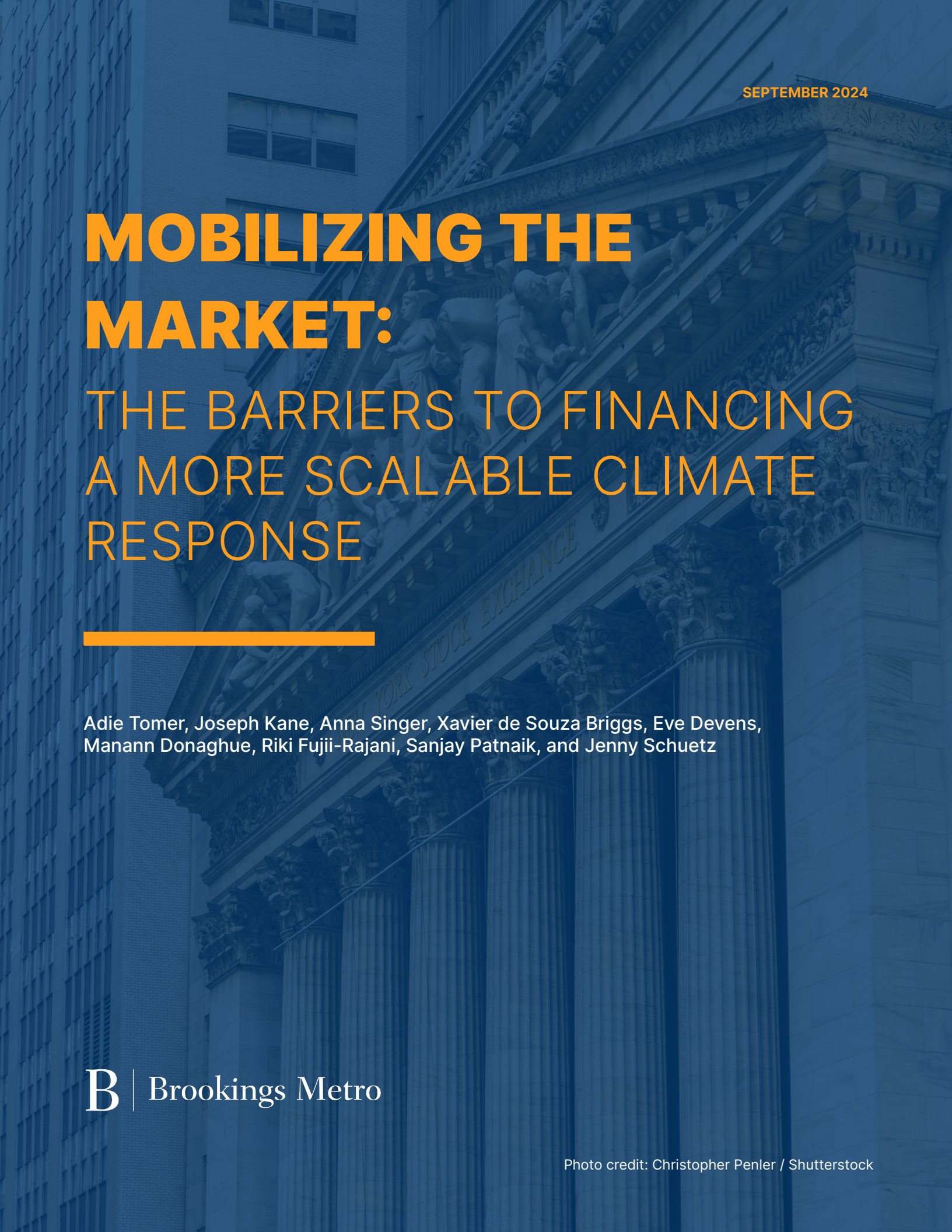

SEPTEMBER 2024

MOBILIZING THE MARKET:

THE BARRIERS TO FINANCING A MORE SCALABLE CLIMATE RESPONSE

Adie Tomer, Joseph Kane, Anna Singer, Xavier de Souza Briggs, Eve Devens, Manann Donaghue, Riki Fujii-Rajani, Sanjay Patnaik, and Jenny Schuetz

Brookings Metro

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Introduction

Climate change is already damaging America's financial health and undermining individual well-being and economic security. In 2023, 19% of American households reported being financially harmed by a natural disaster, while insurance premiums are increasing by 11% or more for many property owners.[1] Dramatic events—potentially exacerbated by climate change—such as coastal erosion sinking houses along North Carolina's Outer Banks; melting infrastructure in Phoenix and Portland, Oregon; and Texas's frozen electrical grid can destabilize entire communities and local economies. And as more researchers, market analysts, and journalists study how communities are impacted by acute and chronic climate impacts (including floods and fires), it is becoming clearer that more people, businesses, and places need help to protect their safety, assets, and livelihoods.[2]

Responding to these widespread structural challenges requires deploying new technologies and infrastructure to accelerate decarbonization and adaptation at a substantial scale. America needs to construct enough renewable and zero-carbon power generation, long-distance transmission lines, and power storage capacity to decarbonize. Billions of square feet of housing, offices, and industrial facilities have to be retrofitted to reduce their carbon footprints. Roads, pipes, and entire communities will have to be redesigned to withstand more rain, rising sea levels, extreme temperatures, and high winds. Climate change is quickly becoming an infrastructure and financial challenge, and building all those projects will likely cost tens of trillions of dollars.[3]

The scientific consensus is that humanity has only a couple decades to avoid locking in the most catastrophic consequences of a warmer and more destabilized climate.[4] Such urgency is one reason why elected officials, corporate leaders, and civic organizations continue to make public pledges to reach goals like net-zero greenhouse gas (GHG) emissions by 2050 or even sooner.

Financial markets can help facilitate—or hinder—climate investments in the coming decades. Banks, investment funds, insurers, and other financial institutions can channel capital toward adaptation and mitigation projects across the energy, transportation, buildings, industry, and agriculture sectors. While their exact objectives and time horizons can vary, financial institutions serve as the matchmakers between investors seeking returns on their capital and project developers who require upfront funding. Put differently, financial markets can help convert the country's climate *intentions* into climate *action*.

Yet private capital alone will not achieve broader social objectives: the most profitable projects may not align with the most urgent climate challenges or social needs. Climate benefits from some projects may not materialize for years, given the long time horizons of these improvements. In many cases, there are market failures in pricing and accounting for climate impacts.[5] At the same time, flawed public policies and outdated regulations often send the wrong signals to consumers, investors, and project developers, leading to over-development of some kinds of projects, under-development of others, and exposure to heightened economic and financial risk.[6] Distorted market signals can result from market and policy failures such as not pricing GHG emissions, lengthy and unpredictable permitting processes, and mispriced disaster insurance.

Catalyzing investment in critical climate projects and incorporating climate equity considerations will require well-designed public policies. New federal funding can benefit disinvested neighborhoods and disadvantaged households. Municipal green bonds help stormwater utilities and local governments bundle their projects to receive beneficial pricing. Information matters too: Notifying potential homebuyers of local climate risks could deter growth in risky areas. These examples illustrate how well-designed interventions can ensure capital takes account of social costs and benefits, but thus far, most of these interventions have only been tried on a small scale.

