration, and this in turn cultivated a sense of doubt and distrust from the private sector. The top-down approach may be effective in its speed and efficiency, but with the limited involvement and understanding from the private sector and the general public, the lack of internalization and coalition remains a key hurdle to sustaining the effort. The government alone cannot set a country or the world on a trajectory for a net-zero emissions economy. The public sector's efforts should be accompanied by other policies and fiscal and regulatory reforms to enhance private participation and investments, such as creating economic winners and coalitions around them, building a strong consensus with the private sector on low-carbon transition, and creating and sustaining a strong institutional base through multi-stakeholder engagement.

Furthermore, domestic industrial policy and foreign policy must go hand-in-hand for coherent implementation and market building, which in turn contribute to the lasting impact of state-led interventions. International coordination can enlarge the pool of consumers for new technologies, creating more experience and learning, better performance, and politically stronger interest groups (Cullenward and Victor 2020). Korea's heavy reliance on exports, and position as a middle power that bridges between the developed and developing countries, make the linkage and consistency between domestic industrial policy and foreign policy ever more important.

Second, appoint a central agency to oversee and coordinate green finance activities. Despite the strong state-driven agenda, its implementation has been relatively less effective due to duplicative roles of state-owned agencies on green initiatives. For example, the Ministry of Economy and Finance, Ministry of Environment, Ministry of Trade, Industry and Energy, and Financial Services Commission are responsible for different aspects of managing green finance and supporting green industries, often limited to one department per ministry. This fragmentation also signals a disconnect between the ambition of the government's policy agenda and the institutional and administrative support necessary to materialize the efforts. Institutional inefficiency can cause unproductive investment capital allocation. For instance, some selected sectors or companies receive excessive investments from multiple public agencies while others have extremely limited investments. The Korean government has attempted to address this by privatizing and merging public institutions with duplicative roles. Yet, privatizing a public agency has proven to be challenging to implement due to institutional and market barriers. For instance, in 2009, the Korean government announced its intent to fully privatize KDB and establish the Korea Finance Corporation (KoFC) to transfer KDB's policy-related financial services. But, in 2013, the government scrapped the privatization plan and remerged KDB and KoFC.

Establishing or designating a coordinating agency is a critical point to consider in designing and managing state-led decarbonization efforts. Today, there is no agency or public platform responsible for systematically accounting for past and current green finance transactions, sharing information about investors, and properly monitoring and evaluating the stock and flow. Instead of privatizing existing public institutions or merging them, the Korean government's focus shifted to establishing a new central coordinating agency in the form of a green bank to oversee green finance activities. In the meantime, KDB plays a leading part in deploying needed investment capital, mostly through equity and loans, to support the country's green activities. Whether it is newly established or designated to an existing public agency, this central agency should be equipped with the expertise to effectively lower the barriers for investors by de-risking clean energy projects, normalizing perceived risks, and bridging the knowledge and information gap. The agency should also be insulated from changes in administration and associated political interests.

Third, form a common understanding around definitions and taxonomy, and plan for a stringent assessment framework for effective Monitoring and Evaluation (M&E) and integrity of green finance. In Korea, the term "blended finance" has not penetrated policy and financial circles, with its usage limited to official development assistance and overseas strategy (Jung et al. 2019). Domestically, the practice of blended finance is more commonly known as a "pump-primer," often used as a vague concept where the government's expenditure is used to prime the flow of private capital. For example, state-controlled funds, which are essentially blended finance funds, almost automatically imply that limited public expenditure is being used to crowd out private capital or that the government is spending taxpayers' money to make up for the loss. With this perception of the public part in blended finance, policymakers can undervalue the importance of engaging and mobilizing private capital in a sustainable manner. In order to secure the consistent flow of capital and system-wide transition, it is important to mobilize the private sector, not just through policy and regulatory pressure but through proper market incentives. Establishing a more concrete definition and understanding of what blending implies would facilitate forming partnerships and encouraging the involvement of institutional and commercial investors.

The lack of consensus is also prominent in the interpretation of "green finance" and "climate finance," with the investor community not fully understanding or embracing the terms or applying them in an inconsistent manner. For instance, most investors in Korea are hesitant to integrate environmental sustainability into their portfolio and perceive that green finance prioritizes societal and environmental aspects over economic value. While forming a consensus on the possible trade-offs among the three aspects in green finance requires more time, the implementation of green finance should at least clarify the expected impact and the means to evaluate its performance. An incomplete or weak evaluation framework may not only discourage private capital from being properly catalyzed, but also cause greenwashing activities, which disclose selective or incorrect information about the impact (see Chapter 3 for more discussion of greenwashing and carbonwashing.) Indeed, the size of the "green finance" products in Korea have skyrocketed to KRW 51.6 trillion, but they have inconsistent definitions and criteria to determine what counts as green businesses and products (Hwang and Kim 2020).

Governments should also implement a stringent M&E framework that takes into account the specific characteristics of decarbonization efforts, such as the long-term horizon and direct/indirect investment needs. In general, public agencies put up their agenda, which is mostly short-sighted in terms of the broader national context, and self-report on their progress. Ex-post assessments are critical to understand the economic and environmental impacts of stimulus measures, requiring detailed planning, comprehensive reporting standards, robust tracking, and data availability. Thus far, evaluation of public finance has been heavily quant-based (e.g., amount of investment deployed, multiplier effect, the number of jobs created), which does little to attract the level of public support needed for decarbonization. The existing evaluation framework may not be able to capture non-quantifiable effects such as the signaling effect and/or the environmental and social impact that public finance can generate. The government, therefore, should establish a comprehensive framework that can assess the role and impact that the public sector plays in the green finance arena.

Fourth, institute proper structural and governance measures in the energy market to incentivize private investors for a long-term low-carbon

transition. The green waves in Korea elevated recognition for renewable energy and the importance of clean energy development. The highly controlled, centralized, and monopolized energy market, however, continues to pose significant challenges for scaling renewable energy and meeting the country's climate targets. Korea's electricity sector is operated as a mandatory pool with a single buyer, KEPCO. The government, and not the market, sets wholesale and retail prices and maintains low generation costs and retail rates. Even with the addition of renewables, the structural features that facilitate low electricity costs remain in place. The Korean government sought large and quick additions of renewable capacity, and the utility sector responded by promoting the development of mega-scale renewable energy projects (Ha and Byrne 2019). These mega-green projects were designed, built, and operated by KEPCO and its subsidiaries, thereby maintaining the status quo of a monopolized market. As a result, the growth of utility-scale green power plants made little contribution to increasing the share of renewable energy in the national energy mix. Consumers in the energy market have limited, and non-diversified energy options, and the market prevents private investors from entering. The deregulation of the energy industry can provide project developers and investors higher confidence to commit to new projects. If Korea's decarbonization efforts through blended finance were to succeed in reaching the climate and energy targets and transforming its energy sector, the government would need to undertake structural reforms in the energy market and recalibrate support schemes to incentivize private investors.

Conclusion

One of the hardest challenges of decarbonizing the economy involves redirecting investment towards technologies and businesses that are ridden with risks for first movers. This endeavor requires a policy strategy, or industrial policy, that is focused on the problem at hand, rather than inducing marginal changes in behavior with known technologies and production methods (Cullenward and Victor 2020; Meckling et al. 2017). The COVID-19 pandemic and the resultant economic downturn has led to rethinking the role of the public sector in building a healthier and greener economy and strategies for effective fiscal measures. This chapter discussed the importance of the various roles of the public sector—including rule-setting, public commitment, creating long-term incentives for the private sector, and setting an institutional and legal base—for a state-led transition to a greener economy. Lessons from Korea's green finance waves point to the importance of focused efforts on blended finance and the co-evolution of public and private sector interactions. The public sector, in particular, demonstrates an evolving position and learning towards the private sector, with flexibility and prioritization of private capital mobilization. Policy and fiscal measures are necessary to enhance profitability of green businesses and projects and redirect investment towards them. This chapter has highlighted some of the actions that the state-led economy has implemented, and conditions that are needed for successful blended finance application.

Blended finance is not a silver bullet for decarbonization. Multiple financial and non-financial barriers impeding the mobilization of private finance to address climate change mean that a comprehensive set of diverse climate finance policies and measures is required. Climate finance policies work best when they are nested in a coherent and aligned set of measures aimed at the achievement of climate goals (Bhandary et al. 2021), and state-led efforts can facilitate the design and implementation of these policies. With the necessary measures and sustained buy-in from private and public actors, blended finance has significant potential to mobilize additional private capital and engage investors in a strategic and productive way to deepen reciprocal understanding. These transactions, in turn, can contribute to the sustainability and scalability of climate interventions. Effective deployment and operationalization of blended finance requires challenging measures and reforms, but under the right circumstances, meaningful decarbonization can be achieved at the scale of transformation needed.

Key Takeaways

- For a state-led transition, the public sector plays critical roles including: rule-setting, public commitment, creating long-term incentives for the private sector, and setting an institutional and legal base.
- A state-led, top-down approach to transition can take place rapidly, but it should be accompanied by an understanding of the market and market incentives, a solid consensus with the private sector on low-carbon transition, and a strong institutional base through multi-stakeholder engagement.
- Designation of a dedicated, central coordinating agency that oversees green finance activities can lessen duplicative roles of existing institutions and result in increased efficiency and effectiveness.
- Setting targets itself is insufficient. Establishing stringent reporting standards and an M&E framework can properly incentivize investors to adhere

to requirements and ensure climate finance is allocated to impactful projects and sectors.
- Climate-relevant sectors should be appropriately structured to encourage private investment and activities.

Notes

1. While green growth has its original meaning (see OECD's definition, for instance), it is perceived in Korea as the government's specific agenda during 2008–2013.
2. See Park (2019) for the debates and lessons related to the capital market liberalization of South Korea.
3. FALCGG enabled Korea to become the first country to establish legal institutions as a guarantor of green growth (Han 2015). The PCGG is a high-level, central body under the Presidential Office responsible for policy coordination and implementation of LCGG. The GGGI was established as the first international organization established by the Korean government to disseminate green growth to developing countries.
4. The government plans to provide indirect support for the Infrastructure Fund and the Private Funds. With the Infrastructure Fund, the government is revamping pre-existing funds using tax incentives and the Private Funds the government supports with improved regulatory measures.
5. Operational since 2013, the Growth Ladder Fund is a blended fund-of-funds (AUM KRW 1.85 trillion) dedicated to start-ups and SMEs.

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7

A Natural Approach to Net Zero

Lorenzo Bernasconi

Editorial Note

The years 2020 and 2021 have seen the proliferation of Net Zero and carbon removal commitments from major companies, including Stripe, Microsoft, and Apple. These commitments have sparked widespread interest in and conversations about carbon offsets and removals, which serve as critical pillars of these tech giants' Net Zero plans. In this chapter, Bernasconi addresses the key question: how do offsets fit with the Net Zero framework? In doing so, he highlights classic challenges associated with the production of offsets, such as additionality and leakage. On a higher level, he also delves into the carbon accounting challenges associated with reconciling corporate action with country-level commitments. Without consistent global carbon accounting conventions that both reconcile sub-national, national, and global efforts, and work to increase national ambitions under the Paris Agreement, offsets and removals run the risk of falling victim to the carbonwashing pitfalls outlined in Chapter 3.

Implicit in this chapter as well is the importance of the timing of emissions reductions and removals. In this discussion we note two sets of countries: (1)

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countries who are reliant on technology-based carbon removal solutions, and (2) countries who are reliant on nature-based solutions. The first set of countries cannot produce mitigation now, as they are dependent on yet-to-be-developed technology in hard to abate sectors. The second set of countries, meanwhile, must act now because, if they cut down their forests today, they will not be able to grow them back fast enough to meet the global Net Zero target of 2050. Thus the promise of carbon offsets to meet Net Zero goals becomes a question of timing and risk—two other key themes of this volume. Should we trust countries who promise to deliver technology gains 20 years into the future? And/or should we trust countries who claim they will manage their forests and land in alignment with promised emissions targets? These questions are representative of deep risk and accounting challenges that we have yet to solve since the Kyoto Protocol was first negotiated in 1997.

Introduction

We face a climate crisis and a biodiversity crisis that threaten life on earth as we know it. Science tells us that this decade offers our last chance to prevent irreparable damage to our natural ecosystems and avoid the most catastrophic impacts of climate change.

The cost of meeting this challenge is immense. The annual cost of preventing biodiversity loss and protecting existing forests around the world is estimated at over $700 billion and $65 billion, respectively (Deutza, 2020; FOLU, 2020). Unfortunately, the crisis is only getting worse. Rates of deforestation and peatland destruction are rising while coastal wetlands, which also represent a significant global stock of carbon, are deteriorating worldwide (Deutza, 2020). In 2020, primary rainforest destruction increased 12% to reach an annual of loss of 4.2 million hectares, an area larger than the Netherlands (WRI, 2021).

The voluntary carbon market presents a unique opportunity to help meet these enormous financing needs. As of June 2021, cities and regions that collectively have a carbon footprint greater than the United States, companies that collectively have a carbon footprint larger than that of India, and sovereign wealth funds, pension funds, and other major asset owners holding more than one third of total assets under management globally had pledged to achieve "Net Zero" by mid-century. That is, they have made a commitment to remove as much greenhouse gases (GHGs) from the atmosphere as they put into it by 2050 (Data-Driven EnviroLab&NewClimate Institute, 2020, Net Zero Asset Managers, 2021).

As these corporations, governments, and investors move to decarbonize their operations and value chains to achieve Net Zero, some will find that emissions from certain sources can only be eliminated at a prohibitive cost and that certain emissions cannot be eliminated at all. Carbon credits, purchased voluntarily, enable those entities to compensate for these emissions by financing the reduction of GHGs from other sources, or the removal of GHGs from the atmosphere through activities that take carbon out of the atmosphere.[1] According to a 2021 report from the Taskforce on Scaling Voluntary Carbon Markets (TSVCM), the voluntary carbon market could grow from approximately $300 million a year today to more than $50 billion a year by 2030 (Ecosystem Marketplace, 2020; TSVCM, 2021).

This exponential growth in the voluntary carbon market is a potential game-changer in our fight against climate change and addressing the world's biodiversity crisis with the promise to mobilize billions in new and additional resources per year. But the extent to which it positively moves the needle will depend on two key considerations: first, for what purposes and under what circumstances the use of carbon credits will be used and said to be appropriate; and second, on the quality and environmental integrity of the carbon credits themselves.

This chapter argues that we risk missing the opportunity to leverage the unique promise of the carbon markets to address the climate crisis without rethinking a dominant view on the first consideration, namely how corporations and investors should incorporate carbon credits as part of their Net Zero strategies. Specifically, the dominant view or "received Net Zero logic" as I refer to it, threatens to divert valuable private sector resources away from one of the most underfunded but critically important areas for climate action, namely Nature Based Solutions (NBS) linked to the preservation and conservation of our ecosystems.[2] Part two of the chapter looks at the question of quality and environmental integrity of NBS credits linked to the preservation of our natural ecosystems to argue that novel approaches hold promise in overcoming traditional hurdles around environmental integrity and quality. While imperfect and in need of continuous refinement, these developments pave the road towards a more natural and more efficient pathway for achieving global Net Zero.

What is Net Zero?

The Intergovernmental Panel on Climate Change (IPCC) calls for a reduction of anthropogenic greenhouse gas emissions to achieve a “Net Zero” target by 2050—that is, a state where carbon dioxide (CO_2) emissions are balanced globally by the removal of an equivalent amount of CO_2 from the atmosphere. However, the IPCC does not provide guidance on how specific industries should meet this goal. In recent years, environmental groups, academics, and standard setters have sought to fill this gap.

The most influential of these is the Science Based Targets initiative (SBTi) which was created in 2015 by a consortium of climate NGOs to ensure that corporate Net Zero claims are aligned with the recommendations of the latest science. To date, SBTi has worked with more than 1,200 corporations to set Net Zero emission targets and the pace is accelerating. In 2019, on average 31 companies joined the organization per month (SBTi, 2021).

Companies that follow SBTi’s Net Zero guidance are required to first reduce their carbon dioxide emissions before using carbon credits to remove any unabated CO_2 that remains in their value chains (SBTi, 2020, 2021a, b).[3] Any activities to mitigate emissions outside a company’s value chain, so-called “compensation activities,” are considered voluntary and external to the Net Zero accounting framework.[4]

This guidance carries important implications for how and when it is deemed appropriate for companies to use carbon credits. Specifically, it implies that carbon credits should be used only after a corporation has taken all possible steps to reduce its own emissions, and that the only types of carbon credits they should use are those that remove CO_2 from the atmosphere (i.e., use “removals” rather than “reductions”). In line with the SBTi guidance, The Institutional Investors Group on Climate Change (IIGCC) Net Zero Investment Framework calls for a similar set of actions requiring investors to commit to only using carbon credits to “invest in long-term carbon removal, where there are no technologically and/or financially viable alternatives to eliminate emissions” (IIGCC, 2021).

This received Net Zero logic is ingrained in corporate sustainability strategies and public discourse on corporate climate action more generally. Take, for example, Aviva, the UK’s largest general insurer and a corporate champion for climate action. In describing its climate goals, Aviva starkly notes: “Net Zero means only carbon removals count; not offsets, reductions or avoided emissions” (Aviva, 2021). More broadly, in public discussions around corporate sustainability, there exists a commonly accepted distinction between achieving “carbon neutrality” and “Net Zero.” Net Zero refers to the state where companies have balanced their residual emissions with only removals—i.e., where they have effectively cancelled out emissions with negative emission activities. Carbon neutrality refers to companies that have offset their emissions through removals and reductions, i.e., including carbon credits linked to the avoidance of CO_2 (World Economic Forum, 2020).

Rethinking Net Zero and the Role of Nature Based Solutions

While the received Net Zero logic has intuitive appeal, closer scrutiny points to both conceptual and practical limitations that make it counterproductive for meeting our climate goals. To see this, it helps to unpack the received Net Zero logic in greater detail as follows[5]:

1. To meet the IPCC target of globally balancing greenhouse gas emissions and removals by 2050, companies must also achieve their own Net Zero by this date (SBTi, 2020).
2. Organizations should set a timeline and targets to achieve Net Zero that are aligned with what best science says is necessary.
   This implies that:
3. Organizations should prioritize reducing their own emissions (Scope 1 and Scope 2) and those within their value chain (Scope 3) to minimize the use of carbon credits in the first place.[6]
4. To the extent that carbon credits are used, they should be used only to deal with emissions that cannot be eliminated, and they should only involve activities that remove CO_2 from the atmosphere.

The argument suffers from two key weaknesses. The first is that it focuses on maximizing Net Zero strategies for individual corporate value chains rather than prioritizing achieving Net Zero at the global level which, ultimately, is the only Net Zero target that matters. The second weakness is that it fails to capture that the path to Net Zero is as important as the goal. While it is true that achieving Net Zero by 2050 requires balancing emissions through removals, it is necessary to first exhaust the biggest opportunities to reduce and avoid emissions (Broekhoff, 2020; EDF, 2020). In other words, we should not prioritize carbon credits linked to removals if significant opportunities remain to first reduce emissions. As one commentator put it: if you find your bathtub overflowing, it makes no sense to pull the plug but leave the tap running at full blast (Bloomgarden, 2021).