Despite bold pledges around climate investment, such as the Infrastructure Investment and Jobs Act (IIJA) and Inflation Reduction Act (IRA), and despite the acknowledged need to help more people and places, public policy in the U.S. is not doing enough to unleash private investment at scale and in ways that advance equitable outcomes. National, state, and local stakeholders should realistically confront what's holding back climate investment at the scale the moment demands for achieving a more equitable climate transition.

This report identifies and analyzes the pain points holding back climate investments across multiple economic sectors in the U.S., with focused attention on climate equity—the principle of fairness in burden sharing and a basis for understanding how the impacts and responses to climate change, including costs and benefits, are distributed across society.[7] Building a broader understanding of these pain points across financial institutions, policymakers, and civic leaders can help foster an investment environment that not only better meets the scale of climate need but also better addresses related climate equity challenges.

The report begins by discussing why an equitable climate transition is important. It then turns to describing the key actors within project development, regulation, and financing. This analysis identifies nine core pain points, using examples and case studies to demonstrate real-world failures and successes. The pain points fall into three broad categories: information, pricing, and governance. The report concludes with implications for ongoing research and action.

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Defining climate investment and climate equity

Mitigating GHG emissions and adapting to emerging climate impacts and risks will be one of the grand challenges of the twenty-first century.[8] A response at such a scale requires a mix of public and private sector leadership, with both sides needing to rethink business-as-usual approaches. That means scoping and testing new project designs, investment strategies, financing tools, and public policies that can simultaneously address climate investment and climate equity needs.

This report highlights these needs through the lens of climate finance—the process of securing the money needed for a project that achieves climate mitigation, adaptation, or both. A **climate investment** refers to the improvement of physical assets (notably infrastructure, buildings, materials, or equipment) used over time to support climate mitigation and/or adaptation. These physical projects can vary widely in their location, duration, and scale (ranging from installing heat pumps for houses to building power plants, for instance), and they are often part of larger human-made and natural systems. Mitigation- and adaptation-focused investments also vary considerably in their uptake and market penetration. **Climate equity** refers to the principle of fairness in sharing the burden of climate costs and impacts as a basis for understanding how the impacts and responses to climate change, including costs and benefits, are distributed in and by society.

Appendix A includes a detailed glossary of these and other key terms used throughout the report, which frequently relies on research from the Intergovernmental Panel on Climate Change (IPCC), a globally leading information source in this space. **Appendix B** contains more detailed context on the scale of needed U.S. climate investment and how this investment process generally works. **Appendix C** contains a more specific description of the economic sectors analyzed in this report, including energy, buildings, transportation, industry, and agriculture.

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Key equity considerations for climate investments

The scale and urgency of the country's climate investment needs are gaining greater attention among policymakers, financial institutions, and other leaders. The wide range of people and places exposed to climate impacts is also raising questions around how such investments—and specific projects—can be implemented in an equitable manner. But questions persist about how to help the most vulnerable people, businesses, and places.

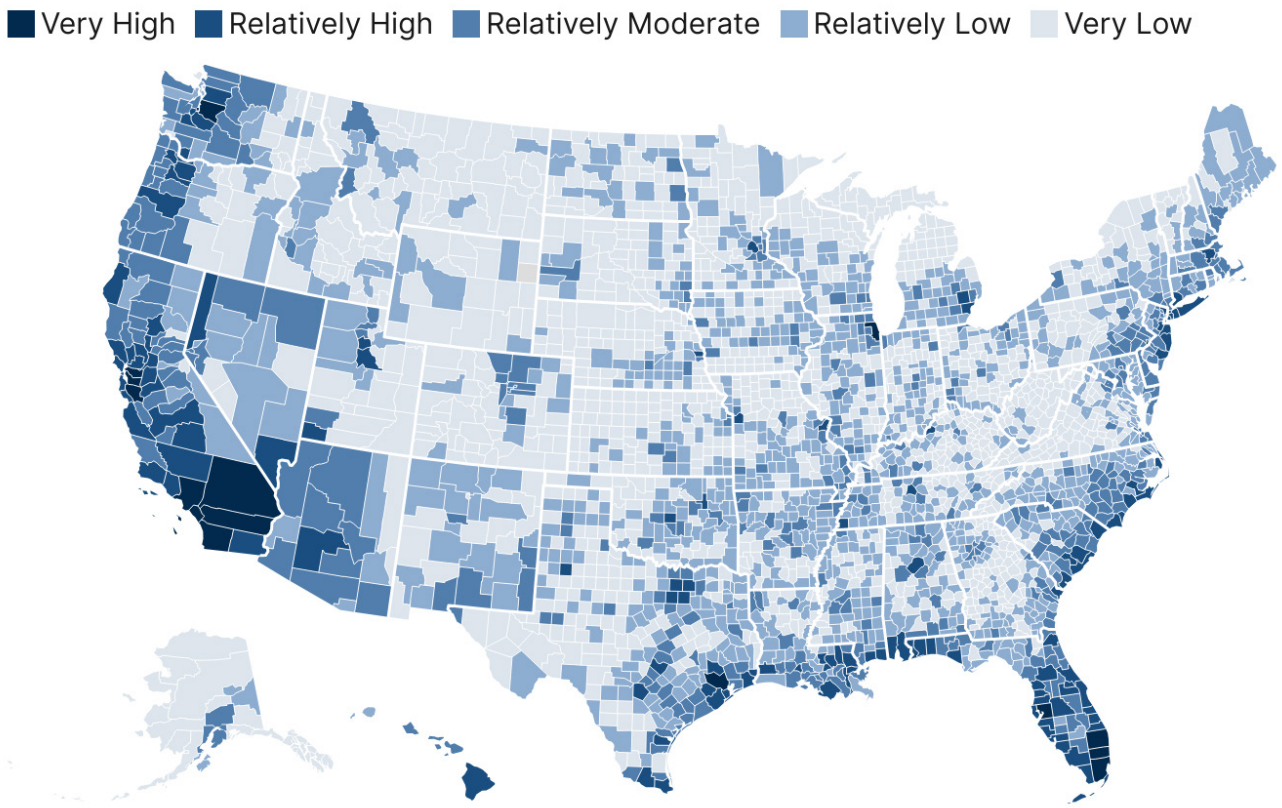
A foremost concern is protecting against direct impacts of climate-related risks—including floods, high winds, extreme heat, deep freezes, and related hazards—that disproportionately affect some of the country's most economically vulnerable and exposed communities. For example, Harris County, Texas—the home of Houston—is exposed annually to billions of dollars in damage from heat waves, hurricanes, and cold snaps.[9] The climate threats in this area are especially pronounced in neighborhoods that have higher levels of social vulnerabilities, like low-quality housing, underlying health conditions, and constrained household budgets that limit local residents' ability to rebound after a disaster strikes.

Flood risks are particularly problematic. About 40% of the U.S. population—or about 130 million people—live along the coast, where they not only face higher storm risks but also contend with daily hazards from sea level rises, such as coastal erosion or flooded roads (see Map 1).[10] People of color, low-income households, renters, and individuals with disabilities are among the most vulnerable populations. They typically lack flood insurance and savings to navigate such risks, meaning that they do not have a financial safety net to avoid falling into poverty during disaster recovery.[11]

MAP 1

U.S. climate risks at the county level

2023



SOURCE: FEMA National Risk Index, 2023

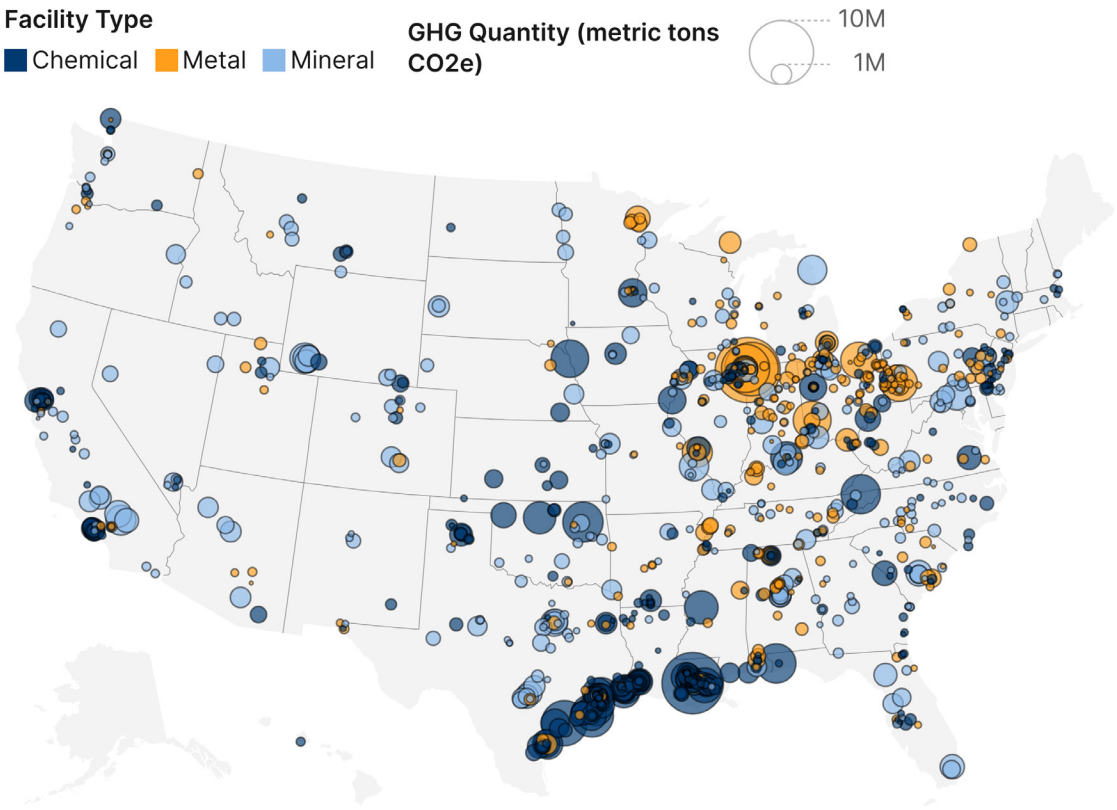
NOTE: The FEMA National Risk measures expected annual loss (likelihood and consequence) against social vulnerabilities (consequence enhancing) and community resilence (consequence reduction).

At the same time, GHG emissions—the primary contributor to climate change—often occur along with other kinds of hazardous local air pollution, which pose considerable threats to the communities least able to rein in or withstand the impacts (see Map 2). These communities tend to share certain characteristics, including higher levels of poverty and a disproportionate share of people of color. For instance, the U.S. counties receiving failing grades for all three major air quality measures (ozone as well as short-term and year-round particulate pollution) are home to over 2 million people experiencing poverty and nearly 13 million people of color.[12] Both GHG emissions and local air pollution are especially high in communities that house expansive industrial facilities, such as Gary, Indiana, where a large steel mill produces primary steel from iron ore using an old technique that results in especially high emissions of local air pollutants.[13] In fact, according to a 2011 analysis by the Environmental Protection Agency (EPA), 92% of "all point source hazardous air pollutants from iron and steel mills" nationally come from just three mills, all concentrated in northwestern Indiana.

MAP 2

Major industrial facilities in U.S. metro and micropolitan areas with emissions levels

2022



SOURCE: Brookings analysis of EPA Facility Level GHG Emission data

The economic ripple effects of climate change are extensive and not simply limited to these vulnerable communities. Direct climate impacts—including storms disrupting supply chains, droughts destroying crop yields, or freezes interrupting electricity generation—can slow and halt the production, consumption, and delivery of different goods and services.[14] These impacts are particularly dire for small- and medium-sized enterprises that tend to have fewer resources to withstand such disruptions, despite "employ[ing] 70% of the world's workforce and accounting for 50% of global GDP."[15] Meanwhile, indirect climate impacts—including lower housing values in flood-prone areas, higher insurance premiums, and various health risks—are also creating economic losses. For instance, homes projected to be at risk of facing 1 foot of sea level rises can be worth 14.7% less than comparable homes.[16]

Nor are climate change's impacts limited to physical damage. Adopting cleaner technologies already threatens millions of people working in the fossil fuel sector and other energy-intensive industries, many of whom are people of color and make good wages in jobs that often do not require a college degree.[17] Failing to help these workers secure careers in the clean economy—or what is known as a just transition—could be especially disruptive to specific demographic groups and many energy-rich communities.[18] Ensuring that this just transition acknowledges different geographic concerns and accounts for the latest evidence of where policies are working (or not) will be crucial in the years to come.[19]