One critically important way to stop the bathtub of global emissions from overflowing is through a step change in investment into NBS linked to the conservation of tropical forests and other natural ecosystems. The 2019 IPCC Special Report Climate Change and Land concluded that "reducing deforestation and forest degradation rates represents one of the most effective and robust options for climate change mitigation, with large mitigation benefits globally" (Shukla et al., 2019). Indeed, if tropical deforestation were a country, it would rank third in carbon dioxide-equivalent emissions, behind only China and the United States (Seymour and Busch, 2021). Releasing the massive stores of carbon in these forests contributes to the acceleration of the warming of the planet, as this warming is a function of the residence time of CO_2 molecules in the atmosphere (Seymour, 2020a; b). Hence, avoided emissions now are much more valuable than removals of CO_2 later. In addition, recent research warns that the carbon stored in forests, oceans, and other ecosystems are not recoverable through restoration on timescales required to avoid catastrophic climate impacts (Goldstein et al., 2020). This further underscores the importance of "turning off the tap" on deforestation from a global warming perspective, not to mention other benefits such ecosystems bring, including safeguarding biodiversity, stabilizing the climate, building resilience to climate shocks, sustaining indigenous and local communities, and public health research (Anderegg et al., 2020).

While the science around the importance of preserving our natural ecosystems is clear, the received Net Zero logic disincentivizes corporate investment into such solutions as a result of its exclusive focus on removals for Net Zero accounting (conclusion 4 above). This has led to shifting scarce private sector resources away from highest impact opportunities into sub-optimal solutions. The debate around planting trees (removals) versus avoiding deforestation (reductions) offers a good illustration. Microsoft has made one of the most ambitious Net Zero commitments in the world with a pledge to become carbon negative by 2030. Aligned with the received Net Zero logic, a core pillar of its strategy is to phase out the use of avoided emission carbon credits to instead invest heavily into activities that remove carbon, including planting trees and investments into future carbon removal technologies. Explaining this shift, a Microsoft article notes: "one way to avoid a reduction in emissions is to pay someone not to cut down the trees on the land they own. This is a good thing, but in effect it pays someone *not* to do something that would have a negative impact. It doesn't lead to planting more trees that would have a positive impact by removing carbon" (Smith, 2020). In 2020, Microsoft planted 250,000 trees. Other large corporations also include tree planting as a major part of their sustainability strategies.[7] A similar logic is reflected by Mark Tercek, former CEO of the Nature Conservancy—the world's largest environmental non-profit—and Peter Ebsen, an entrepreneur and environmentalist:

> "We absolutely agree that protecting forests is essential to reaching our climate goals ... It's hard to think of a higher priority. But the logic of net-zero as recommended by the IPCC is that for every ton of carbon dioxide equivalent we put into the atmosphere, we need to take a ton of carbon dioxide out. And we urgently need to get started with reducing net emissions using this approach and logic. Supporting the protection of forests, as laudable as it may be, does not contribute to taking out carbon dioxide from the atmosphere in this way. Helping to reduce emissions is different than removing carbon dioxide" (Tercek and Ebsen, 2021).

While planting trees holds the promise of contributing to long term needs for removals, it is nowhere near as effective as avoiding deforestation from a climate mitigation perspective. Today, absolute carbon emissions from deforestation, logging, forest degradation are twice as high as the absolute removals from afforestation and reforestation (Hansis et al., 2015). In addition, it is not possible to achieve Net Zero by mid-century through reforestation alone. Preventing the loss of one hectare of mature tropical rainforest avoids releasing an estimated 165 tons of CO_2 into the atmosphere. To sequester that same quantum of carbon through forest regrowth would take 100 years (Seymour and Busch, 2021). This implies that if a tropical forest were cut down today and replanted immediately, it would overshoot the net zero mid-century deadline by 70 years.

Since preserving natural ecosystems is essential to society's transition to Net Zero, companies and investors should not limit themselves to their own decarbonizing efforts. Rather, they should be encouraged to invest in the world's most urgent and highest impact solutions wherever they may lie.[8] This speaks against the first conclusion of the received Net Zero view: that companies should exclusively focus on reducing emissions in their own value chains. It also follows that if the latest science tells us that actions to reduce emissions through the preservation of our natural ecosystems provide a more efficient way to achieve Net Zero than an exclusive focus on removals, the second conclusion—that corporations should only use carbon credits that remove carbon dioxide from the atmosphere—is also brought into question. The practical implication of this argument is that, if we are to achieve Net Zero as quickly and efficiently as possible, there is a strong case for shifting away from only removal credits to incorporating NBS reduction credits linked to the preservation of our natural ecosystems. However, the extent to which this shift positively moves the needle depends on the quality and environmental integrity of these NBS reduction credits. Let us turn to this discussion next.

Strengths and Risks of Nature Based Solutions

The quality and environmental integrity of NBS carbon credit depends on addressing three key risks: (i) first, that the use of NBS credits does not create perverse incentives for companies to compensate for emissions rather than invest in their own emissions reductions ("demand-side" integrity); (ii) second, that these carbon credits have robust environmental integrity, represent real reductions, and include the right social guardrails to protect local communities ("supply-side" integrity) (Seymour and Langer, 2021; Steer and Hanson, 2021); and (iii) third, that the purchase of carbon credits and the claims associated with them are trustworthy and transparent and align with a credible global accounting for Net Zero (Salway and Streck, 2021).

These risks are real and have curtailed the growth of NBS credits to date. However, there is a growing consensus around effective strategies on the demand side and new approaches on the supply side, anchored around a so-called jurisdictional approach to address these concerns. In addition, in thinking of NBS credits through the lens of "contributions" to supply-country nationally determined contributions (NDCs) rather than "offsets," there is a path to avoid the pitfalls of double-counting and misleading claims. Taken together, these elements improve the odds of bringing scale and environmental integrity to the NBS offset market.

Solving for Demand Side Integrity by Setting Interim Targets

The principal concern on the demand side of the equation is the moral hazard problem that companies will use these carbon credits as a lower cost substitute for reducing their own emissions, which could require additional investment and technological innovations. The danger is that we end up in a situation where companies use carbon credits to continue promoting—and continue investing in—polluting activities, resulting in emissions greater than would have occurred without the availability of carbon credits. While this demand-side concern is not unique to NBS, it has garnered particular attention given recent efforts by fossil fuel companies to promote their green credentials through highly publicized NBS strategies while continuing to invest heavily in their traditional businesses. Royal Dutch Shell, for example, laid out a plan in February 2021 to capture 120 million metric tons of carbon dioxide per year via nature-based carbon credits by 2030 to support its bid to achieve Net Zero by 2050. Meanwhile, they continued to channel the majority of their investments into further fossil fuel production (Mackenzie, 2021).

In response to this moral hazard problem, demand side integrity requires that the use of carbon credits enhances rather than dilutes climate action (Seymour and Langer, 2021). The best way to address this risk is through revised guidance by standard setters that takes into account the global mitigation pathway. This guidance should incorporate the need for corporations to decarbonize their own value chains while also exhausting their biggest opportunities for reducing and avoiding emissions. One way to do this is to separate short-term versus longer-term mitigation priorities (EDF, 2020). In the future, once emissions have been reduced to science-aligned levels across all sectors, it may make sense to focus exclusively on carbon negative technologies. But on the path towards achieving the Net Zero goal, companies should be encouraged to have interim or shorter-term, science-based mitigation goals that address the highest impact solutions across all value chains in addition to decarbonizing their own footprints (EDF, 2020).

Standard setters, such as SBTi, can be the source of this new guidance on how to achieve both interim and long-term goals. The guidance should be as granular as possible for each major polluting industry, helping them not only reduce their own emissions but also focus on stopping other sources. The guidance should be reassessed regularly until we have driven abatement to a level that puts us on a 1.5°C pathway (Seymour and Langer, 2021).

The timeline and the calculus for balancing emission reductions with carbon credits is likely to differ significantly by sector and by company. For example, cement, steel, and aviation are unlikely to fully decarbonize for several decades, as many of the necessary technologies for this transition are not yet commercially viable (Energy Transitions Commission, 2018). Indeed, the rollout of new abatement and removal technologies for these hard-to-abate sectors is potentially decades away (Energy Transitions Commission, 2018). In the meantime, it is critical to provide these companies with sufficient incentives to take action today and invest in the most urgent and impactful solutions.

In the absence of necessary guidance for shorter-term or interim Net Zero targets that balance the protection of natural carbon sinks and the decarbonization of value chains, there is a growing consensus on some commonsense strategies for companies to build confidence in their use of NBS credits as a complement to, rather than a substitute for, efforts to reduce fossil fuel emissions. The first step is to commit to a credible, independently verified, science-based decarbonization strategy that aligns with a clear and credible pathway towards Net Zero emissions (Seymour and Langer, 2021; Steer and Hanson, 2021). In addition, companies should commit to only buying high-quality NBS credits that ensure environmental and social integrity. Finally, companies should commit to reporting progress through independently verified annual reports and ensuring that their claims are based on best-in-class guidance and principles for sustainability claims. Some companies are already doing this and moving forward with bold commitments towards the purchase of NBS credits as a core pillar of their Net Zero strategies including, among others, Amazon.com, BCG, and Nestlé.[9]

Solving for Supply Side Integrity using a Jurisdictional Approach

Though there has been more controversy around the environmental integrity of the use of nature-based carbon credits on the supply side, strategies to address these risks are also more advanced (Seymour and Langer, 2021). In recent years, media, activists, and expert outlets have raised concerns over the environmental integrity—or lack thereof—of NBS credits. Articles by environmental journalists—with titles such as "An even more inconvenient truth: why carbon credits for forest preservation may be worse than nothing" (Song and Moura, 2019) and "These Trees Are Not What They Seem: How the Nature Conservancy, the world's biggest environmental group, became a dealer of meaningless carbon offsets" (Elgin, 2020)—have contributed to public skepticism of NBS credits. More importantly, such opposition and reputational damage has kept international forest-linked carbon credits out of compliance regimes, such as the Kyoto Protocol and California's Cap and-Trade Program (Seymour and Langer, 2021).

Much of this criticism has focused on standalone projects that have struggled with such challenges as additionality (emissions reductions as compared to what would have occurred anyway in a business-as-usual scenario), impermanence (emissions reductions reversed at a later date), and leakage (activities that cause emissions are simply displaced elsewhere). Additional concerns have been raised about the impact on local and indigenous communities including land-use competition. Finally, there is the question of scale. In 2019, the total market for Forestry and Land-Use carbon credits was less than $160 million, a tiny amount relative to the size of the challenge.

Over recent years, however, the market has moved towards a new approach to NBS credits, based on reducing and reversing forest loss at jurisdictional scales rather than on a project-based approach. Jurisdictional programs are designed to reduce and quantify emissions reductions relative to a baseline for an entire political jurisdiction, such as nation, state, or province, and are managed by the state or federal government. By contrast, projects operate at a much smaller scale and are generally privately managed. Jurisdictional approaches operate under a United Nations framework, affirmed by the Paris Agreement, known as REDD+ (Reducing Emissions from Deforestation and Forest Degradation and other forest mitigation activities in developing countries). Donors including Norway, the United Kingdom, and Germany have long adopted REDD+ as a core pillar of their official development assistance (ODA), and new standards have been developed to meet market requirements and drive finance at scale, including The REDD+ Environmental Excellence Standard of the Architecture for REDD+ Transactions (TREES) and VERRA's Jurisdictional and Nested REDD+ (JNR). In 2020, the governing council of the International Civil Aviation Organization (ICAO) approved both these jurisdictional tropical forest protection standards for use within CORSIA, the carbon reduction scheme of the aviation industry. Doing so opened up these carbon credits for use in the compliance market. More recently, efforts such as the Green Gigaton Challenge have emerged to help drive the adoption of jurisdictional carbon credits by private sector buyers in the voluntary markets.

A jurisdictional approach helps mitigate many of the risks around the environmental integrity of NBS credits. A well-documented challenge of NBS involves assessments of additionality, which rely on counterfactual evaluations of whether the purchase of a specific offset led to a reduction in emissions that would not have happened otherwise. These types of assessments are difficult to do and are subject to asymmetric information between certifiers and private actors. They also are open to potential gaming. For example, evidence suggests that key stand-alone REDD+ projects in Brazil suffered from crediting baselines significantly overstating deforestation loss and that, more generally, there is no significant evidence that voluntary REDD+ projects in the Brazilian Amazon have mitigated forest loss (West et al., 2020). By contrast, with a jurisdictional approach, given large enough spatial and temporal scale, additionality can be credibly demonstrated by reducing emissions below the level of a recent historical trend, as a transparent predictor for emissions in the near future (Schwartzman et al., 2021). The introduction of a baseline that declines over time, such as exists for the TREES standard, can further ensure increasing ambition over time and certainty that credited reductions are not just temporary accidents.

A jurisdictional approach also helps overcome the challenge of leakage, whereby deforestation is simply displaced from one area to another. Project-scale interventions cannot easily address this challenge. For example, if a rancher is denied access to a particular piece of protected forest, there is little that a project developer can do to stop him or her from simply exploiting the next piece of unprotected land. A jurisdictional approach, however, can address this driver of deforestation by incorporating a whole nation, state, or province into a REDD+ initiative. The larger the area covered by a REDD+ initiative, the lower the leakage risk (Seymour, 2020a; b).

The expanded geographic scale of jurisdictional approaches also helps overcome risks to the permanence of emission reductions due to reversals from natural disasters or policy changes. The key for assessing the permanence of any net emissions reduction over a specific time frame is whether it brings a risk that emissions will later rebound above expected business-as-usual (BAU) levels, providing a temporary climate benefit but erasing all or part of the cumulative gains over time (Schwartzman et al., 2021). The scale of a jurisdictional approach reduces the risk that a single natural disaster event, such as a forest fire or storm, will impact the net climate benefit of a REDD+ program as this risk is pooled across locations, actors, and time periods. Anticipated risks can be factored into buffer reserves or conservative jurisdictional baselines of large enough scale (Schwartzman et al., 2021).

Both jurisdictions and projects are vulnerable to policy reversals. However, jurisdictional approaches have two advantages in this regard. First, only jurisdictional approaches provide incentives to governments to implement key actions required to halt deforestation, such as enforcement of the law or resolution of land-tenure disputes and indigenous territorial rights (Seymour, 2020a; b). Second, only large-scale, jurisdictional approaches can lock in certain economic and development pathways which, once put in place, are more difficult to reverse. For example, reducing large scale deforestation while meeting economic development needs requires new production systems and market infrastructure. These could include more intense grazing techniques, the uptake of sustainability standards by buyers, greater public and consumer awareness, and expectations around indigenous rights that once put in place are not easily undone (Schwartzman et al., 2021).

Most importantly, there is evidence of the success of a jurisdictional approach and its benefits. Through use of a jurisdictional REDD+ program, the Brazilian state of Acre reduced deforestation by 60% in 2010 compared to a 1996–2005 baseline, while increasing its real GDP by 62%, nearly doubling the national average GDP growth (Meyer and Miller, 2014). Similarly, between 2004 and 2012, employing a national REDD+ strategy, Brazil achieved the unprecedented feat among tropical countries of reducing deforestation rates by 84% while increasing cattle and soy production (Nepstad et al., 2014; Junior et al., 2021). These efforts brought measurable change in Brazil. Sadly, Brazil has backslid since then, and 2020 marked the highest deforestation rate in a decade due to weakening enforcement by a government overtly hostile to forest protection and indigenous rights. However, current deforestation rates remain 44% below the historical average of 1996–2005, before Brazil embarked on its national REDD+ strategy (Schwartzman et al., 2021).

A final important advantage of transitioning from a stand-alone project approach to a jurisdictional approach is scale. A jurisdictional approach is the only conceivable way to meet the volume of demand for high-integrity NBS credits that will be needed to achieve a 1.5°C scenario. The TSVCM estimates that the carbon markets would need to supply between 1.5 and 2 Gt CO_2 of carbon credits per year in 2030 to meet demand consistent with a 1.5°C scenario (TSVCM, 2021). The pipeline of jurisdictional-scale REDD+ credits is estimated to be between 1.3 and 1.5 Gt CO_2 over 2020–2025 (Golub et al., 2018). By contrast, in 2019, only 100 million tons were transacted in the voluntary carbon market across all project categories (Ecosystem Marketplace, 2020).[10]

Reconciling Corporate Commitments with Global Carbon Accounting

While a jurisdictional approach may help overcome integrity challenges burdening a project-based approach, a more macro-level environmental integrity question remains. How do the purchases of NBS credits by corporations link into a global accounting of Net Zero that includes countries as well as companies? For this, it is imperative to ensure that if a corporation claims to have compensated for its emissions by purchasing a NBS credit issued by a country, that this purchase actually results in a reduction of an equivalent ton of carbon in that country. Currently, however, there is not a common accounting framework and protocols to guarantee that this important bookkeeping exercise is done correctly.

Under the Paris Agreement, this issue carries particular importance. Historically under the Kyoto Protocol, carbon credits were predominantly sourced from developing countries that did not have legal obligations to reduce their emissions. This significantly simplified accounting needs. Under the Kyoto Protocol's Clean Development Mechanism (CDM), the purchasing entity's home country simply added the purchased CDM reduction to their emissions balance. There was no need for the developing country seller to report a comparable emissions reduction, as it did not have legal obligations to reduce its emissions. Under the Paris Agreement, however, all countries have legally binding commitments to reduce their emissions in the form of NDCs which cover more than 90% of global emissions.

This common requirement to reduce emissions raises the risk of double counting and double claiming of emission reductions. For example, imagine that a tropical forest country invests in an ambitious conservation program and sells a set of carbon credits linked to avoided forest loss to an international corporate buyer. Given that forest conservation represents one of the most cost-effective solutions for large scale GHG emissions reductions, it is probable that the country may feature these emissions reductions as part of its NDC and may count them towards its Paris Agreement commitment. At the same time, the corporate buyer, as well as potentially the country in which it is located, will want to claim these same emissions for their own Net Zero commitments. At that point, the same reduction would effectively be claimed and counted twice—and potentially three times if the buyer's country also claims these emissions as part of their national registry. As a result, there is a danger of public and private actors appearing to individually meet their mitigation goals, even though total actual emissions reductions are less than the calculated total.

The predominant view is that, to avoid the double counting and double claiming problem, tropical forest countries can pursue one of two options. First, they can sell their emission reductions and, through a corresponding adjustment, deduct the sold emission reduction from their own inventory, thus allowing the purchasing company to count the reduction as its own. Alternatively, they can agree to count these emissions towards their own mitigation goals, with the corporate buyer agreeing to "finance" their NDC without taking credit for the resulting mitigation outcomes as part of its own climate goals. From an accounting perspective, the central problem with the first option is that the so-called rule book for how this would work under Article 6 of the Paris Agreement has yet to be agreed upon. Additionally, the infrastructure and systems necessary to implement the corresponding adjustments have yet to be developed. Under the second option, companies have little incentive to purchase these carbon credits if they cannot take credit for the resulting mitigation outcome as part of their climate goals.

The Role of Contribution Credits

This conundrum is particularly important for NBS credits as they frequently involve international transfers. There is, however, a way around this challenge that allows companies to make claims that are transparent and trustworthy while aligning with a credible, albeit imperfect global accounting for Net Zero. The solution requires first clearly differentiating between a compliance and a voluntary purchase of an NBS credit. A corresponding adjustment is clearly necessary for any purchase within a compliance regime such as CORSIA or the trading of internationally transferred mitigation outcomes (ITMOs) between governments that are included in the UNFCCC accounting for Paris compliance. However, for credits purchased on the voluntary market, the insistence on corresponding adjustments is not a prerequisite to avoid double counting. Any carbon credit purchased on the voluntary market is, by definition, not mandated or accounted for under any regulatory or compliance system. Thus, when a company purchases a carbon credit internationally, for the purposes of Paris Agreement accounting, the emission reductions need not be transferred to the GHG inventory of the buyer country. They can remain in the GHG inventory of the host country and thus the challenge of double counting is avoided without the need for a corresponding adjustment.

An important question arises, however, over the nature of the claims that corporations can make in executing such transactions. Implicit in the received Net Zero logic is that all carbon credits are necessarily offsets—i.e., they imply a direct cancellation of the buyer's emissions that is then only attributable to that buyer. To make a credible claim around offsets there is a clear need for corresponding adjustments backed by proper national accounting.

However, there is another way to think of carbon credits as contributions to the achievement of NDCs (Broekhoff, 2021; Dugast, 2020; Salway and Streck, 2021). In these cases, the buyer can still make a mitigation claim and take legal title of the carbon credit through a registry allowing it, for example, to further trade it or retire it in its name. Such a contribution credit needs to be understood as supporting the supplier country's NDC implementation and achievement and cannot be claimed for NDC compliance by the buyer's country. Here, the question of additionality is critical and needs to be assured through crediting standard requirements. As with any carbon credit, for a contribution credit to have environmental integrity, the emissions reduction that underpins the credit must not have been achievable in the absence of the financing generated by the credit. Furthermore, in the case of a contribution credit, it is important to ensure that a host country does not engage in a form of leakage where it claims those reductions at the expense of easing other commitments to reducing domestic emissions. As argued above, there are established approaches for addressing the first of these additionality concerns through a jurisdictional approach that avoids the challenges of counterfactual assessments. The second leakage problem is also critical and needs to be considered on a case-by-case basis, as NDCs vary widely in terms of scope, policy implementation instruments, and degree of legal formality (Mehling et al., 2018). It is worth noting, however, that there is no historical evidence that private sector action would displace public climate action or ambition (Streck, 2020).

The specification of contribution credits also helps diminish the more intractable double claiming problem. Double claiming is an issue that is by no means specific to the use of carbon credits and arises by design for every organization's climate actions that involve upstream and downstream emissions reductions. For example, if an industrial company reduces its Scope 2 emissions by introducing an energy efficiency measure and reducing the polluting power it buys, the fossil-based power generating company may also claim a reduction in its Scope 1 emissions. This reduction could also be claimed by the country's national inventory—thus resulting in potentially three different claims for one climate action (EDF, 2021). This challenge of overlapping claims raises legitimate questions when it comes to achieving transparency and precision in our understanding of global climate action. This said, this issue does not necessarily impact GHG accounting for Paris compliance. By convention, it is accepted that double claiming of internal emission reductions by corporations and governments where they are located will occur. It is not considered a problem from a double counting perspective, as only governments are party to the Paris Agreement. A contribution credit approach, underscored by proper disclosure, would not be a change to this status quo as the supplier country and corporate would both claim the carbon mitigation, but as far as Paris compliance is concerned, it would only be counted once by the supplier country. By contrast, the use of international offsets would heighten the risk that double claiming leads to double counting, for in the absence of a corresponding adjustment, the mitigation outcome risks being counted by both the buyer country's and host country's national inventory.

A pragmatic approach clearly is needed to deal with the double claiming problem (Salway and Streck, 2021). Since current NDC commitments put the world on a path towards warming of 3 °C, we need every tool to drive towards Net Zero (Tracker, 2019). Ending double claiming is critical to achieve an accurate assessment of global efforts, but it's not enough of a reason to delay taking other steps aimed at reaching Net Zero with all deliberate speed.

Conclusion

This decade represents a narrowing window to reduce global GHG emissions and remain within safe carbon budgets. The rise of Net Zero commitments by corporations represents a unique and historical opportunity to mobilize billions of dollars through the voluntary carbon market in our fight against climate change. To realize the true potential of this opportunity, however, we need a new framework and guidance to incentivize corporate climate action towards the most urgent and highest impact solutions.

The received Net Zero logic will not get global society to our stated climate goals, as it suffers from two major conceptual failings. The first is that the unit of analysis is backwards: it focuses on maximizing Net Zero strategies for individual corporate value chains rather than prioritizing achieving Net Zero *at the global level* as quickly and efficiently as possible. The second is that it takes a static, rather than dynamic approach to Net Zero that fails to capture that the *path to Net Zero is as important as the goal.*

In so doing, the current approach misses both figuratively and literally the forest for the trees. Specifically, it threatens to divert valuable private resources from the preservation of our natural ecosystems through high-quality NBS credits. These represent one of the most significant opportunities for reducing emissions while safeguarding invaluable benefits of biodiversity and the livelihoods of hundreds of millions of people.

These considerations carry important consequences, as the protection of the world's natural ecosystems is critically underfunded, and alternative sources of finance cannot rival the level of funding that could be achieved through the carbon markets. There are few large-scale financing alternatives to the carbon credit markets to help address these funding gaps, beyond increasingly constrained public dollars. Apart from the climate mitigation impact, a robust market for NBS also has the potential to provide significant new and additional resources to some of the world's poorest countries. An estimated 90% of the practical NBS potential carbon credits sit in the Global South while 90% of offset commitments today originate from corporations with headquarters in the Global North (TSVCM, 2021).

The good news is we have the contours of a new approach to incorporating carbon credits into a credible corporate Net Zero strategy. The elements of this new approach include rethinking corporate Net Zero goals to include interim targets that incentivize climate action towards the most urgent and impactful activities for global Net Zero, in addition to internal decarbonization efforts. Second, it includes taking a jurisdictional approach to NBS credits to gain heightened environmental integrity and scale on the supply side. Finally, through clarifying the nature of claims and approaches for safeguarding additionality, we can ensure that high-quality NBS credits deliver on their environmental integrity at the level of global Net Zero accounting. None of these solutions are perfect and they all will need continued refinement. But the need to prioritize investment into NBS is obvious and bring nature to the heart to corporate Net Zero commitments. Not a single industrial sector is on track to achieve its share of emissions reductions to avert catastrophic climate change and continued rampant destruction of invaluable natural ecosystems. It's time for new thinking and new approaches.

Declaration of Interests

Lorenzo Bernasconi serves as board chair of Emergent Forest Finance Accelerator, a non-profit organization based in New York City that acts as an intermediary between tropical forest countries and the private sector.

Key Takeaways:

- The "received Net Zero logic" proposed by leading standard setters is that to achieve Net Zero, companies must first and foremost focus on reducing the CO_2 before turning to removing whatever unabated CO_2 still remains in their value chains through the use of carbon credit removals.
- This perspective suffers from two key conceptual failings. The first is that it takes a static, rather than dynamic approach to Net Zero that fails to capture that the path to Net Zero is as important as the goal. The second is that the unit of analysis implicit in the received Net Zero logic is reversed: it focuses on maximizing Net Zero strategies for individual corporate value chains rather than prioritizing achieving Net Zero at the global level as quickly and efficiently as possible.
- As consequence of this, the received Net Zero logic disincentives the purchase of critically important carbon credits linked to the protection of our natural ecosystems that would help ensure that the carbon stocks they

contain are not released into the atmosphere—a *sine qua non* if we are to avoid catastrophic impacts of climate change.

- Recent innovations in the carbon markets linked to NBS credits, particularly around a jurisdictional approach, suggest a new way to incorporate carbon credits into a credible corporate Net Zero strategy. This approach overcomes the conceptual failings of the received Net Zero logic with the potential for unprecedented scale, environmental integrity, and impact.

Notes

1. The voluntary carbon market is contrasted to compliance markets. Compliance markets are regulated and exist as regional or national cap-and-trade emission trading schemes, such as the Regional Greenhouse Gas Initiative (RGGI) or the European Union Emissions Trading Scheme (EU ETS). The voluntary carbon market, by contrast, enables companies to purchase carbon offsetson a voluntary basis with no intended regulatory purpose.
2. Nature-Based Solutions are "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits" (Cohen-Shacham et al., 2016).
3. In SBTi language: "The SBTi follows a broad mitigation hierarchy approach whereby companies are required to reduce their own emissions before engaging in neutralization activities and subsequent compensation" (SBTi, 2021a, b). According to SBTi nomenclature, "neutralization" measures refer to measures that companies take to remove carbon from the atmosphere "within or beyond" their value chain, whereas "compensation" refers to "actions between actions that companies take to help society avoid or reduce emissions outside of their value chain" (SBTi, 2020).
4. In SBTi language: "the term compensation refers to companies' actions or investments that mitigate GHG emissions beyond those covered by their SBTs and net-zero targets. It may include actions such as purchasing high-quality carbon credits and providing direct financial support to projects that generate positive impact outside a company's value chain" (SBTi, 2021a, b).
5. Adapted from Broekhoff (2020).
6. Scopes 1, 2, and 3 refer to three classes of emissions sources identified by the Greenhouse Gas Protocol Corporate Accounting and Reporting Standard (Bhatia and Ranganathan, 2004). Scope 1 emissions refer to emissions that occur from sources that are directly owned or controlled by the reporting entity; Scope 2 emissions are emissions indirectly attributable to the reporting entity from the generation of power, heat, steam or cooling that is acquired and consumed in owned or controlled operations; Scope 3 emissions include all non-scope 2 indirect emissions including both "upstream" activities, emissions

related to products purchases by a company, and "downstream" activities, those related to the products they sell.

7. Apple announced a commitment in April 2021 for $200M in partnership with Conservation International and Goldman Sachs to launch a fund focused on forest restoration (Apple, 2021). MasterCard's Priceless Planet Coalition has pledged to plant 100 million trees over five years in partnership with a host of partners including Barclays, American Airlines, and Citibank (Mastercard, 2020).
8. In addition to the preservation of natural carbon sinks other short-term mitigation priorities include methane mitigation and other Short-Lived Climate Pollutants (SLCPs) (EDF, 2020).
9. These are among several companies that are participants of the The Lowering Emissions by Accelerating Forest finance (LEAF) Coalition, launched in April 2021, which aims to mobilize at least $1 billion in financing for forest conservation through high-quality carbon credits.
10. It should be noted that jurisdictional-scale crediting standards are moving towards integrating high-quality individual REDD+ projects into jurisdictional strategies and methods. JNR already has such a provision while TREES has committed to providing guidance on a nesting strategy in the development of its next version.

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8

A Note on Transition Bonds and Finance

Gireesh Shrimali and Thomas Heller

Editorial Note

In this chapter, we turn our focus to the transition from carbon-intensive production to zero emissions systems. Specifically, the authors tackle the following questions: Why have climate-branded debt products proliferated? Do all the new labels just lead to noise and/or does the creation of a distinct transition bond category serve a purpose? In order to effectively serve a purpose, what challenges must be overcome?

The subject of transition finance also urges the reader to consider their conception of what it will take to facilitate an effective and timely climate transition. Is it supporting only "green" projects, or will it also involve supporting the wind-down of fossil projects, as well as supporting systems-level coordination? Government

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transition plans are currently uncertain, if they exist at all. Instruments of transition finance could stimulate a dialogue between governments and companies. In the future, the hope would be for transition strategies to become increasingly defined and aligned on a common pathway.

Introduction

Transitioning from a high- to low-carbon global economy will require a tremendous mobilization of capital. A successful climate transition will involve overhauling fundamental building blocks of society, from energy systems to transportation infrastructure to food production technologies. In recognition of this significant undertaking, the developed country signatories of the Paris Agreement have already committed $100 billion per year toward efforts to keep global warming below the IPCC's 2°C threshold. Even this sum, however, falls far short of the funding required to facilitate this climate transition The International Energy Agency (IEA) estimated in 2014 that $53 trillion would have to be spent between 2015 and 2035 on energy-related transition investments *alone* in order to achieve low-carbon targets, and that amount has only climbed throughout the last decade. In the absence of meaningful carbon pricing—transition finance offers businesses an alternative mechanism for funding their alignment to global climate targets. Under this umbrella term fall a number of types of purpose-built bonds, including green bonds, sustainability-linked bonds, and, more recently, transition bonds.

Given the apparent multiplication of these tools over the past several years, a number of questions naturally arise: Does the world really need another, separate, transition bond framework? What additional utility could another instrument offer, beyond what can already be achieved through other mechanisms, such as green bonds? And perhaps more critically, can these tools offer a meaningful way to fund climate transition, or do they largely serve as a form of greenwashing for corporate entities? This note will review the progression of development and spread of these financial instruments, but also question the motivation and effects of this proliferation.

To evaluate the effectiveness of transition finance, there must be some standard and metrics that define the scale, scope, and sequences of the transitions to be managed. In bare outline, political economic transitions necessarily imply a winding down of embedded production techniques and the adapted social, organizational, and financial systems around them, and a building out of the new technologies and reformed complements that allow them to replace the incomes, quality of life, and stability of what is being dismantled.

Transition, and therefore transition finance, will likely encompass not just the capital costs of new and on-time infrastructure and production facilities, but also the direct and administrative costs of adjustment to the dislocations required. And around such system-level changes, there are risks on both the downside and the upside that, if not managed efficiently, will increase the disruptive effects of disorder across the transition process or the residual damages from transition left undone.

The Evolution of Transition Debt Instruments

Green Bonds

Since their first issuance in 2007, green bonds have rapidly become the predominant purpose-built credit instrument used for climate transition. The volume of green bonds outstanding began at $230 million in 2010 and rose sharply from around $4.8 billion in 2013 to roughly $142 billion by 2017 (CBI, 2018), with the latter growth representing a nearly 30-fold increase over four years. Annual green bond issuances showed similar patterns, experiencing a nearly 120-fold increase over the same period (Tolliver et. al., 2019).

Green bonds were created to fund projects that have a positive environmental or climate impact. This purpose prompts the question, what types of projects qualify as "green"? The Green Bond Principles, written by the International Capital Market Association (ICMA), provide one potential answer to this question by outlining an indicative list of "eligible" green projects, which include, but are not limited to: renewable energy, energy efficiency, pollution prevention and control, climate change adaptation, green buildings, clean transportation, and terrestrial and aquatic biodiversity.

Despite their meteoric rise in popularity over the past decade, green bonds face a number of critical challenges that threaten the efficacy of their administration. The availability of reliable data, and thus reliable reporting and verification, remains an issue, especially on post-issuance allocation of proceeds (Tolliver et al., 2019). In 2017, less than 10% of the green bonds reported post-issuance allocation, and less than 7% reported impact metrics (Tolliver et al., 2019). Second, the voluntary Green Bond Principles, formulated in 2013, have been reasonably comprehensive in specifying what is needed to capture quality data and to demonstrate additionality for green bonds. These principles are then suitably supported in terms of impact reporting by the Harmonized Framework for Impact Reporting for green bonds (ICMA, 2020a). However, both frameworks are voluntary and flexible (using terms such as "recommend" and "encourage," without being prescriptive), which leads to divergence in impact reporting. A majority of green bond fund investors report current green bond impact accounting to be inadequate, citing both under-and over-coverage of qualified fund uses, transparency, and standardization (EF, 2020).

A number of empirical studies have raised concerns around the performance of green bonds at the firm level, albeit with contradictory findings. Some investigations find that green bond issuances improve performance on financial metrics and environmental indicators (Flammer, 2020; Sebastiani, 2019). On the other hand, multiple studies find that green bond issuances are not correlated with statistically significant improved environmental performance and that green bonds do not result in a reduced cost of capital (Ehlers et al., 2020; Economist, 2020). While it is not straightforward to reconcile these results given differences in dataset and methodologies, this dispersion merits a strong note of caution about the incentives in voluntary regimes to label, monitor, report, and audit the quality of "green" financial assets (a theme carefully examined in the first part of this book).

While a broad gap between the pre-issuance intended deployment of green bond funding in projects and the disclosed use of proceeds plagues green bond reporting in many jurisdictions, the problem of the additionality of green bond funding is likely of greater consequence and concern. Unless the use of proceeds for declared and qualified green uses is disclosed at the portfolio (or even the associated financial group) level, even ring-fenced green bond funds may not add to the total investments in sustainable projects. Incentives to separate green and fossil value chains to attract dedicated green investors do nothing significant for a climate mission. As suggested in Chapter 3, the coincidence of a systemic lack of reliable data and questionable analytical metrics for additionality nominate the candidacy of green bonds for careful scrutiny of financial carbonwashing. For example, an investigation in 2019 found that at least one-third of green bond issuances in the last three years did not meet three well-known criteria, such as credible issuer Environmental, Social, and Governance (ESG) performance, alignment with the green bond framework, and measurable quantitative impact (Kendall, 2019; Flammer, 2020; Bachelet, 2019).

The record of green bonds is arguably consistent with a cycle of introducing new classes of green instruments that attract large capital flows followed by repeated industry or civil society efforts to organize high-quality standards for these new assets. Such efforts have persistently led to difficulties in agreeing or enforcing these standards. Rather than increasing investor confidence in any label, new issuers prefer to replay this cycle around differentially designated green instruments. This may suggest that transition bonds will run the same course, and ought not to be welcomed.

Transition Bonds

While experience with green bonds casts cautionary shadows of doubt over the added value of new classes of transition denominated financial assets, it does not exclude the possibility that a focus on transition itself calls for financings at a scale that have been excluded from creditable green bond qualification. Credit Suisse and the Climate Bonds Initiative, who partnered to publish a transition bond framework (CBI, 2020), articulate three reasons why a transition bond framework beyond (and potentially encompassing) the currently existing green bond frameworks is needed. First, investors are asking for greater diversity in the uses of proceeds than is widely accepted within green bonds practice, as well as for participation from more issuers. Second, many high-carbon emitters are looking for opportunities to invest in transition-related projects and are frustrated by the lack of opportunities. Finally, regulators are asking for capital markets to play an active role in financing corporate transitions. What seems common to these three criteria is a conviction that some features of the movement from high- to low-carbon systems still remain conventionally unconsidered or left out of what has been classified as Green Finance. An informal grouping of the uncovered features of transition might follow four lines of thought.

Transition as project. Much of the proposed use of proceeds of financial issuances around transition centers on equipment or physical hardware associated with low-carbon energy, transport, or industrial processes. The European Union's Green Taxonomy imagines a first such framework built by policymakers and regulators to distinguish green from other investments by project type (EU, 2020). This guidance sets performance thresholds for economic activities that meet the following criteria: make a substantive contribution to one of the six environmental objectives (e.g., climate change mitigation, climate change adaptation, protection of water and marine resources, transition to a circular economy, pollution prevention and control, protection and restoration of biodiversity and ecosystems); do no significant harm to the other five; and meet minimum safeguards that are already established as standards (e.g., OECD Guidelines on Multinational Enterprises and the UN Guiding Principles on Business and Human Rights). While the EU is quite detailed in identifying approved economic activities, critics suggest its positive core listing of eligible transition investment may still be too prescriptive and not flexible enough for industry (Harris, 2019). China also has produced a catalog for Green Bond classification with similar design and purpose.

The issuing firm or financial institution that funds a portfolio of such firm and project-specific investments may seek transition credentials tied to either the particular installation of low-carbon gear or, increasingly, to a longer-term transition plan to which the organization announces its commitment. For such project-based investments within an issuing firm, whether funded through project-specific or general corporate bonds, there seems little reason to distinguish transition from green bond recognition. Moreover, green bond qualification has also begun to migrate from immediate projects to future plans that might otherwise distinguish transition from more generic green finance. The overlap between green product-based taxonomies and this particular claim to transition finance reinforces the seemingly questionable value of generating a new instrument class for this reason alone.