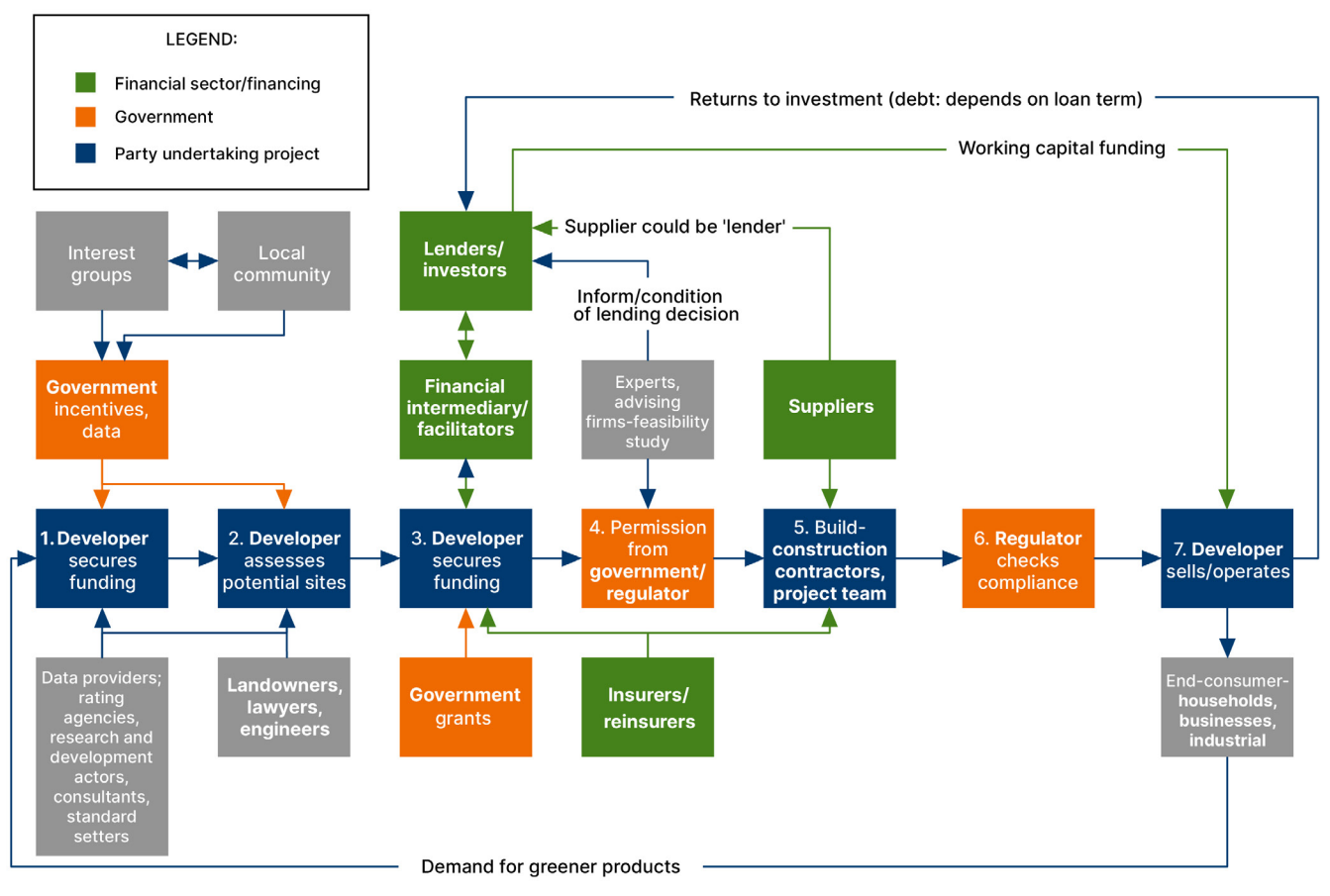
BOX 1

How private-led climate investment currently takes place

Ultimately, the nation's climate response depends on building new assets or modernizing older ones to reduce GHG emissions and adapt to new climate conditions. The execution of these projects depends on a relatively sequential process of identifying, financing, and carrying out needed improvements. Figure 1 below provides a stylized, broadly applicable model of how project development and execution typically occur in the U.S., including the major actors involved, the steps they follow to select and finance projects (including those that are climate-related), and the various junctures where specific considerations, such as climate equity, could play a role.

FIGURE 1

General flow for climate investments in the U.S., including relevant stakeholders



SOURCE: Brookings' analysis of climate financing across different built environment sectors

BOX 1 CONTINUED

The process starts with a developer (a manufacturer, agricultural producer, or other party undertaking the improvement) identifying and planning the investment project with inputs from government policy, data providers, and end-user demand. After assessing the project in more depth, the developer then obtains financing from the public and/or private sectors via a loan or other instrument, while also undertaking any necessary permitting and/or approval processes. Finally, the developer builds and implements the investment, typically coordinating with contractors and suppliers, with a final good or service provided to end consumers or users. Some of the biggest end consumers can be government actors themselves—such as utilities or departments of transportation—which can influence the demand for certain projects (such as roads).

Beyond the developer, the primary stakeholders for private financing of climate investments are financial regulators and financial institutions. Financial regulators primarily include federal, state, and local government bodies—such as the U.S. Treasury Department or the Federal Deposit Insurance Corporation (FDIC)—that can either incentivize, disincentivize, or restrict certain types of investments via grants, tax relief, and regulation. Regulated financial institutions, such as private equity firms and commercial banks, in turn provide direct financial support for projects. Typically, they may provide loans or other capital directly or through financial intermediaries, including green funds and community development financial institutions (CDFIs).[20] There are also larger institutional funding sources, such as the EPA's newly launched Greenhouse Gas Reduction Fund, that help structure climate projects and facilitate investments mainly via gap financing, largely through CDFIs, nonprofit developers, and other intermediaries.[21] Both financial regulators and financial institutions can be informed and influenced by ratings agencies and standard setters through their analyses and assessments.

The devil is in the details, of course, in terms of the exact types of developers, financial regulators, and financial institutions involved in different climate investments—and when there may be specific opportunities to address issues of climate inequity. For instance, when looking to invest in more sustainable and resilient buildings, real estate owners and developers operate in a highly fragmented and localized regulatory landscape. The ability of local governments to incentivize climate projects—via land use regulations and building codes, taxes, or subsidies—can vary widely depending on staffing and technical capacity, political leadership, and other factors. Financing to support such projects can also be limited and diffuse depending on the specific types of housing, commercial properties, or other buildings involved. Ensuring that such projects are affordable and accessible to all types of individuals and communities can be a slow-moving and complex undertaking.

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Understanding ways in which prevailing and future investments can influence climate equity

Many individual private sector actors—developers, utilities, manufacturers, and shippers, among others—carry out projects without fully thinking about the climate impacts, let alone how these projects can address or worsen issues of climate equity.[22] Inconsistent data and indicators to quantify impacts across different geographies, economic sectors, and communities can further complicate any steps toward improving climate equity. Multiple competing policy frameworks and definitions of climate equity can also obscure what needs to be done and by whom, with global organizations such as the IPCC and World Bank offering guidance that may differ from that of domestic authorities such as the EPA. Furthermore, state and local guidance on climate equity can be ever-changing or missing, depending on changes in political leadership or staffing.[23]

This report primarily focuses on what it will take for **private financial institutions** to invest in and/or offer lending for industrial or built environment projects that support more equitable climate outcomes. These actors include private equity firms, corporate banks, insurance companies, and other investors who could consider climate equity across a range of assets related to energy, transportation, buildings, agriculture, and other sectors. There are several specific ways in which they can influence climate equity, including the following ones.

- **Altering investment mandates and allocation strategies:** Flows of capital not only influence what projects get done but also invariably have consequences for how inclusive and just a society is. When social equity is not a consideration in policy and practice, climate investments risk compounding inequities, undermining other policy objectives, and increasing social costs.

- **Disclosing activities:** Transparency around the types of projects supported, including relevant climate impacts, can reveal ways in which investments are helping or hurting different communities. The lack of required disclosures and consistent reporting standards remains problematic, particularly for climate equity; for instance, only 36% of corporate standards and voluntary initiatives on net-zero goals, for example, explicitly include a consideration of equity or justice.[24] While there is fatigue among some companies around changing regulatory and disclosure rules—especially in Europe—the lack of consistency still complicates efforts to consider an investment's climate impacts and the potential for more equitable outcomes.