Transition as (low-carbon) bridge. More problematic discussion concentrates on other transition bonds where proposed uses of investment proceeds are currently disqualified as eligible for green bond qualification. Assertions of green- or carbonwashing have circulated around transition bond issuances or uses of proceeds inconsistent with widely subscribed norms or standards, most often linked to investments in "lighter fossil" solutions such as higher efficiency coal-fired generation or natural gas refineries, pipelines or liquefaction. A Repsol green bond in 2017 came under attack because neither its intended use of proceeds, nor its broader corporate strategy were at the time aligned with the Paris Agreement (CBI, 2020). Similar disrepute followed a SNAM Climate Action Bond in 2019 seeking finance to support a methane leakage target, which increased from 25% to 40% over time (CBI, 2020). More generally, transition bonds have been deplored as non-additional toward approved activities, such as bond issuances not resulting in improvement in carbon intensity at the firm level (Ehlers et al., 2020). In all of these cases, advocates of an added transition bond status argued that their proposed investments would play a necessary role in moving from a higher-toward a lower-carbon economy. Especially in industry sectors and geographies where the costs of low-carbon technologies at relevant scale remain significantly above currently available, reduced carbon fossil alternatives, investments in solutions that would maintain economic and social stability during a *transitional* period would better satisfy joint climate and employment/consumer concerns. In effect, these non-green transition bonds constitute implicit industry claims about (in)feasible rates of technology change, and the present economic value of continuity in largely fossil-dependent policy, business models, and finance. Those who resist these plans and contest the transition bond label, are essentially raising the question of who gets to define the shape and timing of transition.

Transition as systems. While early issuances of, and debate over, transition bonds has concentrated on funding of essentially green projects or asserted bridges to future zero carbon technologies through more efficient or less carbon heavy fossil alternatives, transition finance might principally be targeted at investments that complement zero carbon technologies through systems integration, policy reform, business model reorganization, or financial innovation. The fundamental insight of a focus on systemic transition is that the added economic value of new technologies emerges only with accompanying changes in the soft infrastructure that adapts the organizational and political context in which these technologies become widespread. Ready-at-hand investment needs for low-carbon energy still lack financing for control software, market re-design, intelligence services, and flexible capacity development. Similar systemic investment opportunities lie in precision agriculture or automated vehicle computation that may conceptually fall into green finance taxonomies, but are not represented in current investment portfolios. While deficits in systemic investment often signal issues in blended financial structuring or mispricing of infrastructure returns, these deficits help explain the slow pace of transition that transition bonds might relieve.

Transition as restructuring. If transition as systems looks to speeding the build-out of low-carbon technologies, the record of transition more broadly would equally call for transition finance as dedicated investment in the winding down of embedded firms, industries, and whole economies. Transition plans that could meet the shrinking windows for agreed climate stabilization will be defined against a standard of rapidly accelerated systemic reorganization across core economic sectors with massive unamortized investment in capital, production know-how, consumer tariffs, and jobs. Disruptions of returns and price expectations can create near-term and concentrated losses that impede effective transition. In addition, effective restructuring will often recognize, in existing firms in declining sectors, spheres of excellence in research and development that can be segregated and ported with high economic returns and shortened timelines into the redesigned systems that successful transition prioritizes and requires.

Although tight carbon budgets increasingly conflict with the historically slow pace of economic transitions, customized institutions and processes for restructuring declining firms and industries are available. In the United States, Chapter 13 of the bankruptcy code empowers specialized receivers or trustees to consider the several concerns of capital, labor, communities, and existing and incoming investors in corporate restructurings. The World Bank has developed an inclusive program to examine the upside and downside aspects of transition in economies dependent on fossil exports (Peszko et al., 2021). Exceptional wartime agencies or the special purpose vehicle (Truehandanstalt) created by the German government during the process of reunification to manage the restructuring of the former East Germany's industrial conglomerates have been charged with the social and political, as well as the economic, reorganization of systemic transitions. Though the destination of effective transition finance will evolve toward transition as restructuring, as discussed below and in Chapter 9, this practice still lies mainly across the horizon.

Transition Finance Frameworks and Pathways

An effective transition finance framework must perform three essential functions. First, a transition bond framework must align with well-defined *climate goals*, such as the 2°C temperature target agreed in the Paris Conference of the Parties (IPCC, 2015), and soon refined down to 1.5°C. Second, the framework provider needs to be able to define and certify *transition pathways*, or linear paths to Net Zero by 2050. Third, it needs to specify *business level activities*, such as investments in solar power plants, systems integration software, carbon capture equipment, sequestration pipelines and sites, precision agriculture, and synthetic protein manufacture. Associated business strategies, production models, labor needs, investment sources, complementary policy reforms, and risk management would need to be specified credibly at the firm level as well (Ehlers et al., 2020).

However, a transition bond framework also needs to allow for flexibility in getting to climate goals. The IPCC identifies multiple pathways to get to a 1.5°C target (IPCC, 2019; RMI, 2020), demonstrating a tension between stringency and flexibility of choosing pathways and associated activities. One IPCC pathway blesses an estimated increase of natural gas consumption by 85% by 2050, while another estimates an 88% reduction over the same time period. Although more constrained rosters of pathway choices would reach climate targets in a more certain manner, they will ignore the value of industry creativity and competitive strategies in making the required transition. (CBI, 2020). More inclusive approved portfolios of pathways will foster flexibility in getting to climate goals, but also facilitate the carbon-washing that discredits green markets. In the current state of transition play, with competing voluntary associations proposing diverse metrics, controversy centers on whether a pathway framework (and associated qualification of transition financing instruments) should begin with climate science-driven emissions or temperature goals derived from global carbon targets and work down to firm level applications (top down), or whether pathways are better grounded in low-carbon technology patterns to be aggregated up into normative systemic change (bottom up) (Brest and Honigsberg, 2020).

Top down frameworks. The framework from the Transition Pathway Initiative (TPI 2020) engages its subscribing companies through both setting pathways and scoring compliance. It uses a top down sectoral decarbonization approach (SDA) to assign differentiated transition pathways to industrial sectors and individual firms within them (Krabbe et al., 2015), and measures their performance against these transition pathways over time. However, it neither specifies actual business level activities to get to these transition pathways nor allows flexibility around a prescribed sectoral timing schedule. Because TPI appears to focus only on Scope 1 and 2 emissions, its sense of transition will miss the more comprehensive strategies for emission reductions covered by Scope 3 (Shrimali, 2021).

By contrast, the framework offered by the Science Based Targets Initiative (SBTi, 2020) sets out pathways that both recognize the role of flexibility in setting transition pathways and the need for minimum rates of transition. It prescribes these rates for the 2°C and 1.5°C climate targets, at 2.5% and 4.2% per year. Science Based Targets Initiative is working with measurement frameworks designed for specific industry groups (e.g., CDP, 2020; PCAF 2020; PRI, 2020), which include all scopes of emissions. However, this framework remains highly aggregated with sparse-specific guidance on how actual business models and strategies can be fitted to the arithmetic contours of the transition pathways.

Bottom up frameworks. Traveling in the opposite direction, the framework from the Energy Transitions Commission (ETC, 2020) is a bottom up approach, focusing on plans for conversions of production to selected low-carbon technologies required to get to Net Zero pathways consistent with the 1.5°C target. These activities include renewable power, electrification of buildings and transportation, green hydrogen, and bioenergy with carbon capture and storage. Like other comparably constructed frameworks that substitute physical proxies and linked investment calendars for temperature or emissions metrics aligned with decarbonization goals and interim carbon budgets, this framework presents major challenges assigning activities to different plausible transition pathways even within the 1.5°C target. The gap between all highly aggregated and standardized pathways and credible firm-level transition commitments (time-specific packages of technology and business-line conversions, R&D programs, acquisitions and mergers, insurance and financial hedges) that add up to a low-carbon transition across an entire economy threatens to remain beyond the reach of voluntary carbon initiatives.

Market and Regulatory Approaches to Transition Finance

A Market Approach

In the continuing search for market-based solutions that inform and encourage quality transition finance, looking beyond stakeholder (firms and investors) agreement on sector-based transition metrics, a formidable challenge awaits around the quality of information that supports evaluation of issuance and performance claims made for transition finance instruments. A familiar approach to this challenge builds on the know-how of existing ratings agencies to evaluate the underlying ambitions of planned investments or portfolio strategies of funds announced with climate targets and associations with transition pathways. These transition ratings, which would be separate from the credit ratings, would also appropriately bypass the debate around the need to incorporate the climate risk aspects into credit ratings (SP, 2020).

Reliance on a transition-focused rating system would assume the practicality of defining Paris or Net Zero consistent climate pathways, with a focus on demonstrating their additionality compared to business-as-usual, using both simple and sophisticated statistical techniques (Ehlers et al., 2020; Flammer, 2020). For ratings purposes, transition bond issuances would be assigned to such agreed targets, pathways and activities. Special purpose vehicles would be created to segregate and account for the proceeds of the bonds. Credible external verification methods would be certified to demonstrate that the proceeds in these special purpose vehicles are actually allocated to the promised activities, pathways and targets. The verification of allocations and their additionality generally relies on incorporating procedures for independent and trusted third party agencies (UNFCCC, 2020). It is arguable that a highly rated transition bond may attract more capital due to higher demand by investors with ambitious climate preferences and command a lower cost of capital. However, even if markets are not explicitly incorporating transition risk, transition bond ratings could be directly linked to contractual terms like those of sustainability linked bonds (ICMA, 2020b), where the cost of capital would be reduced contingent on meeting stated targets.

Claims for best practice in defining transition pathways and activities have clustered around metrics that offer detailed guidance on transition pathways as well as mitigation activities, where the pathways are outputs of integrated assessment models (IAMs), and the sector-specific mitigation options are inclusive rather than narrow. Other characteristics that have been suggested to benefit the spread and effectiveness of transition bond ratings include: (1) transition pathways set with reference to the Scope 3 emissions of the firm, to ensure that supply chain emissions are accounted for, and not simply transferred to the ledgers of less transparent or less regulated associated entities *(leakage*) (Song et al., 2020; Shrimali, 2021); (2) a focus on the overall transition record of the issuing firm or financial institution relative to specific climate targets and a transition pathway, which would be updated if the organization-level commitment or performance changes over time; and (3) appropriate data with a high-degree of transparency and accuracy. In all these regards, transition bond issuance and performance ratings mirror principles developed earlier for green bonds (ICMA, 2018) and have also been recently reiterated not only for green bonds (NPSI, 2020) but also for sustainability linked bonds (ICMA, 2020b). At the same time, in new transition bond markets, caution regarding regulation of the use and asset quality of offsets, whose effects on the credibility of transition compliance are discussed in Chapter 7, will demand particular attention. In all, experience with these now well-rehearsed scripts for market-driven financial solutions are as likely to compromise as to reinforce the record of implementation under voluntary frameworks.

A Regulatory Approach

The market for transition bond frameworks is already populated by numerous coalitions, with prevailing inconsistency of definitions and frameworks (TCFD, 2020). As found in the analysis of the aggregate confusion investors face in ESG markets (Berg et al., 2019), without convergence toward commonly accepted definitions, it is difficult to lay claim to time-relevant effectiveness, efficiency, and integrity in a market-driven industry-led approach (Piemonte et al., 2019; FT, 2020, EF, 2020). Looking at these issues historically, Brest and Honigsberg argue that we need not only robust internal mechanisms (i.e., processes and procedures) to accurately measure progress toward stated targets, but also strong external mechanisms such as auditing and regulatory enforcement (Brest and Honigsberg, 2020). Researchers concur that, even in financial reporting, which is the backbone of well-functioning financial markets, strong regulatory interventions were needed in developed economies (Habib et al., 2014; Leuz and Wysocki, 2016), led by the US Securities Exchange Commission (SEC) and the International Financial Reporting Standards Foundation (IFRS). Brest and Honigsburg further recognize that financial regulators may need to work together with environmental regulators to create such regulations, including for transition bonds. The empirical case for mandatory reporting to approach required climate finance outcomes has also been suggested in an initial analysis of France's TECV law that was found to have curtailed fossil fuel financing by institutional investors by 39% (BF, 2021).

States and Transition Management

This chapter notes that the direction of travel in low-carbon transition planning and finance will be from green projects toward systemic restructurings. Because these restructurings target core industrial sectors, their impacts will be felt across whole economies and marked by heightened physical and transitional risks across the accelerated time frames that climate dynamics impose. Climate risks, as they become systemic or collectively significant, will lie with the state agencies—central banks and financial regulators—charged with the stability and strength of the sovereign balance sheets to which they will ultimately migrate. Systemic risks of transitions in the form of restructuring will fall on or be transferred to states. These risks require management from the state. The risks and associated management decisions include: trade-offs between deferred and higher cost (incomplete) transitions and residual physical risk in the long-term; costs of dislocation of human and financial resources stranded by well-managed, mismanaged, or failed transitions, especially where there is a history of legal or political-economic transfers of concentrated losses to sovereign accounts; coordination of upside (low-carbon) and downside (high-carbon) orderly transition over time; and implementing vehicles for distributing transition costs including transition-specific funds, social insurance, and international transition assistance.

Where credible estimates of transition risks and any post-transition residual physical risks present systemic political or financial problems for which someone must be accountable, these risks lie neither in the self-interest nor capacity of private actors to manage. Structural transition from high- to low-carbon systems then suggests a management process that runs from a state-driven accounting of systemic risk metrics and planning; through to state delegations of assigned risk management obligations, whether to sub-national governments and to private actors or associations with better sector-specific knowledge, organizational competence, and tools; and finally to the redistribution of income streams and wealth around the consequences of transition through a network of targeted investment funds, customized transition financings, and reformed delivery vehicles for social insurance. A reverse transition governance process that works up from private actors and then patches on state management of revealed gaps of unmanaged systemic risk is futile because private actors will behave strategically, shifting climate risk back to sovereign balance sheets in what appears as disorderly transition. The real question of transition is neither its direction nor its governance, but which vehicles states can deploy that combine an efficient strategy for climate risk management, the well-timed wind down and coordinated wind up of production systems, and sufficiently just distributions of post-transition outcomes across a politically subdivided world.

When the demands of climate change are recognized as the management of orderly transition at an accelerated, perhaps breakneck pace, the focal point of transition finance logically shifts to structured instruments—public, blended, and private—that mobilize funds aligned with the state-organized process and objectives that define the systemic transition. In Chapter 9 we turn to a more detailed discussion of transition finance in this expanded sense through analysis of securitization structures with systemic ambitions in the United States. More comprehensive prospects for the definition and uses of transition bonds, including two immediate applications in India, may be found in Shrimali (2020) and Koberle and Shrimali (2020).

Conclusion

This chapter explored the rationale, goals, and challenges of a transition bond framework, and investigated lessons learned from experience with green bonds and other climate finance instruments that have proliferated in number and volume of funds raised in the past decade. These frameworks are predicated on creating markets around widely accepted quality standards for transition bonds that allow for appropriate sector- and firm-specific flexibility in issuance, but also avoid green- or carbonwashing in gaps between announced transition plans and discordant performance.

Key Takeaways:

- Transition bonds have the potential to add to the current green finance toolbox by going beyond existing project focused definitions of climate transition.
- Directions of travel in transition finance will turn to transition pathways and timelines that focus on *transitional* sequences, low-carbon systems, and economic restructuring.
- Effective market-based frameworks will need to connect transition pathways to transition bond ratings to provide appropriate and credible signals to investors.
- States, as enabled regulators, and as the bearers of sovereign risk in economies exposed to increasing transition impacts, will have primary responsibility for orderly transition.

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9

Securitization as a Model for an Equitable Transition

Uday Varadarajan

Editorial Note

In this final contribution to the volume, our discussion turns toward the future. The endeavor of transitioning from a high- to low-carbon economy presents numerous risks and challenges, both economic and behavioral. The impacts of this transition will extend far beyond our carbon budget—from reshaping our energy system to altering the landscape of economic opportunity in communities across the country. Varadarajan deftly walks us through these challenges, as well as the sets of incentives across a multitude of stakeholders—from utilities to investors to customers—that motivate resistance to this transition. A key insight to underscore is that capital owners are largely shielded from the costs of transition. Rather,

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these costs often are passed on to customers, which has significant implications for what constitutes a fair and equitable transition. In fact, the question of how to develop mechanisms to address risk and ensure a fair transition is an animating theme of this chapter.

Introduction

The falling costs of clean energy technologies—solar PV, wind, EVs—now mean that significant global decarbonization of energy supply and use may be economic in the long run. However, with rapidly accumulating carbon pollution leaving the world with few pathways to avoid the dangerous impacts of climate change, there is no time to wait for that long run to materialize. In an ideal world, the improved economics might allow for gradual transition of global energy infrastructure to clean energy as the former lives out its useful life. No such path is open today, however, and a very rapid transition to a zero-carbon energy system is now required.

The reality of the political economy and power structure of the global energy system is such that, in the absence of further intervention, owners and investors in energy infrastructure have often insulated themselves from the risks of rapid transition. Therefore, the impacts of a rapid transition of global energy infrastructure would fall most heavily on energy customers, workers, and communities. And that burden would fall most heavily upon the most vulnerable among them—disadvantaged and low-income communities in particular.

Such an outcome would deepen already significant inequalities associated with the environmental, health, and economic burdens of fossil production and use already borne most heavily by vulnerable populations in energy communities. Such an outcome is also highly unlikely to be politically sustainable—and therefore very unlikely to be successful in achieving the goal of reducing the risk of dangerous climate change.

Therefore, if action to address climate change is to succeed, the challenges associated with the rapid transition of energy infrastructure—and achieving an equitable transition for the energy customers, workers, and communities likely to be negatively impacted by such a transition—must be addressed.

Unfortunately, while traditional economic approaches to drive carbon reduction—such as carbon taxes or cap-and-trade regimes—are well suited to efficiently drive long-run change, they are not directly designed to achieve rapid change while mitigating transition costs and risks. Essentially, these mechanisms finance climate policy action on the backs of those already at greatest transition risk. The direct impact of these policies is to levy fees or taxes on carbon-intensive energy industries that have the power to pass those costs on to energy customers, communities, and workers—thereby magnifying costs and risks to those already facing the greatest threat from rapid transition. And while reallocation of the taxes or fees collected back to those communities is a common practice in these regimes, those reallocations only partially make up for the damage done.

Innovative financial tools can help. The potential long-term benefit streams of clean energy unlocked by rapid technology cost reductions offer a potential source of value that could be brought forward to address transition costs and risks. Transition financing tools take a portion of the future benefits in the long run from a transition to clean energy that would otherwise primarily accrue to potential winners—power companies, EV manufacturers, etc.—and bring them forward to mitigate transition costs and risks for energy customers, workers, and communities. The potential winners benefit from the greater likelihood of rapid growth of their businesses, while energy customers, workers and communities benefit from cash and financing in their time of need. The net result is a more equitable acceleration of the transition to clean energy.

This chapter introduces examples of such transition finance and policy tools that have been deployed by the US regulated electric utility sector and could serve as models for addressing transition challenges more broadly to enable a rapid and equitable transition to clean energy. First, we review the broader evidence around the centrality of transition challenges to the politics of climate action. Next, we turn to a discussion of how investors in energy infrastructure have protected their interests against transition risks and effectively passed through the burdens of rapid transition to energy customers, workers, and communities. We then introduce in greater detail the potential role that financial tools could play to address these challenges. To make the discussion more concrete, we turn to the example of transition challenges faced by the US regulated electricity sector in particular, focusing on the perspectives of three key stakeholder groups—utilities and their investors, electricity customers, and energy workers and communities. We then introduce a specific tool—ratepayer-backed bond securitization with capital recycling and transition assistance—that can mitigate the transition challenges faced by key US regulated electric utility stakeholders. We describe in greater detail progress in implementing securitization across US states and utilities. Finally, based on the example of securitization, we introduce the generalized concept of transition financing and discuss two innovative tools that could help accelerate transition across a broader range of sectors and geographies.