- **Altering partnerships and community engagement:** Mobilizing additional climate investment has been a long-standing struggle, let alone directing this capital to projects that are responsive to climate equity concerns. Deepening community engagement and reaching different types of partners—including with individuals or organizations who have been traditionally marginalized and under-represented in decisionmaking—can lead to more durable climate action and more innovative solutions while helping to minimize the risk of maladaptation, increased vulnerability, and risk exposure for some groups.[25]

- **Applying pressure to owners of capital assets:** Since financial institutions do not tend to directly own or operate built environment assets, steps toward greater climate equity depend on their ability to influence owners and operators. Demanding cleaner or more resilient performance from assets that generate local negative externalities, such as high-emitting facilities in vulnerable communities, is one avenue for action. The threat of divestiture gives financial institutions significant power in the marketplace, yet divestment by itself is not a catch-all solution either. Climate-conscious decisions, ideally, go beyond single projects or investments.

- **Changing risk strategies:** Financial institutions often do not include up-to-date environmental risk models when judging potential investments. This is especially the case, for now, across the insurance industry; for instance, more than half of the 52 largest property and casualty insurance and reinsurance firms did not have any formal climate policy for either their underwriting or investments, according to a recent academic study.[26] Risk profiles also spread to industrial competitiveness, where it is up to investors to judge the upside of emerging clean technologies and the likelihood that established, higher-emission technologies will lose market demand over specific time horizons. Financial risk and return, after all, depend on all these factors and uncertainties.

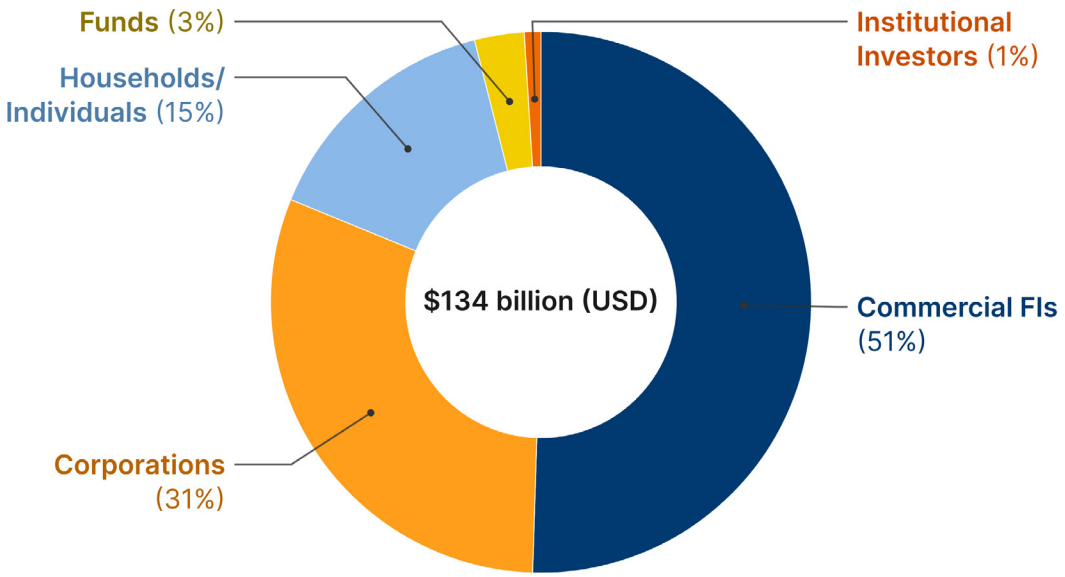
- **Certifying the greenness of different investments:** Corporate strategies for climate equity tend to focus on process, like improving the transparency of investment decisions, practices for sourcing and selecting investments, or processes for the certification of green credentials for built or renovated end products, such as buildings and factories.[27] Because these metrics are designed to measure changes in business structures, strategies, or operations rather than outcomes, they can have little correlation with the goals that they aim to deliver, at least in many cases.

Sustainable funds and sustainability-linked finance (more generally) are among the most common ways that private financial institutions support climate upgrades. Sustainable funds, or green funds, are typically offered by investment banks to give investors an opportunity to take an equity stake in climate-conscious companies or climate-related projects based on different environmental, social, and governance (ESG) criteria.[28] Likewise, sustainability-linked bonds (SLBs) and sustainability-linked loans (SLLs) help provide debt financing to projects based on a range of ESG criteria.[29] In the U.S. and Canada, for instance, there is just over $134 billion in climate finance, split across multiple private actors (see Figure 2).

FIGURE 2

Climate finance by private actor type in the U.S. and Canada

Fiscal year 2022



SOURCE: Data drawn from Buchner et al., "Global Landscape of Climate Finance 2023," Climate Policy Initiative, November 2, 2023.

Despite the growing interest in climate finance among investors—and the growing number of instruments to steer private capital toward climate-related investments—the reality is that climate considerations alone do not drive investment. The same is true for climate equity. For now, these instruments more often serve as communication tools and virtue-signaling devices for investors, rather than fundamentally changing how capital is distributed.[30] Above all, investors prioritize the ***bankability*** or return on investment of a given project, and those returns may still favor more traditional, risk-averse assets.[31] Unfortunately, the failure of traditional bankability measures to account for climate conditions now exposes the entire financial system to new forms of risk that markets are not currently taking into account.[32]

In addition, this report explores how **financial regulators and stakeholders** create laws and guidelines for climate-related investments. Examples include federal agencies, such as the U.S. Treasury Department and the Securities and Exchange Commission (SEC), as well as state and local government leaders. Ratings firms, such as Moody's, Fitch Ratings, and S&P Global Ratings, also influence how investment is directed. The following represent a few ways in which these regulators and stakeholders can influence climate equity.

- **Setting standards and codes of practice for disclosures:** In the past, U.S. financial market regulators have not mandated climate risk or emissions data disclosures, and financial institutions themselves have been slow to voluntarily include climate risk when assessing the strength of their investments. However, the SEC recently adopted rules that provide "more consistent, comparable, and reliable information

about the financial effects of climate-related risks" for public companies, including reporting on how different activities mitigate or adapt to climate impacts as well as greater specificity on climate-related metrics and goals.[33]

- **Creating legislation to subsidize investment in particular sectors, regions, or industries:** Traditionally, federal regulators have relied on policy to enable or incentivize capital market activity to flow to certain industries and sectors rather than directly regulating emissions reductions.[34] The passage of the IIJA and the IRA expanded this government approach, deploying unprecedented federal funding—via tax credits, loans, and grants—to transportation, energy, and other climate-related projects in amounts exceeding $1 trillion over the next decade.[35]

- **Changing taxation to incentivize investment:** Beyond regulations and subsidies, federal, state, and local leaders can also encourage or discourage private sector climate investment through taxation. Tax credits, for instance, can expand the uptake and scaling of new technologies with a positive climate impact, including clean energy and building upgrades via the IRA, in particular.[36] This expanded public funding is also creating new needs and opportunities for hybrid public/private finance solutions, such as bridge financing to help eligible sponsors cover upfront project costs and await reimbursement from the Internal Revenue Service. At the same time, taxes can also help better price negative externalities, including GHG emissions, as policymakers have previously proposed through carbon taxes.[37]

- **Setting and enforcing national, state, and local targets for climate equity:** By providing policy and regulatory guidance around climate investments—and climate equity specifically—government leaders can offer greater incentives to both the public and private sectors as they take on projects. For instance, the Justice40 Initiative of President Joe Biden's administration sets specific targets (40% of federal funding) for certain climate and clean energy programs to reach "disadvantaged communities that are marginalized by underinvestment and overburdened by pollution."[38] Likewise, at the local and state levels, governments have also implemented climate equity plans, including policies to leverage private sector climate finance.[39] Yet the implementation of this guidance and measurement of these targets remain works in progress.

Collectively, these various impact pathways show how financial institutions and financial regulators and policymakers have opportunities to consider—and possibly advance—climate equity (see Figure 3). The shared pathways they can follow are also numerous. Identifying regions and groups in need, setting and measuring specific (and quantifiable) climate equity targets, and gathering and publishing climate risk data are among the many ways in which these actors can foster more equitable climate investment.

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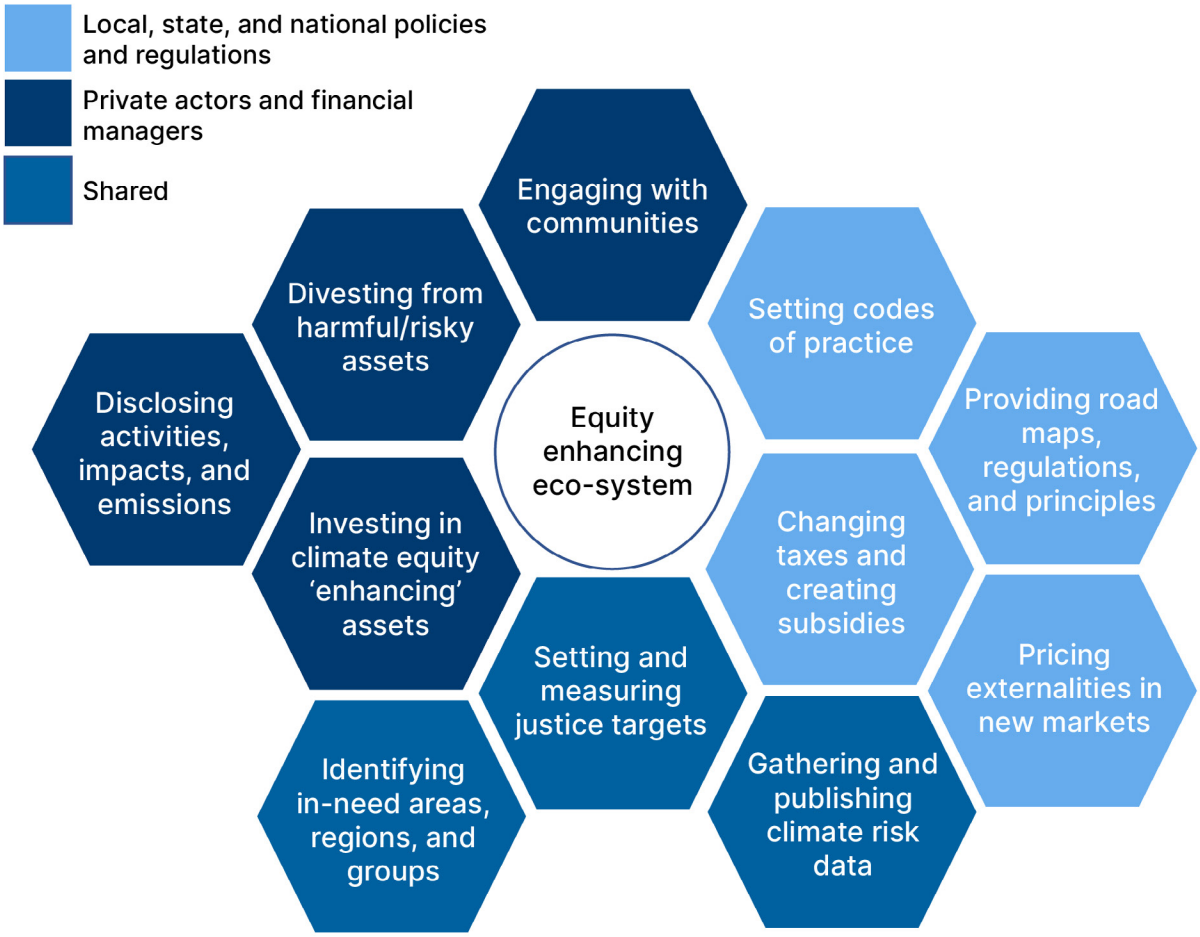
FIGURE 3

Impact pathways for climate finance to advance climate equity



SOURCE: Adapted from Brendan Curran et al., "Making transition plans just: How to embed the just transition into financial sector net zero plans," London School of Economics and Political Science, Grantham Research Institute on Climate Change and the Environment, October 2022.

But the reality is that climate equity, though it is an important goal, is often not a priority in how and where leaders across the country decide to invest. Bold pledges and commitments are easy to make, but the mechanics of how the U.S. chooses and executes on projects are out of sync with equity goals.[40] There are challenges in interpreting and applying the concept of climate equity, institutional obstacles that are likely to impede the development of meaningful indicators, and logistical and governance challenges in implementing different indicators and targets, all of which this report explores more fully in later sections.

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Why is private-led investment falling short?

The U.S. is fortunate to have sufficient capital to finance a cleaner, more resilient, and more equitable economy. The country's financial institutions and private investors should have access to enough deployable capital to deliver a wholesale environmental transition over the coming decades.[41] Stakeholders from across corporations, government agencies, and other asset owners are all adept at using financial instruments to deliver projects, and many publicly proclaim their goal is to help the people, businesses, and neighborhoods most vulnerable to climate change. Yet even with these clear advantages, private capital is not being mobilized at the scale or speed the moment demands. What is holding the country back?

In addition to an extensive literature review, we conducted more than 30 interviews with financial sector leaders, researchers, and other stakeholders to better understand the barriers to more equitable climate investment. While there is no single answer for what is limiting the scope and speed of private investment, a theme emerged during our interviews and careful review of published analyses: public policy has not done enough to bridge the disconnect between current measures of project profitability and long-term environmental and social costs. This is particularly true when it comes to monetary and physical threats to specific people and places. **Today's public policies do not incentivize a level of risk management commensurate with the financial threats posed by climate impacts.**

To be clear, this overarching finding does not mean that U.S. financial markets are failing—far from it. The U.S. continues to benefit from government rules and regulations that instill confidence among investors, financial institutions, and asset owners. Private sector dollars continue to flow into built

environment projects, including new real estate developments, renewable power plants such as solar farms, industrial facilities, and modern farms. Investors have access to clear and trusted information to respond to consumer demand. Comparatively speaking, the U.S. is a safe place to invest and take risks, and the opportunity to generate profits will always be a powerful tool to motivate physical construction.

And yet the rules governing and guiding U.S. financial markets—the public policies—are inadequate for the current climate moment. Each time public officials avoid taking a position on how changing environmental conditions can affect current and future economic outcomes, governments effectively distort market action or fail to account for predictable market failures. Moreover, the financial and technical capacity of leaders to implement different climate upgrades differs markedly across the country—by geography, sector, project type, and more. It is still too easy for asset owners and investors to overlook emissions-related impacts as they measure project profitability. It is still too difficult for consumers and project developers to account for future damage avoided, including acute shocks from extreme weather or more chronic conditions like degrading public health. And even as national policies are designed in pursuit of aggregate reductions in GHG emissions to benefit all communities, the country is failing to deliver a more equitable distribution of the costs and benefits of climate action in the nation's most vulnerable places.