Beyond Collective Action: Climate Change as a Transition Challenge

For decades, tackling climate at the national and international level has been synonymous with reaching agreements for collective action—figuring out who ought to cut emissions by what date and making sure that all parties were doing their part. However, the reality of global climate action over the last decade has been much less about coherent collective action and much more about unilateral action at various levels—by cities, states, companies, as well as by countries.[1] Entities that have chosen to take strong action often have had strong internal drivers for that action, including near-term climate-linked physical risks, economic interests in low-carbon technologies, or strong pressure from voters, customers, or investors. At the other end of the spectrum, politicians and corporations in states and nations with substantial carbon-intensive industries have built significant political movements around climate denial. These extremes serve to illustrate the extent to which distributional and political economy considerations at a national or subnational level, rather than collective action concerns, have played an outsized role in determining action or inaction on climate (Aklin and Mildenberger 2020). That is, whether or not a state or country acts on climate hinges more on whether politically powerful factions believe they will be winners or losers if action on climate is taken than worries about what other states or countries are or are not doing.

Fortunately, recent technological progress means that action to reduce emissions is looking likely to create far more winners than losers—at least in the long run. Policy action and investment in innovation by some states and nations have led to a steep decline in the costs of many clean energy supplies and end-use technologies such as wind, solar, storage, electric vehicles, and LEDs. As a result, in many regions across the globe—including many with significant fossil resources—choosing to decarbonize through deployment of low-carbon technologies is close to or already net beneficial in the long run, even without accounting for health and environmental impacts.

For example, a recent analysis suggests it is more expensive to keep operating 39% of the over two terawatts of coal generating capacity across the globe today[2] than it would be to generate that power from new renewable and storage assets today—with that fraction jumping to 78% by 2025 (Bodnar, 2020). This example suggests that rapid action on climate is increasingly compatible with the long-run economic self-interest of public- and private-sector actors across the globe.

However, this rapid climate action isn't actually happening. In fact, the opposite has been true. While coal is already uneconomic for many actors, global coal capacity has yet to decline any year in this century.[3] This trend suggests that simple energy economics considerations alone do not tell the whole story—and that the balance of winners and losers may be tied to less visible structural, political, or institutional barriers that are impeding rapid transition. If climate action is indeed determined by alignment of national and subnational interests, then those transition challenges ought to be surfaced and addressed as a central focus of climate policy, especially if we are to take advantage of the opportunity that technological progress presents.

Key Transition Challenges: Stranded Costs, Energy Workers, and Communities

One oft-discussed barrier to decarbonization is the significant capital invested in existing fossil infrastructure, which could be stranded—i.e., may not have the realized value to investors that they anticipated—in a rapid transition. Roughly $2 trillion in net undepreciated book value of capital invested in coal plants globally could potentially be at risk of stranding in a rapid transition.[4]

However, while rapid coal transition likely would involve significant costs and risks, the direct risks of losses to coal plant investors are quite limited. Investors in over 90% of the coal plants operating across the globe today have contractual, regulatory, or political protections in place (Bodnar et al. 2020). These include, for example, long-term power contracts, administratively set tariffs, and favorable policy or political power structures. These types of measures largely insulate investors from direct losses associated with early coal phaseout and contribute to significant inertia against a rapid transition that might introduce material reinvestment, regulatory, and operational risk where there was little before. As a result—contrary to common perception—measures that only compel or accelerate coal phaseout do not necessarily directly punish the owners and financiers of polluting plants by forcing their owners to take a loss. Instead, investors face the relatively modest risk associated with productively redeploying their capital.

Rather than influencing economic hardship on fossil fuel plant owners and financiers, measures to compel plant retirement—in isolation—often end up pushing those costs and risks onto those without the means to protect themselves. It is often electricity customers, coal workers, and communities—particularly vulnerable communities already bearing significant energy cost or environmental burdens from decades hosting plants and mines—that face the prospect of significant near-term disruption from a rapid transition, due to price spikes, job losses, loss of funding for essential services, and inadequate funding to clean up contaminated lands and waterways in their communities. For example, coal plant customers that may wish to replace the power they purchase from a coal plant owned by a regulated utility or whose power is purchased through a long-term, take-or-pay contract face the burden of having to continue to pay plant and/or mine owners and investors even if they are no longer receiving power from the plant. As a result, for as long as two or three decades they may be required to continue to pay those costs on top of the costs of replacement clean power. And in coal plant and mine communities without strong labor laws or unions in place, there may be little protection or compensation for workers—and significantly reduced property and tax collections from the plant or mine—resulting in significant tax revenue, jobs, and wage losses. Compounding this challenge is the legacy of the coal pollution itself, which leaves community residents with a lifetime of health consequences along with polluted lands and waterways that depress property values and raise the specter of unknowable future environmental liabilities that keep potential entrepreneurs and businesses away. Worst of all, these risks disproportionately impact already vulnerable communities—in the US, Black and low-income White communities are nearly twice as likely to face mortality risk from particulate matter pollution from fossil energy relative to other populations (Thind et al. 2019).

As a result, while the cost declines in renewables suggest a rapid transition away from coal should be possible, the distributional impacts of such a rapid transition are likely to be highly inequitable and threaten the durability of any meaningful climate action—in the absence of policies focused on mitigating transition challenges. Indeed, rhetoric around the plight of coal workers during the previous decade and the "War on Coal" were prominent themes during the 2016 presidential campaign in the US, the result of which led the US to (temporarily) leave the Paris Accords.

Yet, in 2020, coal power represented 30% of global CO_2 emissions. Any hope of avoiding dangerous climate change requires that coal be phased out within a decade in the OECD and within two decades elsewhere. There is no time to wait for coal contracts and tariffs to pay-off investors in two or three decades—and no margin for error to allow for any future reversals or backsliding associated with rising energy costs or unjust community impacts from transition (Yanguas Parra et al. 2019). To be successful, climate policy must swiftly and decisively address the inequitable burden of transition on energy customers, workers, and communities.

Regulated Utility Coal Transition in the US and the Need for Innovative Transition Finance Tools

New financial mechanisms will be critical to any climate policy regime aimed at addressing transition challenges. These new mechanisms build on the observation that for every coal plant or mine community that would see steep local losses, there are others—future electricity consumers, clean energy investors, clean technology workers, communities hosting clean energy facilities—who could benefit from rapid transition. This observation suggests a strategy to unlock rapid action through a shared-savings mechanism that allocates a portion of the future benefits from clean energy to mitigate near-term risks and costs. Executing such a strategy requires utilizing a financial mechanism to facilitate the associated cost and risk reallocation between winners and losers today and into the future. Emerging examples of such mechanisms are the focus of this chapter—and, we believe, the key to rapid and sustained climate action.

To explore transition challenges and potential financial solutions in greater detail, take the example of coal power in the US. Across the US, coal used for electricity generation has plummeted in recent years, falling by more than a half since 2005. However, from a carbon perspective, much of that decline was offset by a more than doubling of fossil gas consumption (EIA 2021). At the end of 2020, with US federal tax incentives having been extended through 2025, the levelized total cost of renewable energy with storage was already below the operating cost alone of between 79–83% of the remaining US operating coal capacity.[5] This means that, at the time of the writing of this chapter, most US electricity customers could, in principle, save money in the long run if they purchased even less electricity from coal plants and more power from renewables and storage (Bodnar et al. 2020).

In practice, however, most US electricity customers cannot make such a choice independently—80% of the 240GW of US coal capacity operational at the end of 2020 was owned and operated by governments, co-operatives, or regulated investor-owned utilities.[6] These monopoly utilities have the exclusive right to sell power to a captive customer base. Virtually all these monopoly utilities have made significant recent investments in pollution control equipment in their remaining coal assets to comply with EPA regulations. Moreover, as many of these utilities either are not taxpaying entities or have very limited tax liabilities, they are unable to take advantage of federal incentives that flow through the tax code and would otherwise play a significant role in making ownership of renewable assets attractive. As a result, management and investors in coal-reliant monopoly utilities have little incentive to make a rapid shift from coal to renewables.[7] The same is true for their customers. As a result of intergenerational equity considerations, financing constraints, and regulatory practice, a rapid transition to lower-cost renewable resources can paradoxically lead to a short-term price increase for customers of monopoly utilities. This increase is driven by the need to pay financing charges at an accelerated pace for existing assets on top of the total cost of any replacement generation, often without the full benefits of federal tax incentives. Finally, as much of the replacement generation is capital intensive and not likely to be located within existing fossil communities, the result is often significant coal community job losses that are highly unlikely to be replaced locally by the new renewable and storage deployment alone.

Taken together, these factors suggest that, despite economics that appear favorable for a rapid phaseout of coal, structural, regulatory, and political factors render the transition unattractive for three key stakeholder groups: (1) utilities and their investors, (2) customers along with the regulators, government officials, or other governing bodies that are responsible for overseeing their rates, and (3) coal workers and communities. To motivate the introduction of potential solutions to this conundrum, we begin by discussing in greater detail the challenges faced by each of these three key stakeholder groups—and then turn to a description of ratepayer-backed bond securitization as a key element of a solution for the regulated investor-owned utility case.

Utilities and Their Investors Don't Have the Right Incentives to Transition Coal to Clean Energy

We begin with utilities and their investors. As we noted above, utilities and their investors have little incentive to transition an operating coal fleet that has seen significant recent investment in pollution control equipment—and to clean energy resources they aren't incentivized to own. This misalignment of incentives can be traced to three key factors.

First, utilities' investors do not bear direct risk associated with deteriorating plant competitiveness. Utilities' customers pay for power from these plants based on rates that are set administratively by a governing body or independent regulator to cover the cost of providing service. The estimated total cost of service for all US coal power plants owned by monopoly utilities at the end of 2020 includes[8]:

1. **$25–30 billion annually in coal fuel and operating expenses:** Utilities are generally able to pass through fluctuating fuel costs to their customers in rates and can request adjustments to those rates periodically to account for anticipated non-fuel operating costs.
2. **$15–20 billion annually in coal capital costs:** Utilities investors also have the opportunity to recover the roughly $130 billion in coal capital investments yet to be recovered over the life of the asset and earn an administratively set rate of return on that investment.

Second, utilities face reinvestment, regulatory, political, and operational risks if they are compelled to or choose to accelerate phaseout of their remaining coal assets**.** Regulated, investor-owned utilities have reduced coal generation by 45% since 2005. However, most of the plants that have been retired had already reached or nearly reached the end of their useful lives and were retired in the face of significant additional investment required to comply with environmental regulation to continue operation. The assets that remain in operation today saw significant recent investment, largely in pollution control equipment. As a result, a typical 1 GW coal asset that remains operational in the US now has roughly $600 million in unrecovered costs, up from just over $200 million in 2005.[9] This means that if a utility were to retire these assets early—unlike the case for the bulk of retirements to date—they would need to manage the transition of significant investments that would no longer be directly tied to an asset that is providing essential services to their customers. As is discussed further in a later section, the utility is still likely to recover these costs—and often more rapidly—but will face regulatory and political risks associated with that recovery, as future regulators and government officials may not take kindly to continuing to pay investors for nothing. Even if they do achieve cost recovery, investors face greater reinvestment risk, as they will need to find other options to invest the capital that is being recovered earlier than anticipated. Further, investment opportunities within the same utility are subject to approval by the relevant regulatory or oversight body, may be politically contentious due to jobs losses from early plant shutdown, and involve operational risk associated with replacement of the services provided with new equipment.

Third, US utilities that currently own 80% of US coal cannot directly use federal renewable tax incentives to finance lower cost renewable energy, making it much less attractive for them to replace their coal plants with renewable power than a naive economic argument might suggest. Government-owned utilities and cooperatives are generally not taxpaying entities and cannot directly take advantage of renewable tax incentives to lower the cost of the assets they finance and build. Regulated utilities, on the other hand, are taxpaying entities. However, over two decades of recession-fighting investment incentives in the form of bonus depreciation provisions mean that most capital-intensive industries in the US, like utilities, have little or no anticipated tax liabilities for the next decade. So even those utilities that are taxpayers have little forecasted tax liability to offset with federal renewable tax incentives, only allowing them to collectively build and own an estimated four gigawatts of solar and storage annually.[10] In total, this estimate suggests that monopoly utilities, who own 80% of US coal across the country collectively, have the tax liabilities to use federal renewable tax incentives to cost-effectively finance replacement of just one or two coal plants per year. As they lack the means to use tax credits, utilities would be forced to rely on third parties to either monetize the tax credits or build these plants and sell the power back to the utility and its customers. However, this comes with a higher cost of capital than the utility can achieve for alternative fossil-fueled assets. Further, to achieve a reasonably attractive cost of capital, independent power producers generally prefer to enter into a long-term power purchase agreement. For credit ratings purposes, these instruments are treated akin to long-term debt on utility balance sheets. If the utility is simultaneously retiring its owned assets, this puts significant pressure on its credit metrics, which in turn can affect its long-term capital costs. As we discussed above, if utilities are compelled to purchase clean energy rather than invest their capital, they face reinvestment risk as they recover their previously invested coal capital.

Due to these three key factors, utilities and their investors have been lukewarm at best to an accelerated coal transition. However, an additional factor has been materially shifting this calculus over the last one to two years—the emergence of significant pressure on investors on environmental, social, and governance (ESG) issues. As a result of both retail customer interest in ESG friendly investment options and a renewed focus on climate risk, many investment managers are increasingly putting pressure on their portfolio companies to mitigate their climate transition and physical risks. This pressure is beginning to materially impact decision-making by utility management, as evidenced by significant recent commitments to short- and long-term emissions reduction targets.[11] Despite ambitious targets, however, analyses of detailed utility regulatory submissions describing their resource plans do not currently suggest that these targets have translated into concrete transition actions—a fact traceable to the four factors described above.[12]

Customers and Utility Oversight Bodies Face Possible Rate Hikes with Transition

Next, we turn to the challenges that customers and the bodies responsible for their oversight face in a rapid transition. Monopoly utilities are overseen by regulators (investor-owned utilities), government officials (government-owned utilities), or other governance bodies (cooperatives) whose responsibility it is to ensure that their customers can access power at a reasonable price. The rates monopoly utilities charge for the power they sell to their captive customers are determined administratively by these oversight bodies and are generally set to cover the cost of providing service and provide the opportunity for investors to recover their investment along with a fair return on capital. The cost of service includes expenses associated with the investment of capital by the utility's debt and equity investors. Unlike other plant operating or fuel expenses, these costs continue to be incurred regardless of whether the plant is still used to provide electricity services to the utility's customers.

A utility's overseers could, in principle, require rapid phaseout and replacement of coal assets with purchased clean energy. However, the three challenges faced by utilities discussed above are linked to risks or costs that customers today, or in the future, are likely to bear—which often weigh on overseers, discouraging rapid transition.

First, customers, not investors, are on the hook to continue paying coal capital costs. When a coal plant is phased out of service well before a utility has fully recovered its capital, utility oversight bodies could, in principle, disallow further recovery of costs. Regulators can and do disallow recovery of costs in some cases, and government officials or cooperative boards could declare bankruptcy and argue that they cannot repay their debt investors for a plant that is no longer economic. But such a decision has significant negative short- and long-term consequences for customers:

1. **Any default on debt or disallowance is likely to significantly increase the cost of capital for any future investment needs.** Power customers benefit from the reduced risk to investors associated with the explicit or implicit government guarantee or regulatory approval through a lower cost of capital than could otherwise be achieved. This lower cost of capital contributes to lower electricity costs. A default on debt or significant disallowance is likely to negatively impact both the cost of equity and debt for any future debt or equity issuance.

2. **Utilities can mount strong, costly legal challenges to such actions on the grounds that a decision not to repay the invested capital constitutes a taking.** In the case of a regulated utility, since the capital costs in question are for investments that were made with explicit approval by a government regulator, the investors financing the assets have strong legal recourse to recover their capital under the takings clause of the constitution. The primary exceptions are if they can be faulted for misrepresentations in proceedings related to the authorization to invest in the coal plant, or for operational decisions that contributed to the plant's poor economic performance subsequent to approval. In the case of a municipal or co-operative, unless the utility or municipality declares bankruptcy, a lender has strong recourse to collect on any unpaid debt.

As a result, government officials and regulators are generally loath to disallow costs in the absence of clear mistakes or misrepresentations by the utility and, in so doing, increase investor perceptions of regulatory uncertainty, thereby risking their ability to finance future capital needs at a reasonable cost for their constituents.

Second, intergenerational equity concerns align utility and regulator interests with accelerated cost recovery in the event of rapid coal phaseout, resulting in material rate shock. Intergenerational equity concerns associated with customers in the future paying for the costs of plants that they are no longer receiving service from often serve as the rationale for accelerating cost recovery of plants that are scheduled for phaseout well before full cost recovery in rates is possible. If cost recovery is accelerated, then revenues required to be collected in rates can increase sharply. Further, retirement costs are pulled forward and must also be recovered more rapidly than anticipated. As a result, the cost of service can often sharply increase upon a decision to accelerate phaseout of an existing asset—even if replacement resources' total cost is below coal plant operating costs. This "rate shock" is a disincentive for both the customer and their oversight bodies to move swiftly to transition assets that both have significant unrecovered capital and are uneconomic. This rate shock can be material—if all the coal owned by monopoly utilities were retired rapidly and cost recovery accelerated to between five and ten years, coal capital costs could increase from a \$15–20 billion annual rate burden to closer to a \$20–30 billion rate burden—nearly as high as the total annual customer bill for fuel and operating costs currently. This additional rate burden would disproportionately impact those customers and communities already struggling with energy burdens.

Third, customers can't realize the full benefits of federal tax incentives. Due to the limitations the utilities that serve these customers face in utilizing tax credits, the relative cost advantage of renewables with storage as compared with fossil generation made possible by federal tax credits is significantly muted. Instead, they must rely on purchasing power from third-party owned and financed renewable assets to benefit from tax incentives. However, third-party financing renders moot the cost of capital advantage that monopoly utilities otherwise have due to their lower risk profile. Hence, their customers are unable to fully realize the cost difference that customers served by generation competing in wholesale markets might see from clean energy (see Annex A.1 for a detailed example of how this works in practice for the retirement of a coal plant by a regulated US utility).

Coal Communities See Little Upside in Green Jobs and Face Significant Local Losses

Coal plants and mines have relatively compact geographic footprints, often in remote rural areas with few other economic activities. While many of these communities have hosted these energy assets for decades, the towns that have sprung up around them have not generally seen significantly diversified economies. In the US, this pattern is exacerbated by local government funding models that utilize property tax revenues to fund essential government services, such as schools, policing, and emergency response services. In the event of a plant closure, this can mean that a significant fraction of both community wages and funding for critical services can fall dramatically. Further, in the case of coal mine workers, the lack of unionization and the poor financial condition of coal mine operators may also mean that many workers face the prospect of job losses with little in pension benefits to show for years of service. Together, these issues paint a bleak picture for the future of communities experiencing accelerated coal plant retirement and mine closures—and indeed, repeated experiences with such retirements bear this out.[13]

On the other hand, in principle, the economic activity associated with replacement resources should serve as a counter to these trends. Investments in clean energy to replace coal plants are often many multiples of the unrecovered capital and do indeed require significant labor—at least in the construction phase. However, renewable projects are often built in a matter of months, not years—so the construction jobs do not last very long—and often involve rather different skills than coal plant or mining jobs. The low operating costs and highly geographically distributed nature of wind and solar translate into jobs that are sparse, not necessarily located near existing coal communities, require different skills, and often do not pay as well. As a result, there is little lasting direct community benefit from renewable facility construction and operation.

Finally, we note that many coal communities have seen significant health impacts from air and water pollution and may experience significant economic impacts (in terms of depressed property values and investment) due to the legacy of environmental contamination from fossil fuel use. These costs are borne by community members and are generally not directly considered in electricity sector decision-making or cost allocation. Addressing these historic environmental inequities (and prioritizing stopping harm where it is most severe) is another challenge that neither coal retirement nor replacement clean energy based on electricity sector economics alone can adequately address.

Ratepayer-Backed Bond Securitization: A Tool to Address Transition Challenges

Ratepayer-backed bond securitization (or just "securitization" for short), is a well-established financing tool first introduced in the power sector to help address stranded asset challenges during the restructuring of some (but not all) electricity markets in the 1990s. The primary insight that led to the development of securitization was the realization that traditional utility financing in the context of cost-of-service regulation suffers from a key defect when utilities incur unexpected losses or are presented with an unanticipated opportunity. In both cases, the problem arises from customers being left with having to pay utility investors back—including a return on debt and equity—for previously deployed assets that may either no longer be operational (say, due to storm damage) or no longer economic (in the cases of stranded assets in restructuring of electricity markets, or the current coal transition).

Securitization addresses this issue and creates savings for customers by refinancing the utility debt and equity, paying the utility investors back for the capital they had not yet recovered using very low-cost debt from bond investors. The refinancing helps customers by replacing the effective 8–10% rate of return they were paying utility investors in their bills with the roughly 3% interest on debt they owe bond investors (see Annex A.2 for more details on the mechanics of securitization). Note that securitization requires state legislation that is generally not in place in states with cost-of-service regulation for generation assets.

In practice, utilities oppose securitization in isolation due to the significant reinvestment risk they face associated with identifying opportunities to reinvest returned capital. As such, many utilities often dismiss the tool as dilutive to shareholder value. However, if securitization legislation is paired with a well-timed, predictable competitive process to allow for reinvestment of utility capital in replacement clean energy or supporting grid infrastructure ("capital-recycling"), then it offers the opportunity for the utility to create accretive value. By replacing fossil-fueled generating assets that do a poor job of generating earnings from ratepayer dollars with capital-intensive assets, utilities can be more efficient in generating earnings from customer bills. As a result, securitization with capital recycling can be accretive to shareholder value, providing a powerful incentive for utilities to accelerate their transition to clean energy (see Annex A.2 for a discussion of a detailed example of how this mechanism works in practice).

Further, the securitization bond could also be used to help finance worker and community transition costs in the immediate aftermath of coal retirement, at the expense of some customer savings. Communities would have critical resources to help cover some lost wages and the cost of essential services timed with the shock of closure. While this amount does not come close to fully compensating impacted communities, it can materially help while still delivering significant savings to customers.

Two additional challenges complicate this story that likely would benefit from intervention by the federal government. First, as we noted in our discussion of capital recycling, if regulated utilities were able to take advantage of federal tax incentives, utility ownership of replacement generation could be an attractive alternative to third-party ownership. However, as we discussed earlier, this option is limited by utility tax capacity nationally. Effective capital recycling therefore requires action at the federal level to allow most utilities that currently serve customers with coal power to take advantage of renewable incentives to make the transition work. If this were possible, and if plant workers were unionized, it is also likely that the utility could help manage the transition of the plant workforce to new opportunities locally and elsewhere in its service territory. Second, as we noted above, securitization alone does not come close to fully compensating impacted communities. Here again, federal policies that recruit additional resources would be helpful. Since it is unlikely that clean energy jobs are sufficient to enable a meaningful economic transition for the community, it is particularly important that such assistance includes broad economic development targeted at taking advantage of the unique infrastructure and resources already present in many plant and mine sites—such as high voltage grid interconnection, water rights, rail service, broadband—and addresses their unique risks. For example, the infrastructure present at these sites could be of significant interest for electricity-intensive manufacturing or high-technology service providers. On the other hand, private investment in these sites may be discouraged due to possible exposure to unknown future clean-up risks and costs associated with abandoned coal plant and mine sites. Financial mechanisms that mitigate private investor exposure to these environmental risks could unlock these opportunities to create local jobs near coal plant sites. Additionally, direct federal funding for land and water remediation could further mitigate these risks while employing many previous mine workers for up to a decade. Finally, we note that securitization could also be used to address a small portion of the historic injustice visited upon coal-adjacent communities from the environmental and economic hardships they have endured. But again, it is likely that additional federal policy (and/or novel transition financial tools, as we will discuss briefly toward the end of the chapter) may be required to complement such funds in order to properly address the scale and scope of the challenge.

Securitization Is Being Used to Facilitate Coal Transition in Multiple States

The use of securitization to refinance cost recovery obligations associated with accelerated closure of fossil generating facilities was pioneered by Consumers Energy in Michigan in 2014. Since then, regulators have now authorized $1.5 billion in securitization transactions to refinance recovery of early fossil generating asset closure across three states (Michigan, New Mexico, and Wisconsin). Further, securitization legislation authorizing the use of the tool to refinance fossil generating asset cost recovery has been approved by legislatures in seven additional states (New Mexico, Colorado, Montana, Kansas, Missouri, Louisiana, and Indiana) beyond the three states with legacy authorities (Michigan, Idaho, and Wisconsin), and has been introduced in three additional states (North and South Carolina, Utah). These new bills and applications of securitization also feature the additional transition elements we described in the previous section, including transition assistance to communities financed by securitization and the authorization of potential capital recycling to allow utilities to redeploy their capital in clean energy. As a result, there is a growing body of empirical data on the performance of this financing mechanism and its realized track record in addressing the equity concerns raised above. Here, we briefly discuss the New Mexico transaction as an example of these concepts in action (Varadarajan et al. 2020,2021).

New Mexico

New Mexico passed the Energy Transition Act in 2019 (SB 489), which included specific authorization for Public Service Company of New Mexico (PNM) to use securitization to address cost recovery for its share of the accelerated retirement of units 1 and 4 of the coal-fired power plant, San Juan Generating Station. The bill also directed PNM to finance coal community transition costs, and included provisions to provide PNM the opportunity to own replacement resources. PNM filed a financing order in February 2020 to use securitization to recover $283 million in unrecovered costs as well as $20 million of severance and job training costs for PNM and coal mine employees and $19.8 million for tribal transition assistance. In total, PNM has been authorized for a $361 million transaction with a 25-year tenor, currently planned for 2022 to coincide with the retirement of San Juan Generating Station. The replacement resources were procured through an all-source procurement process that was approved in July 2020 and consisted of only clean resources—650 MW of solar, 300 MW of storage, and an additional 24 MW of demand response. However, we note that PNM has yet to be authorized to own any of the replacement resources approved thus far. PNM estimates that with plant retirement, replacement, and securitization, residential customers on average will see a $7/month savings. Further, the replacement resources were required by legislation to be sited in four school districts adjacent to the coal plant and mine that were closed, to ensure continuity of funding for essential services and new job opportunities in the affected areas.

New Mexico's implementation is as close to a complete transaction with all the elements outlined in the previous section as we have seen to date. However, as we noted, utility ownership was not part of the final replacement resource mix.

Transition Financing Beyond Securitization and the US Electricity Sector

The primary barriers to the energy transition are often linked to political economy considerations. Energy supply and use are highly regulated and politically charged almost everywhere. The transition to clean energy generally results in concentrated, up-front losses to firms, workers, and governments engaged in the supply and use of incumbent energy technology with often very diffuse and uncertain benefits that are only realized in future years.

Innovative financing can, in principle, help with this problem. New financial vehicles—such as ratepayer-backed bond securitization—can allow the winners to siphon off a stream of future benefits to help offset the near-term costs and risks borne by the losers in the transition. Transition financing mechanisms that monetize a portion of the long-term benefits from a clean energy transition can be used to compensate negatively impacted utilities, investors, and communities, thereby mitigating regulatory and political resistance and potentially accelerating progress (Fig. 9.1).

While low-risk bond mechanisms such as securitization have seen significant recent uptake, broad applications may involve very different balances of potential benefit streams with different risk profiles. The benefits from replacement of diesel buses in dense urban areas may be dominated by health cost savings due to reduced pollution, which are less predictable and more challenging to monetize than cost savings and incentives in regulated utilities. While the financial risk associated with these additional benefit streams may be greater, they have the potential to engage a much broader range of stakeholders including investors with greater risk appetite as well as communities and workers that may otherwise not be inclined to support rapid action

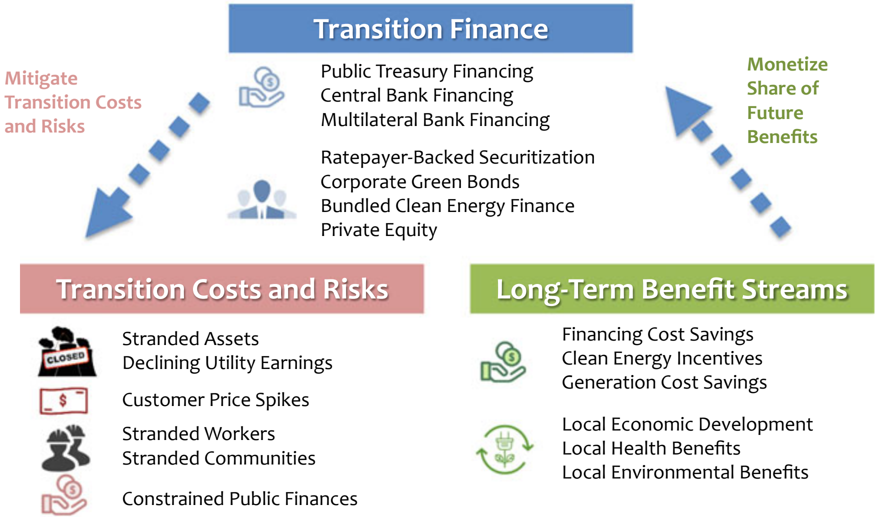

Fig. 9.1 Framework for innovative climate transition finance mechanisms

on climate. Potential benefit streams that could become available with a clean energy transition to various stakeholders include:

1. **Public incentives for clean energy and/or costs for continued fossil energy use**—low-risk public incentives available for wind, solar, energy storage, electric vehicles, efficiency improvements, and other clean technologies and/or greater market costs associated with continued use of fossil energy resources (such as through a price on carbon) provide a stream of potential benefits for clean energy use.
2. **Short and long-term energy supply cost savings for consumers**—particularly with public incentives in place, but also with falling costs due to technological progress and economies of scale, relatively certain savings on energy supply costs are possible for consumers.
3. **Economic opportunities for large-scale replacement energy resources**—utilities, developers of large-scale energy resources, and manufacturers of electrified end-use technologies could redeploy capital in clean technologies, a low-risk opportunity if deployed under cost-of-service tariffs or regulations.
4. **Local economic opportunities for distributed energy resources**—if replacement resources for older energy resources are distributed more broadly across a local economy and consist of clean supply (such as rooftop or community solar PV)—but also flexible demand or customer-sited storage, these can be higher-risk opportunities with a broader economic impact.
5. **Local health benefits associated with removal of polluting energy supply resources**—the removal of air and water pollution from dirty appliances, vehicles, or assets could reduce both acute (i.e., asthma) and long-term (i.e., chronic pulmonary disease, cancer) health risks—and the corresponding health care costs. If these risks are borne by a small number of insurers, the benefits may be monetizable, but as higher-risk benefit streams.
6. **Local environmental benefits from removal of polluting energy supply resources**—the removal of a polluting resource—such as a fossil fuel refinery, diesel bus or generator, a peaking gas plant, or a gas station—could lead to increases in local property and asset values associated with corresponding improvements in ecosystem services, making the region more attractive for new economic opportunities. These are higher-risk benefit streams contingent on future market, environmental, and policy considerations.

These benefit streams are realized only over time, accrue to a broad range of stakeholders, and have varying levels of certainty and risk. While bonds are appropriate for monetizing low-risk benefit streams, finding an avenue for realizing the other, higher-risk potential benefit streams (particularly the local economic, health, and environmental benefits) can be critical to developing the political will needed to move forward with any given energy transition opportunity. These benefit streams are often higher risk and may not be immediately suitable for investment by the regulated, public, or private-sector entities that currently own the incumbent energy assets.

So how could these additional benefit streams be used to help hasten the energy transition more broadly? First, note that each of these additional benefit streams can be tied to specific economic, environmental, or health outcomes that are enabled by the energy transition opportunity of interest. These beneficial outcomes have the potential to be monetized to accelerate an equitable energy transition to the extent to which they are:

1. of direct relevance to one or more potential payors (i.e., a government entity with an outcome-related target or company with outcome-tied financial revenues or costs), and
2. of broad societal interest to a potential impact investor (i.e., result in some quantifiable public benefit or good such as reduced air or water pollution, rural economic development, etc.).

Next, if these outcomes meet the above conditions, it may be possible to raise additional capital (impact capital) to help realize those beneficial outcomes by structuring an outcomes-based transaction around the energy transition opportunity.

Such a transaction would involve the provision of risk-bearing capital from the impact investor with an interest in the outcome that would be repaid with a stream of payments that depend on the achievement of well-defined outcomes of direct interest to payors. The up-front investment could then be used as a part of the overall capital stack available to finance the energy transition opportunity of interest, which, in turn, would be executed by the appropriate service provider or project implementation partner. An evaluator is then engaged to track outcomes and determine whether the project has achieved outcomes sufficient to merit any success payments due to investors.

The structuring of such a transaction would need to begin with the selection and engagement of a payor. The next step would be to negotiate terms with investors and agreement on design, and finally execution of contracts with service providers and evaluators. After structuring, the project would launch with capital flowing to the service provider who in turn uses the funds to implement the program envisioned, while the evaluator determines whether success payments are made over the life of the project.

Health Cost Savings Impact Financing as an Example of How to Help Achieve an Equitable Transition Through Outcomes-Based Transactions

To make this discussion more concrete, we introduce a novel health cost savings financing mechanism that can address additional political economy barriers and opportunities more suitable for higher-risk capital. This instrument uses a shared-savings mechanism to monetize health system cost savings associated with lower incidence of asthma and other air pollution-related health impacts to prioritize the transition of fossil resources that are currently doing the greatest harm to vulnerable populations.

While the health benefits associated with the transition to clean energy supply and end use are often a major part of the regulatory cost–benefit analysis or political arguments for supportive policy, these benefits have yet to be monetized or otherwise used to facilitate transactions to accelerate the transition.

The closure of coal plants, dirty oil and gas burning peakers, diesel or other fossil-burning modes of transit such as buses or trains, and fossil-burning industrial assets, create measurable and definable improvements to the health of nearby communities. Many of these communities have long borne the negative health, economic, and environmental burdens of fossil pollution, and are the focus of efforts aimed at addressing historic inequities tied to fossil production and use. Unfortunately, while there is a public benefit from cessation of fossil fuel production and use which may draw a wide range of interested impact investors, these health benefits are generally difficult to monetize—to the extent to which they are diffused across a broad swath of the public.

However, if the dirty assets are located in regions where public health risks associated with the facilities have been transferred to a small set of firms or governmental entities (for example, in regions with public health insurance or health care, or served by a small number of health facilities or health and/or life insurers), then monetization of these health benefits becomes more realistic. Specifically, in this case, estimation of the *health cost reductions and/or* *expected mortality reductions* associated with such a transition based on historical data could be used to directly demonstrate a stream of future savings that could accrue to the small set of stakeholders bearing health cost risks in the region. A portion of these future savings could then be securitized into a financial instrument (such as an impact bond) that could be used to provide additional financing to address near-term challenges and barriers to the transition. For example, these costs could be used to create a fund to cover ongoing health insurance costs for affected workers—or be deployed to re-train workers or invest in distributed resources.

Insurance providers could be ideal candidates, both as potential payors and investors in these instruments. They can facilitate replacement of fossil-fueled assets through deployment of their capital, which could provide not only a long-term debt return, but also create secondary benefits by de-risking their pool of policies. The environmental benefits of coal plant closures should also drive demand for investment because private-sector actors are likely to see financial returns beyond income from debt payments. Once again, insurers may see alternate value streams in investments, but other private-sector actors could also find value from investment due to lower risk of environmental damage to water and agriculture and improved living conditions for the local workforce.

Finally, impact investors with an interest in economic development may find this instrument particularly interesting, as the continued operation of the dirtiest assets is often correlated with low regional economic development outcomes, and thus transition finance can help address both negative health impacts while simultaneously providing capital to enhance local economic development. As a result, this mechanism can be a multi-impact win for mission-driven investors.

Conclusion

The urgent and rapid transition of our existing energy infrastructure necessary to avoid dangerous climate change could have significant repercussions for energy customers, workers, and communities. Climate policies that don't address these as a primary focus are not likely to be politically viable and will likely lead to inequitable outcomes. Transition financing vehicles like ratepayer-backed bond securitization with capital recycling and transition assistance can bring utilities, energy customers, and energy workers and communities to the table to find a path forward to decarbonization by providing financing to address the transition challenges faced by all parties.

They accomplish this by using a portion of future benefits that would accrue to the winners in the transition to help offset near-term transition costs and risks. As these transition costs and risks would otherwise burden the most vulnerable populations, these mechanisms could provide a means for accelerating a more equitable transition to a zero-carbon energy system. Financing tools that monetize a broader range of higher-risk benefit streams could be critical to allow these ideas to be extended to other sectors and geographies.

With $1.5 billion in four securitization transactions completed or in progress to facilitate coal transition in the US (Fong and Mardell 2021), this approach is now being actively tested. Further, with legislative progress in authorizing the tool in several additional states, there is strong evidence of continued interest in scaling the concept. However, it is interesting to note the uneven nature of progress across the US, as well as the slow pace of diffusion of the concept. There are leaders in many states across the Southeast and Midwest that have been slow to consider the tool—or dismissed it outright. This uneven progress highlights the importance of behavioral factors that are often bespoke to particular geographies—and at times, individual utility or political leaders—that can have outsized influence on the pace of transition. With little time to spare, these idiosyncratic factors can often loom larger than even the most creative financial design. This observation suggests the importance of flexibility in the design and execution of financial tools to tailor the solution to the specific needs of a given geography or business.

Coal in the US electricity sector is just 10% of the global coal transition challenge (Bodnar et al. 2020), so while securitization is a helpful solution, the adaptation of this thinking globally is vastly more important. Over 90% of the global coal fleet has protections in place analogous to those in place for plants owned by regulated utilities. However, the bulk of that fleet is held by state-owned enterprises that would not see substantial cost reductions for its customers from refinancing mechanisms such as securitization. Nevertheless, the broader paradigm of refinancing paired with utility reinvestment and transition assistance is still likely required for achieving rapid and equitable transition (Bodnar et al. 2020). For state-owned enterprises, the opportunity to pair refinancing with health impact and local economic development financing could be particularly attractive, making explicit two key additional politically relevant drivers for accelerated action. Local economic development financing, in particular, could be paired with reforms to better align the utility's business model and services with integration of a broader range of distributed and demand-side electricity resources. Together, this broader suite of tools that includes refinancing as well as impact vehicles to monetize higher-risk value streams could be essential to drive more rapid global transition.