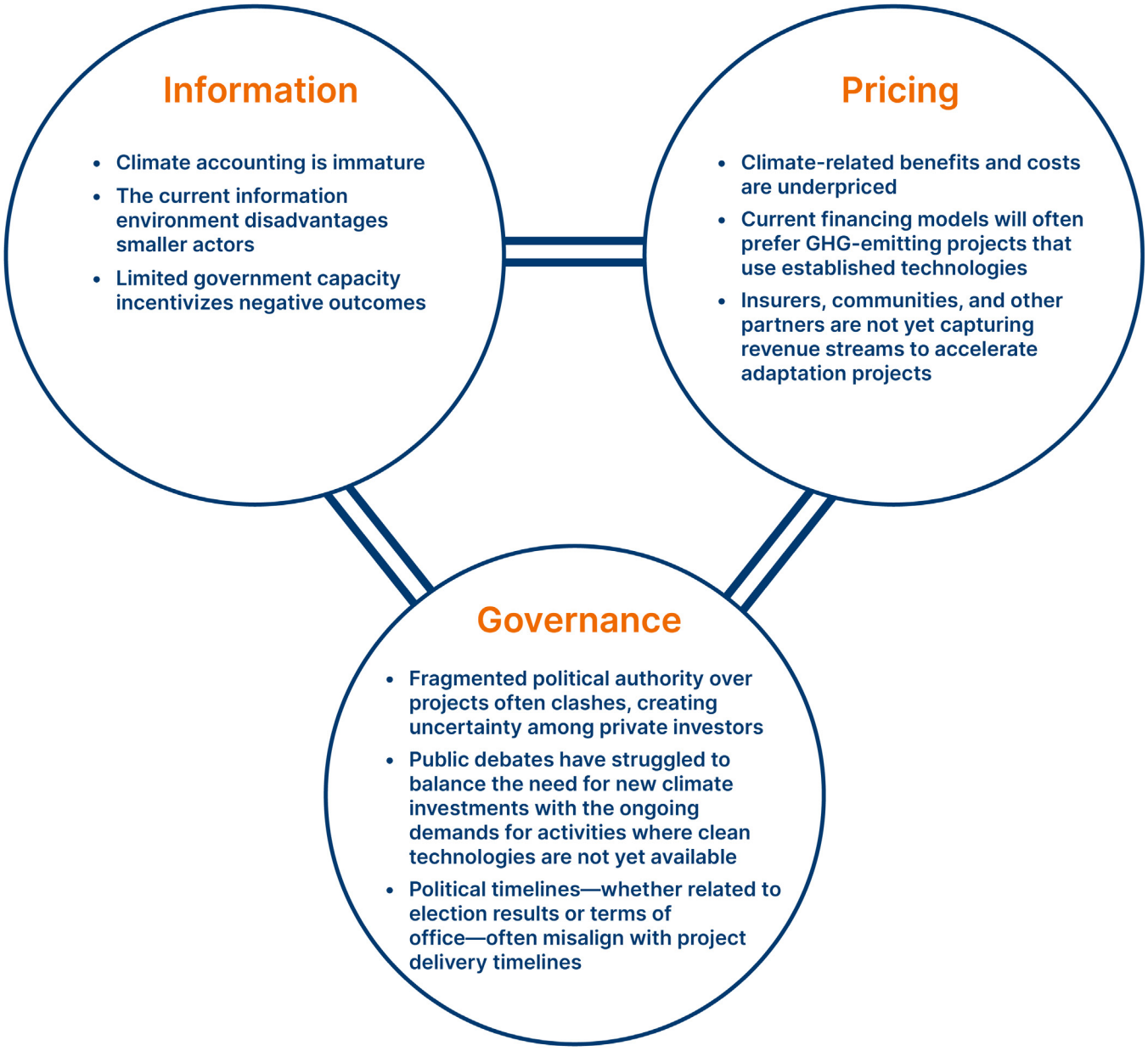
Unleashing private capital to scale and speed up project delivery requires addressing these underlying policy failures and better aligning risks. We have identified nine ***pain points***, which we have sorted into three categories: information, pricing, and governance (see Figure 4). While each of these pain points are distinct, their complex interplay also explains why—even in the face of prominent climate pledges from governments and major financial institutions—private investors are not yet delivering all that they can.

What makes these pain points important is that they do not consistently occur at one set point in time, in every sector, for every project developed. Instead, it is their very ubiquity that makes their effects so damaging to the greater pursuit. Additional context and specificity can be found in the sector-specific briefs.

Photo credit: Shutterstock

FIGURE 4

Pain points in efforts to finance more equitable climate outcomes



SOURCE: Brookings authors

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Information challenges

Effective markets benefit from transparent, accurate, and timely information. Consistent disclosures of information help build trust among stakeholders. The faster that high-quality information is shared, the less friction there is in terms of moving project plans from blueprints to shovels in the ground.

U.S. stakeholders already understand the benefits of a high-quality, high-integrity public information system. For nearly a century, public accounting and disclosure laws have helped investors understand the financials of publicly traded companies. Regulated ratings agencies create confidence in understanding companies' and governments' ability to repay debts. Many real estate transactions require disclosures to protect buyers and sellers. Examples like these prove that formal rules help level the playing field for actors of all sizes.

But information can be inaccessible or lacking on climate-related needs, particularly around climate equity. The marketplace is tilted in favor of actors that privately invest in climate risk data, including insurers and many private equity firms.[42] Information deficits, particularly among government staff who may struggle to understand a project's costs and benefits as they weigh permits or public capital outlays, slow project development and can especially restrict investment in communities with lower information capacities. Left unaddressed, information challenges will continue to limit total investment in a clean, resilient, and more equitable economy.

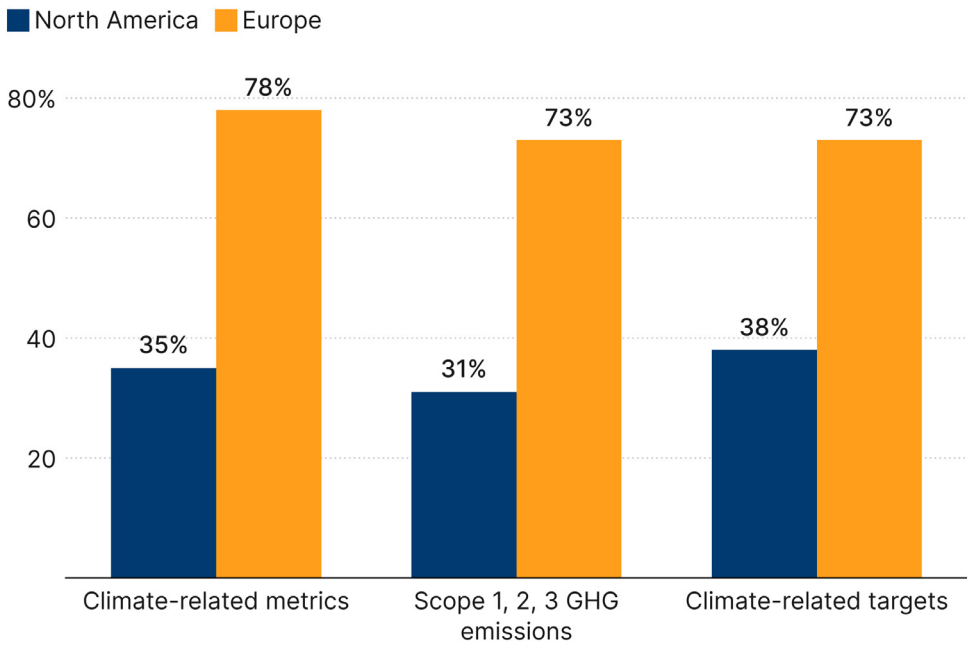
PAIN POINT 1: CLIMATE ACCOUNTING IS IMMATURE