Key Takeaways

- The urgent and rapid transition of existing energy infrastructure necessary to avoid dangerous climate change can have significant repercussions for energy customers, workers, and communities.
- Climate policies that don't address these repercussions as a primary focus are not likely to be politically viable and will lead to inequitable outcomes.
- Transition financing vehicles like ratepayer-backed bond securitization with capital recycling and transition assistance can bring utilities, energy customers, and energy workers and communities to the table to find a path forward to decarbonization by providing financing to address the transition challenges faced by all parties. They accomplish this by using a portion of future benefits that would accrue to the winners in the transition to help offset near-term transition costs and risks.
- As these transition costs and risks would otherwise burden the most vulnerable populations, these mechanisms could provide a means for accelerating a more equitable transition to a zero-carbon energy system.
- Financing tools that monetize a broader range of higher-risk benefit streams could be critical to allow these ideas to be extended to other sectors and geographies.

Notes

1. See, for example—https://www.sierraclub.org/ready-for-100/commitments for US city and state commitments, https://rebuyers.org/deal-tracker/ for corporate clean energy deals, and https://climatenexus.org/climate-change-news/country-climate-pledges/ for national pledges.
2. See, for example, https://globalenergymonitor.org/projects/global-coal-plant-tracker/dashboard/.
3. With the possible exception of 2020, see IEA, *Electricity Market Report—December 2020*—https://www.iea.org/reports/electricity-market-report-december-2020/2020-global-overview-capacity-supply-and-emissions.
4. RMI estimate for the roughly 2 TW of currently operating coal based: (1) on the lower end, from US data from FERC Form 1 published in the

Utility Transition Hub (https://utilitytransitionhub.rmi.org/) for US regulated utilities, roughly $600 million in net book value per GW of coal, and (2) on the upper end, the midpoint, roughly $1500 million per GW, of the range of overnight costs for new coal used in IEA forecasting for various regions (https://www.iea.org/reports/world-energy-model/techno-economic-inputs) of between $800–2100 million per GW.

5. Updated RMI analysis using methodology outlined in RMI (2020), *How to Retire Early*, op. cit.
6. RMI analysis of EIA Form 860 M data released at the end of 2020 as well as ownership data from 2019 EIA Form 860—see https://www.eia.gov/electricity/data/eia860m/ and https://www.eia.gov/electricity/data/eia860/.
7. Note that some competition even in regulated monopolies has long been enforced since the passage of the Public Utility Regulatory Policies Act of 1978 (PURPA)—which indeed required utilities to purchase alternative energy resources at the avoided cost of generation from their own assets. However, the Act restricts that obligation to small power producers, and while it has been significantly successful in driving initial deployment and scaling of clean energy, it has met with significant resistance from monopoly utilities during implementation that has blunted its effectiveness in driving system-wide transition.
8. See the RMI *Utility Transition Hub*™ (2021)(https://utilitytransitionhub.rmi.org/).
9. Ibid.
10. Ibid.
11. See, for example, SEPA's Utility Carbon Reductions Tracker—https://sepapower.org/utility-transformation-challenge/utility-carbon-reduction-tracker/.
12. See, for example, Sierra Club's Utility Scorecard—https://coal.sierraclub.org/the-problem/dirty-truth-greenwashing-utilities and RMI's *Utility Transition Hub*—https://utilitytransitionhub.rmi.org/.
13. See, for example, https://www.politico.com/news/2021/04/18/coal-country-revitalization-biden-482659.

Annex A: Securitization and Retirement of a Coal Plant by a Regulated US Utility

A.1 Plant Retirement with Conventional Regulatory Treatment

Consider the example of a typical coal asset owned by a US regulated utility that we will use to illustrate the challenge and the mechanics of an innovative transition financial tool. Due to recent investment in pollution control equipment (made with the approval of a state regulator) suppose that the utility RegCo has invested $600 million in its 1 GW GoodCoal power plant that generates 6 billion kWh of electricity annually. The utility anticipates operating the coal plant for another 20 years, at which time it anticipates incurring $100 million in plant removal costs. As a result, RegCo requests its regulator to approve recovery of $35 million annually in depreciation expenses in customer rates over the next 20 years to both recover its $600 million investment in pollution control equipment and build up a reserve to pay for $100 million in plant removal costs. Further, as the $600 million invested included roughly an even amount of debt and equity, the utility also requests that rates provide sufficient funds to allow the utility to pay its investors a 10% pre-tax rate of return. As a result, the utility's regulator sets customer rates to include the revenues required to cover these capital costs, including:

- $35 million annually in depreciation expenses to cover the return of capital to its debt and equity investors (note that in practice, these funds are retained by utilities to reinvest in replacing the services being provided by assets that are being depreciated away rather than actually returned to investors) and build up a reserve to cover the cost of plant removal at the end of the plant's life, and
- another $60 million annually (declining by $3.5 million each year as the utility recovers its capital and builds up a reserve to cover costs of plant removal) to cover a 10% grossed-up, pre-tax return on equity and debt capital in rates.

The total is $95 million annually in capital costs. In addition, the regulator also includes an estimated $210 million in expected annual fuel and operating expenses in the annual revenues required to be collected in rates. Of this amount, $30 million annually goes to pay coal plant workers wages and salaries and nearly $120 million likely goes to support mine workers wages and salaries, property taxes, and royalties. Note that from RegCo's perspective, the bulk of customer revenues are used to pay for fuel and operating expenses—not to generate returns for plant investors. So GoodCoal is not a particularly efficient use of ratepayers' revenues to generate earnings for RegCo. In total, customers currently pay $305 million per year for the roughly 6 billion kWh in electricity generation they purchase from the coal plant, equivalent to a contribution to the electricity rate paid by customers of about 5 cents per kWh.

Suppose that RegCo could buy clean power with battery storage from a third party for just 3.5 cents per kWh under a twenty-year contract that could replace the power it generates from its GoodCoal plant. Since RegCo doesn't anticipate having significant federal tax liabilities over the next few years and due to other tax rules that disfavor utility ownership of assets eligible for the Investment Tax Credit in particular, utility ownership of the same clean energy facility would not be cost-competitive for its customers. It would stand to reason that RegCo's regulators should mandate early closure of the GoodCoal plant for economic reasons, and mandate that RegCo purchase replacement clean energy with storage. Unfortunately, under current regulatory practice, the capital costs of the GoodCoal plant not only remain a burden to customers in the event of early retirement, but actually increase in size in the near term. If the GoodCoal plant is retired immediately, then RegCo would immediately incur $100 million in costs associated with removal of the asset on top of the $600 million in unrecovered costs, leaving customers with $700 million in costs that need to be recovered in their rates. As a result of intergenerational equity arguments and utility risk considerations, RegCo and its regulators agree to accelerate recovery of these costs over just ten years, resulting in revenues required to be collected in rates for capital costs of:

- $70 million annually in amortization expenses to recover costs in just 10 years, and
- $70 million annually to cover return on capital (declining by $7 million each subsequent year).

That results in revenues required to cover capital costs increasing post-retirement to $140 million each year, a nearly $45 million initial rate shock for customers. Adding this to the $210 million annually needed to now pay for the replacement clean power, rates would actually need to increase by 0.8 cents per kWh to 5.8 cents per kWh in the near term. Further, over the following ten years, the utility's credit metrics will tighten relative to business as usual due to rapid cost recovery and the increase in imputed debt associated with the long-term contract for the replacement clean energy, resulting in potentially higher borrowing costs for any further transition capital needs.

Together, these factors make both accelerated retirement of existing coal assets and their replacement by clean energy with federal tax incentives much less attractive to customers and the utility regulators/oversight bodies than naïve economic analysis would suggest—particularly in the near term.

A.2 Plant Retirement with Securitization

Securitization addresses this issue by recognizing that the obligation to repay utility investors for unrecovered costs associated with a physical plant no longer in service (the “regulatory asset”) is a mispriced asset in traditional utility financing. A regulatory asset is different from a physical plant that provides services to customers in that the regulatory asset no longer entails any operational risk that can uniquely be managed by the utility and that justifies its allowed return on equity. Instead, a regulatory asset is only subject to regulatory risk associated with the possibility that a future regulator may disallow recovery. This suggests an opportunity for cost reductions if regulators are confident that cost recovery is justifiable and that the option for a future regulator to disallow costs is not likely to be pursued. By ceding the possibility of a future disallowance, the regulatory asset could be refinanced using debt alone. Securitization does just that, by allowing utility customers to refinance future obligations to repay the utility for costs associated with an asset no longer providing service using a dedicated rate surcharge and third-party bond financing. By selling (“securitizing”) the rights to the proceeds from a dedicated, non-bypassable, and automatically adjusted rate surcharge on customer bills to a special purpose vehicle (an SPV, a company with just a single mandate to own the surcharge, issue a bond, and repay bond investors with the proceeds from the surcharge), customers can use the proceeds from the bond issuance to pay off the utility’s investors. Since this replaces financing by debt and equity with just debt over a potentially longer period of time, the surcharge can be lower than the total impact of the allowed return of equity and debt on rates prior to securitization. That is, securitization replaces a grossed-up, pre-tax utility allowed rate of return on debt and equity of between 8–10% for the regulatory asset that customers pay in rates, with a surcharge that only reflects a cost of debt comparable to that of a AAA-rated corporate bond, currently roughly 3%. Note, however, state legislation is required to provide a legal guarantee that future legislators and regulators will not alter the conditions of the surcharge before customers can be assured of the full savings from lower-cost debt. As securitization was originally authorized primarily in states that restructured, and therefore do not, for the most part, host regulated, vertically integrated utilities, new state legislation is generally required to implement securitization.

To be more concrete about how securitization works, consider again the example of accelerated retirement of RegCo’s GoodCoal power plant with $600 million in unrecovered costs and 20 years of remaining life with clean energy. As we saw earlier, early retirement of the asset resulted in a rate shock of 0.8 cents per kWh for customers, due to the need to pull forward $100 million in retirement costs and accelerate recovery of the resulting $700 million in unrecovered costs associated with the GoodCoal plant. With securitization, the $700 million in unrecovered costs is refinanced with a 20-year amortizing bond. That is, a special purpose vehicle, GoodCoalEnding SPV is set up with the rights to a surcharge levied on RegCo's customers, and issues $700 million in bonds. Those proceeds are transferred to RegCo, which is deemed to have recovered its investment in the GoodCoal plant, including $100 million in retirement costs. The bondholders are then repaid with the revenues from the surcharge. The surcharge is adjusted as needed to collect the $47 million each year needed to make level annual payments to bondholders at a 3% interest rate on the $700 million bond. Since that surcharge replaces payments that were required as part of the cost of service, customers would see savings of:

- $48 million annually relative to the $95 million in coal capital costs they had been paying for continued operation of the asset, and
- $93 million relative to the $140 million in capital costs they would have paid without securitization, associated with accelerated amortization of the regulatory asset with early retirement.

Thus, securitization could turn an immediate $45 million rate shock for customers with retirement and replacement of a coal plant with renewables and storage into an immediate $43 million rate reduction for customers. This translates to a rate reduction of 0.7 cents per kWh for customers to 4.3 cents per kWh for clean power as compared to 5 cents per kWh for coal power. However, as we noted above, this arrangement alone does not really work for RegCo or the energy communities that host the GoodCoal plant and the mines that supply it. RegCo has just lost future earnings from $600 million in capital that it must now reinvest with all the attendant risks. And GoodCoal's workers and communities just lost roughly $30 million annually in coal plant wages and nearly $120 million annually in mine wages, property taxes, and royalties. The third-party renewable developer invested nearly $3 billion in building the replacement solar, wind, and storage over a year and a half providing some short-term construction jobs—but these, along with the roughly $15–30 million annually in O&M jobs are mostly in surrounding counties. If the securitization bond size were increased by $100 million and the amount was immediately available to cover worker and community transition costs in the immediate aftermath of coal retirement, customer savings would fall by $7 million annually. However, communities would have critical resources to help cover some lost wages and the cost of essential services timed with the shock of closure. While this amount does not come close to fully compensating impacted communities, it can materially help while still delivering significant savings to customers.

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10

Conclusion: Accounting for Climate

Thomas Heller and Alicia Seiger

Open Accounts

The chapters of this volume offer empirical studies of Net Zero in practice. Taken together, they expose a series of unsettled accounts: problematic and persistent features of Net Zero implementation that bring into question both its accountability and credibility in the triple senses of accounting for climate. These open accounts defy and resist consensual or authoritative settlement and increase incentives to game the regime, potentially redirecting its outcomes away from the narrative that justified Net Zero's ascendance. The roster of open accounts can be associated categorically with: (1) increasing levels of *noise* in the information Net Zero accounting sends out to its users; (2) contested rules over Net Zero's boundaries for *coverage*; (3) unclear enforceability of future-centric commitments that create incentives to defer compliance and transfer responsibilities (i.e. *timing*); and, (4) undefined *management* obligations that both over-simplify risk and, through decentralized accounts, fail to add up to a coordinated climate policy.

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Noise (Greenwashing)

It is universally understood that the quality of Net Zero accounting depends on intensive data collection. Soh-Young In and Kim Schumacher (Chapter 3) detail an emerging industrial ecology of sustainable finance populated by data providers, standards, taxonomies, targets, ratings agencies, and thematic products, rapidly coalescing into a fragmented and specialized sub-financial domain. The authors also cite and add the category of carbonwashing to the well-developed literature on the political economy of information quality. All non-audited business communications create a potential for fraud, selective disclosure and, in their collective effects, systemic noise that can overwhelm the purported value of information flows.

In their chapter on financial theory and sectoral industry organization (Chapter 5), Marc Roston and Richard Kauffman, both lifers inside the US financial system, amplify Schumacher and In's concerns by contextualizing the incentives that motivate the providers, managers, raters, and marketers of the data, metrics, and products driving Net Zero finance. Financial practice might adapt to low-carbon demands, but not without resistance to lower margin opportunities, loss of established clients, and at a pace slower than science-based targets would imply. Roston's hedging climate risk chapter (Chapter 2) carries modern portfolio theory into Net Zero product development and harks back to Schumacher and In's fears that selective disclosure and noise will pervert the claimed impacts of financial services. Roston notes that claims of outperformance in the crusade for outsized returns (alpha) that populate Green Finance lie anywhere between unlikely and pure hype. Counting emissions and managing risk are essentially different activities—as we will turn to later in this conclusion.

Coverage (Scope 3)

Net Zero's widening coverage from a firm's own and purchased electricity emissions (Scopes 1 and 2) to the broader sweep of the emissions of others (Scope 3) tees up conceptual and administrative issues that become most apparent to banks, insurers, and their corporate counterparties who take seriously their Net Zero pledges. Furthermore, as North Atlantic market-centric economies reach into supply chain emissions, they quickly touch Asian state-centric economies, and surface questions of control and political responsibility for climate action that may extend beyond the pay grade of even the most committed Net Zero adherents. Scope 3 disclosure thus becomes a platform upon which larger questions about who has the economic power and geopolitical obligation to define, administer, and enforce climate action in a post-Paris regime.

Marc Roston's discussion of Scope 3 accounting conventions (Chapter 4) describes the current state of play along Net Zero's most contested and least controlled data frontier. In the original UNFCCC design, carbon prices were to be imposed by nation states as far upstream as was practical. Profits on emitting sources were taxed or passed on across the downstream value chain where market power and price elasticities allowed. Distributive impacts of the system were to be managed through original allocations of carbon rights or via post-market income transfers. By contrast, in the practice of Net Zero accounting, Scope 3 includes a firm's upstream and downstream emissions, raising the question of whose emissions are in scope, how far these accountable entities extend, and how reported emissions should be valued relative to the carbon policies of the legal authorities under which they operate. In a globally connected economy, this surface threatens to explode each time it is scratched. To settle Scope 3 accounts, firms will be called to monitor and manage the behavior of distant and scattered others, and incentivize their actions to do so.

The yet uncertain obligations of private actors to define, disclose, and manage their Scope 3 emissions promises to trigger geopolitical sensitivities. Furthermore, emissions can be, and regularly are, transferred across balance sheets via sales, derivatives, hedges, and pools, with or without appropriate accounting for changed carbon balance sheets and risk transference. Like tax accounting, strategic behavior and gaming by emitting organizations imply a need for consolidating accounts, or green and fossil value chains will separate and flourish. Regardless of the extent to which nations or regulators believe themselves entitled to regulate or enforce the rigor of emissions tracking, the reach of uniform, consolidated accounting will be politically, as well as administratively, challenged. Multilateral national emissions accounting has long been contested; the rules of Net Zero accounting and its associated climate responsibilities remain yet more obscure.

Net Zero aims to address the impact of financial actors on the real economy through indirect channels of supervision. More assertive interpretations of the obligations of Net Zero adherents will demand that financial investors impose internal carbon prices to reweight their portfolios as a surrogate for governmentally imposed carbon taxes or border charges. At the same time, the extent and reform of financial regulation may produce reactive behavior in financial markets to relocate climate sensitive investment away from politically regulated and disclosure-laden markets, like public equity and commercial bank lending, toward private equity, shadow banking institutions, and national financial systems where the coverage and rules of extensive regulation are less intrusive and restrictive. If carbon-intensive capital finds refuge from increasing governmental supervision necessary for Net Zero climate action, a financial disclosure route to transition becomes less viable. While Net Zero flourishes initially under self-organization and decentralized forums for negotiating agreement on its conventions and technical roll-out, memory of the landscape of the initial climate action framework prompts attention to whether, when, and how states and hierarchy may need to be brought back in.

Timing (Offsets)

Like comedy, climate action is all about timing. There is little doubt that the landscape of a sustainable future is that of a low-carbon economy. The question is only whether we can arrive at that future without doing lasting, if not catastrophic, damage by being too slow in getting there. In this sense, effective climate action is less a story about "if" transition will occur than when, where, and with what degree of costly disorder. Net Zero generally looks to 2050 as the end date of the transition's completion. But in the shift of its internal accounting emphasis from carbon footprints to carbon futures, and its substantial reliance on carbon offsets, Net Zero hinges on a transition away from carbon intense systems playing out quickly and fairly across jurisdictions in very different stages of economic development and political capacity. Such a transition is hard to time.

Carbon budgets have been constrained with constantly updated windows between the narrowing horizon from the moving present (1990, 2000, 2010, 2020) to 2050. The climate history since Rio has been one of the deferrals of effective action in what is essentially a disorderly transition that has drastically shortened the available budget windows. In these windows, more ambitious promises of targets to be met with rapidly increasing timelines have become more central to Net Zero announcements. As reporting of current carbon footprints gives way to stress on prospective plans out to 2050, credible accounting of the future and the relative lack of such practices in standard financial accounting have moved centerstage.

Firm-level transition risk is at best proxied by pledging to align the trajectory of (declining) future emissions with a normative metric or technology pathway that moves in the direction of Net Zero in 2050. Increasingly, given the scientific constraints of carbon budgets over time, these pledges may also announce interim alignments with windows inside that horizon and/or specific plans explaining how these timely commitments will be implemented. But managing transition at a planetary level presents a deep accounting problem that has confounded climate actors since the design of the 1997 Kyoto Protocol.

Net Zero is a flow concept—the flow of emissions in 2050 is supposed to add up to zero. But the planet also has a stock problem. Scientists have defined a maximum allowable balance of carbon emissions in order to avoid runaway climate change. The earth must stay within its carbon budget on the way to the target flow year. The practice of Net Zero invokes the question, who is going to manage carbon stocks and decide the interaction between stocks and flows in any given year?

To better understand the implications of timing emissions reductions, we look through the lens of carbon offsets, which are more and more relied upon by reporting entities seeking compliance with interim goals. Lorenzo Bernasconi (Chapter 7) considers the role nature-based carbon offsets could play in light of the checkered experience of the CDM in the original UNFCCC regime. His work exposes the stylized timing issues in Net Zero accounting, and its troubling limitations in the absence of an "accountant on high" to settle the global ledger. If offsets are an instrument that allows reporting parties simply to adjust their Net Zero accounts to optimize the timing of their compliance behavior, and to avoid or delay investment in underlying technologies necessary to deliver permanent emissions reductions at the firm level, Net Zero will not add up by 2050. Empirical evidence of loading up on offsets to legitimize Net Zero accounting suggests a worrying trend.

Management (Obligations)

Perhaps the sharpest edges of Net Zero practice have to do with management. Once emissions are known, coverage is appropriately applied, and timing issues are sorted, how should actors respond? This volume's contributions on the record of initiatives to define transition planning, and mobilize transition finance, highlight current practice in the absence of serious efforts to attend to the details of how an equitable and effective transition can be implemented. The orderly winding down of carbon-intensive industry with attention to economy-wide employment, taxation, and risk management is submerged in the simplicity of divestment. More generally, the question of what a practicing Net Zero adherent is committed to do once it has calculated and reported its emissions exposes largely uncharted territory.

A close look at the rough edges of management reveals a wide gap between Net Zero risk objectives and methods—a divorce between risk management and emissions alignment that has yet to be clarified in practice. More specifically, the alignment of calculated emissions with a targeted path to Net Zero is not the same project as reporting and managing a firm's prospective climate-related risks over various geographies and time periods.

In Net Zero reporting and disclosure, largely implemented through the TCFD framework, there are few disorderly or granular scenarios for risk analytics and little discussion of decision rules like value-at-risk, core to robust risk management. Where risk is considered in connection with emerging climate disclosure practice, it is usually limited analytically to short-run physical risk of acute events already embedded in climate systems or, lifetime physical risks to infrastructure projects if effective climate risk management does not occur. Climate risk management products are largely confined to off-the-shelf, sectoral diagnostics for transition risks with notable exceptions in the insurance industry, such as parametric pooling or insurance-linked securities. Development of analytical models that integrate physical and transition risks or couple financial and macroeconomic models is necessary and still largely untapped. The implications of these trending directions lead toward "emissions alignment" and away from functional risk management.

As a result of emphasis on emissions alignment, risk management practices have gravitated toward divesting or singling out of high-emissions investments. More effective transition risk management would incorporate metrics like imposing specific internal carbon prices to reweight a supply chain, corporate engagement with Scope 3 counterparties, demonstrated specificity and accountability to future emissions trajectories, and detailed lists of offset purchases. With regard to firm or bank-specific transition risk planning, there remains scarce reference in Net Zero pledges to operative obligations defined or required for: (1) transition models and methods (firm-specific scenarios and decision rules); (2) transition planning at asset or business-line level with bespoke and committed risk management strategy; or (3) just transition or climate justice plans or commitments.

Net Zero's rise reflects the deep appeals of markets, mainstreaming, and convergence around decentralized governance. In avoiding the third rails of downside risk and the uncertainties of managing transitions, Net Zero can become an avatar of projection, denial, and procrastination. Risk is the language of transition, and climate risk migrates to the state. As the saying goes, "you manage what you measure," but states tend to only measure what they can manage. If the practice of Net Zero is emissions alignment, and it is not an illusion that alignment approximates transition, better emissions accounting can take us a good way down the road to climate stability. But whether in attempting to perfect Net Zero accounting, or suggesting its limitations as a climate narrative, the chapters of this volume consistently find their way back to the need for greater accountability and risk management, and the role of states in assuring them.

Accounting by Association

As firms struggle to settle these open accounts, Net Zero associations have emerged as mechanisms for standard setting and, to some degree, accountability. In North America and Europe, where Net Zero is principally in play, an important and increasing segment of public companies and investors is joining Net Zero associations and developing dedicated organizational resources toward compliance with the processes and conventions of one or more associations. These associations often agree to and publish defined standards on data, metrics, and targets though wide variation remains regarding Scope 3 boundaries, offset quality and use, and obligations beyond reporting and disclosing emissions. Further, Net Zero associations have yet to materially venture into management of (downside) transition risks, system impacts, long-term physical and transition risk integration, or investment in efficient hedging instruments.

In projecting the direction of Net Zero travel, a worst case scenario threatens a future that is noisy, self-claiming, and chaotic; a collection of clubby bubbles that add up to gaming and growing physical risk; deferral of mitigative action and deflection of responsibility for near-term action onto nations and actors without capacity to assure it; and divestment-based management that can be mobilized only around the most extreme climate offenders and yields only a psychologically comforting illusion of efficacy.

At the other end of the spectrum, a best case imagines an outcome where the emerging practice of Net Zero suggests an ascending formation of clubs that agree to conventions about standardized data and metrics, the boundaries of Scope 3 inclusion, the use of offsets and timing of reduction commitments, and the reporting and management obligations that members will share. Given sufficient scale, geographic extension, and sufficient market power to impose their agreed terms (especially among enrolled global financial institutions and oligopolistic corporates in sectors with exceptional economic productivity), these clubs could make serious advances toward defining and institutionalizing a low-carbon regime.

The road ahead likely lies somewhere in the middle of these best- and worst-case scenarios. Net Zero associations will have to climb a ladder of obligations that reaches deeply into the emissions of others, thereby imposing effective prices on supply chain transactions. Further up the ladder, associations must confront norms of responsibility for risks that will impact system stability (sometimes called "double materiality"), and the distribution of inevitable losses of income among communities, nations, and generations. Yet, at the top of the ladder, the wisdom of this direction of travel looks sharply problematic. One source of concern is that, along the way up, the likelihood of gaming and strategic behavior to transfer risk and obligation to competitors or governments increases. Second, as clubs or coalitions enlarge and include less homogeneous membership, the likelihood of defection from their agreed rules increases and the shared costs of monitoring and sanctioning deviant behavior strain their coherence. More disturbing is that delegating the roles of setting prices and managing risks to coalitions of private organizations only defers a replay of the politics in the original UNFCCC design. Perhaps most troubling, however, is that along this path to Net Zero at its "best," private action has morphed into behavior more characteristic of the attributes of state functions and duties. The logic of Net Zero's shifting responsibility implies less a delegation from states to markets and more a contest over their spheres of power. Associations will neither succeed nor survive without a turn back toward the state—a turn that affirms both the jealousy and competences of state authority.

In re-negotiating the contested interplay between states and markets, the record of what was incorporated and what was left behind in the Turn to Net Zero is significant. In its embrace of mainstreaming and privatizing, the Turn to Net Zero at once integrated and avoided elements of the earlier Turns to Green Finance and Risk. The optimism of Net Zero is grounded in the declining costs of low-carbon technologies and the market alignment of green new build investment with positive economic and environmental returns. But in its observed operations, Net Zero has taken but small notice of the absolute levels of still growing global emissions that signal the downsides of transition and points of resistance to progressive climate action. While the proportions of new investment in green approach Net Zero assumptions, retirements of existing investment have been far slower than projected timelines. Net Zero pledges of future emissions and their alignment with normative targets turn away from the complexity of measuring and managing the costs of transition. Net Zero associations are still a long way from adding up and coordinating the distribution of dislocation costs or standardizing obligations for managing the accumulation of long-run physical climate risks that come with a slow or disorderly transition.

Transition, Risk and States

To the extent the practice of Net Zero accounting accelerates a world in which it is cheaper to build green, this contribution is clearly to be supported and welcomed. The push to rely on voluntary market behavior and self-organized collective action is understandable, if not preferable, in the light of failures of state-centric climate processes like the multilateral negotiations that derailed at Copenhagen.

But even if, with generosity and hope, we imagine that Net Zero associations settle the open account of greenwashing, the road forward on Scope 3, offsets, and obligations lead straight into the heartland of geopolitics, and core state responsibilities for infrastructure and collective risk. To properly settle those outstanding accounts, climate action must push back into rough and earlier contested terrain, but perhaps, with a renewed appreciation of what governments can do, more and less well, in the areas where the limits of Net Zero action require state attention.

In turning back to states, two questions stand out: (1) what do states do well; and (2) how do these specialized competencies play out in climate? States have three tools that can be used in service of climate action. To drive effectively toward climate stabilization, drivers of Net Zero must turn back to states as stewards, as owners and operators of infrastructure, and as the ultimate bearers of risk.

States as Stewards

States as stewards carries a double sense in which states can be active as both players and regulators. States participate in Net Zero practice and associations through their stature as asset owners (infrastructure or state enterprises), financial managers (public pension funds), investors (sovereign wealth funds or bonds issuers/proceeds allocators), which all run in parallel to private-sector reporting and disclosing. But states, as stewards, may also take on regulatory or policing powers that monitor and enforce norms, correct and advance standards toward announced collective objectives, and hold members accountable to coordinate and add up behavior that will keep the association on track. States as stewards inside public/private associations both subject themselves to common standards of conduct and steer the coalition to its self-imposed goals. Ultimately, Net Zero associations may need governing conventions wherein states are central parties so as to settle persistently troubled accounts.

The state of California, for example, is engaging in Net Zero mobilization as both an owner of infrastructure and large, place-based assets, and as an investor through its treasury, IBank, and public pension systems. Like its peers in leading Net Zero associations, California is threatened by acute physical climate change risk which it seeks to measure accurately, prevent, and insure. And, like its peers, California relies on the increasingly valuable put option it holds to the federal government to distribute the costs of these risks. Like fellow Net Zero practitioners, it is committed to disclosing its direct and Scope 3 emissions future, seeks investment support for low-carbon transition infrastructure from the federal government, and faces rising demands for sustainability in its credit portfolio. California will be impacted, like private banks and asset managers, by the same structural pressures of Net Zero market development, including the flight from public (regulated) to private equity markets and shadow banks.

Beyond the value of collective consideration of Net Zero concerns with fellow association members, states-stewards may bring their heritage as regulators to serve as internal advisors and mediators on the credibility of replacing mandatory solutions to climate disclosure controversies with associational self-governance. Further, state stewardship may facilitate wider climate responsibilities as states become better able to consult and debate within specialized networks of private firms and other participating government agencies on identifying efficient risk managers, diagnosing and avoiding gaming and strategic manipulation of climate risks, and pre-negotiating distributions of transition liabilities and remedies, like income transfers and social insurance.

States as Owners and Operators of Infrastructure

Few might have predicted that the definition of "infrastructure" would preoccupy United States politics in the spring of 2021. Yet, we argue that financing and management of infrastructure is not only a central feature of the state, but one that will be critical to harness in order to achieve climate goals. Political theory has always pictured states as monopoly players. States are either organizations that have the power to impose and exercise monopoly (classically, arms, salt, tobacco, irrigation systems, customs ports, diplomacy), or the regulators who define, limit, and franchise its private operations. Infrastructure tends to produce monopoly returns—long coveted political assets for enrichment, patronage, or redistribution—that have made it the compulsory object of state ownership and administration, and a core tenet of modern state practice. In industrial economies with critical reliance on energy and mobility, carbon intense systems with complex infrastructure demands have developed around state production monopolies, state budgets and balance sheets, and competing political claims of what the public interest mandates in the access, price, and quality of electricity, water or transport. But low-carbon production systems will favor investment in newly adapted infrastructure, where networks of intelligent software replace hard facilities, as in the case of the twenty-first century electric power grid and automated transport. The weight of the state as the controller of monopoly powers will invariably constrain the privatization of transition from high- to low-carbon infrastructure and inclusive distribution of monopoly profits and services.

In the wake of the COVID-19 pandemic, the demand for state-driven economic revival and a desire to "build back better" recall and reinforce the central place of fiscal expenditure as the recognized province of states. Even against a Net Zero backdrop that displaces states as the primary climate actors, the political wave that prioritizes growth via state infrastructure finance has swept climate advocacy back toward alliance with the state. In the West, wide turns to unprecedented public debt are now embraced by ecological activists, while in China, and the emerging markets long derided as overly state infrastructure reliant, preoccupation with debt to gross national product (GNP) ratios is causing friction with this strategy.

Irony aside, the principal charge against state monopolies in the ownership, finance, and management of infrastructure systems, whether high- or low-carbon, is that it is done wastefully, corruptly, and in assets with lagging productivity. If it is the case that new build renewable or transportation investment is the market-preferred choice over new fossil, then why should public finance be involved other than as an agency that stimulates the aggregate growth in demand that will incentivize new low-carbon supply? If it is the case that new build renewable facilities or (automated) electric cars will only realize high returns from increased productivity in a restructured energy system, then state finance ought to concentrate on systems development and integration investment and not facilities projects. But public investment in clean energy from Indiana to India is concentrated in the construction of physical plant. The links between structural growth, transition, and investment are not yet widely understood, let alone practiced.

Recovery goals are short-term. They involve "shovel-ready" and familiar infrastructure projects with well-established project financing vehicles, and immediate jobs for an unemployed labor force. Yet low-carbon transition goals are long-term. They emphasize systems integration and digital infrastructure, and require experimental financial structuring to account for zero marginal cost services with returns dependent on new, low-carbon market design, new business models, and disruptive labor patterns. For good reason, Esther Choi and Soh-Young In (Chapter 6) insist upon the reform of the established organization of the bureaucratic banking channels of state-driven infrastructure investment. At the same time, it is worth noting the potential dynamic advantage of state-led systems in the explicit Korean (and Chinese) overlay, and coordination between the digital and sustainable transitions. In this regard, and in the context of low-growth and climate risk, states in the West might attend to, in rethinking their competition rules and infrastructure financing for an information-driven and ecologically constrained period, classes now being conducted at the leading edge of evolving Asian growth models. In any case, the power of states to determine investment levels and management of low-carbon infrastructure cannot be ignored.

States as Ultimate Bearers of Risk

The frontier of transition risk measurement and management has migrated to central banks and financial regulators. This should not be surprising; since even cursory research on risk dynamics and strategic behavior in climate reveals that, like financial risk before it, climate risk is transferred to sovereign balance sheets. There exist multiple channels—through taxes, social insurance, regulated industry terms, and bailouts—that facilitate these transfers. With discretion and extreme political caution, the expansion of the NGFS recognizes central banks' and financial regulators' claim to climate jurisdiction. This claim was enabled by the effective abdication of policymakers to manage climate through taxation. This cumulative failure appears on sovereign balance sheets as a mounting risk.

Even in Western advanced economies where central banks and financial regulators have experience with jurisdiction over managing systemic risks, there is a litany of cited limits to expanding into authority over climate. These objections or self-restraints, expressed regularly by monetary authorities and politicians who generally oppose any action in the name of climate, center around the recognized responsibilities and regulatory actions of the monetary and financial agencies aimed at long-term economic growth and cyclical smoothing. They have not been asked or explicitly entitled to deal with structural disruption and potentially deflationary conditions like climate change. Further, as noted in the evaluation of pilot stress testing by France's prudential regulator (ACPR), the modeling toolkit of central banks was not designed for the kind of granular, probabilistic, and locally differentiated analysis climate requires. Defining the boundaries of management obligations also plagues NGFS members—efficient allocation of risk management responsibilities, and managing the distributional impacts of dislocation from economy-wide climate transition lie outside the expertise of financial authorities. And finally, in the absence of legislation delegating this competence to financial regulators, action may be contested as inappropriate.

Turning Ahead?

The quest to settle Net Zero's accounts threatens to replay the initial record of climate change disappointments by escaping into familiar territory. As the Turn to Net Zero necessarily leads back through the well-explored landscapes of market incentives, globalization, uneven economic development, and non-convergent politics, it holds out fading promise of arriving at an orderly and timely low-carbon transition without turning back to some of the elements in the original UNFCCC framing.

As the chapters of this volume depict, the roadblocks that stand in the way of climate security suggest a turn back to states and their demonstrated capacities of stewardship, infrastructure, and risk management. The preceding examinations of data (Chapters 2, 3, and 4), metrics (Chapters 2, 4, and 5), financial organization (Chapter 5), and offsets (Chapter 7) all come back to, and emphasize, the need for states as Net Zero inside players in designing and managing the ongoing process of settling open accounts and coordinating movement in the desired direction of travel. The contributions on Korea's green record (Chapter 6), transition bonds and finance (Chapter 8), and securitization and equitable transitions (Chapter 9) further push toward a conclusion that states must take on systemic issues or Net Zero will have limited prospects of tolerable results.

States as stewards, investors, and risk managers have irreplaceable accountability in the management of low-carbon transition. The speed and trajectory of the transition will be determined by how the knowledge of specialized public finance and risk management institutions gets deployed, and whether appropriate attention is paid to differentiated local patterns of governance and timing. One intuition that might be followed is whether, in the absence of existing state agencies (military, fiscal, monetary or regulatory) designed for such rapid and comprehensive transitions, it makes good sense to consider special purposes vehicles (SPVs) constructed around the terms and conditions of climate change. An eccentric compilation of such SPVs built to manage extraordinary or crisis situations that could merit such consideration might begin with the US National Recovery Administration (depression), the American Office of Price Administration (wartime economy), the French Commission du Plan or Japan's MITI (post-war restructuring), or, most recently, the Treuhand Anstalt (German reunification).

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In pretended summary of issues whose history cries out against simplification, conjecture about the next turns toward climate stability might begin with recognizing three notable features of the road in 2021. The first observation is that most ownership and investment in production at scale in climate-intensive sectors are in the hands of states. Second, the economic and technological systems that measure climate risks and divide up accountability for their management are globalized, and will principally remain so. And third, the politics of climate continue to be substantially decentralized, playing out at the state level where, not coincidentally, the downside of transition is critically important.

Net Zero accounting and associations, particularly when they facilitate, inform, and coordinate stewardship interactions with states, can complement and shape the work of states as infrastructure investors and sovereign risk bearers. To the extent that Net Zero targets and metrics are imagined as effective proxies for the primary obligations of states in finance, diplomacy, or risk management, they will delay and deflect climate action from the narrowly time-constrained course toward orderly transitions to which climate action must now sharply turn.

Postscript: System Priorities and Directions

The rise of Net Zero testifies to its attractions—an optimistic embrace of a sustainable future as an incremental correction of familiar patterns of Western development, and as the generalizing of solutions for even the most challenging systemic problems. But, like all compelling storylines, mainstreaming political messages brings techniques adapted to the effective practice of governance at mass scale. These tools often include the use of checkboxes and lines that are useful precisely because they simplify complex technical, financial, and social changes. Checking boxes and drawing lines work to demarcate contested fields and mobilize mainstream coalitions. The exercise illuminates the good and bad guys—who are on the right and wrong sides of history—by checking the boxes that score on which side of the dividing lines groups, corporations, banks, and even nations, stand. Mainstreaming politics, especially those like climate with global reach, will profit from the value added by the Net Zero toolkit and be liable for the costs. Mobilization is a condition of political success, yet simplified solutions run the risk of incomplete and short-lived results. Within this spirit, we can both applaud the advances of Net Zero and suggest precautionary guidelines to protect against overestimating either its stability or the likely scope of its ultimate contribution to managing the climate future.

We conclude by reiterating five precautions that look beyond the likely limits of Net Zero. The (fanciful) road signs we would post for those will require constant monitoring and testing.

Look out for (downside) *risks*.
Look out for (upside) *systems*.
Look out for (accountable) *management*.
Look out for (mostly) *Asia*.
Look out for (multiple) *transitions*.

Correction to: Securitization as a Model for an Equitable Transition

Uday Varadarajan

Correction to:
Chapter 9 in: T. Heller and A. Seiger (eds.), *Settling Climate Accounts*, https://doi.org/10.1007/978-3-030-83650-4_9

The original version of Chapter 9 was inadvertently published with an incorrect author name as 'Christina' instead of 'Christian' in the chapter end reference list, which has now been corrected. The book has been updated with the changes.

The updated original version of this chapter can be found at https://doi.org/10.1007/978-3-030-83650-4_9

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Index

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D

E

I

J

K

L

M