Many within the financial sector recognize the need for improved climate accounting. The U.S. Treasury Department, Federal Reserve Board, FDIC, and SEC have all conducted studies and simulations to learn how environmental hazards could impact their designated sectors, each of which demonstrate how difficult it is to track systemic risks due to limited and low-quality information.[43] Domestic and international efforts to increase climate disclosures, including the European Union's formally adopted rules or the investor-led push to disclose clean energy financing ratios, all reflect a broad recognition that climate-related accounting should catch up to more established financial accounting (see Figure 5).[44]

FIGURE 5

Share of companies issuing climate-related disclosures by global region

Fiscal year 2022



SOURCE: Data from FSB Progress Report on Climate-Related Disclosures (2023).

While the efforts to address data gaps and outdated accounting rules are gaining more attention, the downstream effects of the current system are less often discussed. First off, the lack of consensus about how to quantify benefits and costs makes it more difficult to fundraise for mitigation- and resilience-focused projects. For example, there is no accepted accounting standard for the cost of carbon, which is an estimate in dollar terms of the damage done by each additional unit of carbon emissions.[45] Instead, financial market actors experience a veritable Wild West, where asset owners and investors may all use different assumptions to express benefits and costs, each of which functions like a language barrier that either takes extra time to overcome or causes project owners and investors to not do business at all.[46] Moreover, planning and discussions around different climate topics—such as mitigation versus adaptation—are also frequently fragmented and occur at varying levels of detail among these actors, which further complicates any consistent accounting.

The lack of consensus on benefits and costs is especially problematic for projects with potentially higher social returns. Many institutional investors, like pension funds, have strict requirements on what types of companies, investment funds, and other asset classes they can invest in. An inability to formally account for social returns—in the case of, say, a heavy industrial company that plans to use capital expenditures to reduce its high particulate matter emissions in a disadvantaged neighborhood—means that projects with positive externalities may not be fairly considered. If forced to rely solely on traditional financial accounting, many climate-related social projects may not fit the risk-return profile of many investors.[47] All told, this lack of accounting clarity means certain

communities will be disadvantaged, although it is impossible to say exactly who and where; the same can be said for gauging losses and other social impacts because of climate change.[48]

A lack of climate accounting standards also creates openings for asset owners and investors to overstate the climate-related benefits of their projects or financial assets, a practice often referred to as greenwashing. Without such transparency and controls, investors who want to promote mitigation or resilience may see their financial capital channeled to suboptimal projects.[49] Even worse, the lack of standards makes the policing of greenwashing—whether by private investors or government staff—extremely difficult. For example, the U.S. Treasury Department has stressed the need for information integrity to allow voluntary carbon markets to work effectively.[50]

Photo credit: Shutterstock

PAIN POINT 2: THE CURRENT INFORMATION ENVIRONMENT DISADVANTAGES SMALL ACTORS

Climate data is a growing field, with rapid improvements and the near-constant introduction of new products for tracking environmental risk, emissions, sustainable investment opportunities, and more.[51] Yet there are real barriers to acquiring and using this data, including financial cost, data management expertise, and the knowledge to understand each product's advantages and disadvantages. That kind of business environment inherently favors larger companies, investors, local governments, and research institutions that can commit the human and financial resources to put climate data to use.

The reverse is also true: small actors face additional hurdles to accessing and applying climate data to their respective activities—and there are multiple examples of how this disadvantage plays out within specific sectors. There are millions of homeowners and commercial property owners, most of whom are relatively small actors. Delivering information across a fragmented and decentralized sector with widely varying capacity across owners is challenging. One example is property-level climate risk data; insurance companies, mortgage lenders, and large corporate real estate firms have the financial resources and staff to purchase and analyze this data, while homeowners and small commercial property owners do not.[52] Likewise, it has been difficult to communicate the climate considerations and current federal discounts around heat pumps to homeowners and the country's many small companies that install heating, ventilation, and air conditioning systems, which limits uptake of this potentially energy- and cost-saving technology.[53]

BOX 2

Enterprise Resilience Academies[54]

THE CHALLENGE

Retrofitting apartment buildings that serve low-income renters to provide more resilient, energy-efficient homes poses stiff challenges. This housing segment is characterized by highly fragmented ownership, making it difficult to provide guidance on resilience strategies at scale. Low-income rental buildings are often older, in poor physical condition, and have urgent needs for energy-efficiency and resilience retrofits.[55] These buildings house some of the nation's most vulnerable households: people with low incomes and almost no savings—including families with children, older adults, and people with disabilities—who have extremely limited housing options. The properties operate on narrow financial margins. Unlike market-rate apartments, owners of subsidized housing face programmatic limits on raising rents, which also makes it difficult for lenders to underwrite loans for major upgrades. Some public subsidies and philanthropic funds exist to cover capital improvements, including green retrofits, but these funds are not always easy to find or access.

WHAT RESILIENCE ACADEMIES DO

In 2021, Enterprise Community Partners, a national nonprofit organization, launched a series of Resilience Academies to help owners, property managers, and developers of affordable housing learn about strategies to increase the climate resilience of low-income housing.[56] Each Resilience Academy has brought together a regionally based cohort of affordable housing providers—including nonprofit organizations, public agencies, and for-profit firms—for several weeks of in-person training sessions. The curriculum covers a range of topics, including:

- Assessing portfolio risk
- Ensuring continuity of operations during and after natural disasters
- Building new and resilient home constructions
- Retrofitting existing homes
- Understanding local laws and regulations
- Engaging community
- Securing funding and financing

The geographic grouping has allowed the training sessions to focus on climate risks that are similar across each cohort. For instance, hurricanes have been a primary concern to organizations across the Southeast and Gulf Coast academies, while wildfires have been a chief concern among Rocky Mountain participants. Sessions have included presentations from subject matter experts, supplemented by an extensive set of written training materials.[57] The in-person gatherings also have supported peer-to-peer learning and networking among similar organizations.

BOX 2 CONTINUED

OUTCOMES

Between 2021 and 2023, Enterprise Community Partners completed five regional Resilience Academies—respectively located in the Southeast, Gulf Coast, New York, New Jersey, and Rocky Mountain regions—attended by over 150 participating organizations.[58] To better understand the outcomes and effectiveness of the Resilience Academies, the organizer has contracted MEF and the Institute for Sustainable Communities to conduct an evaluation.[59]

LOOKING AHEAD

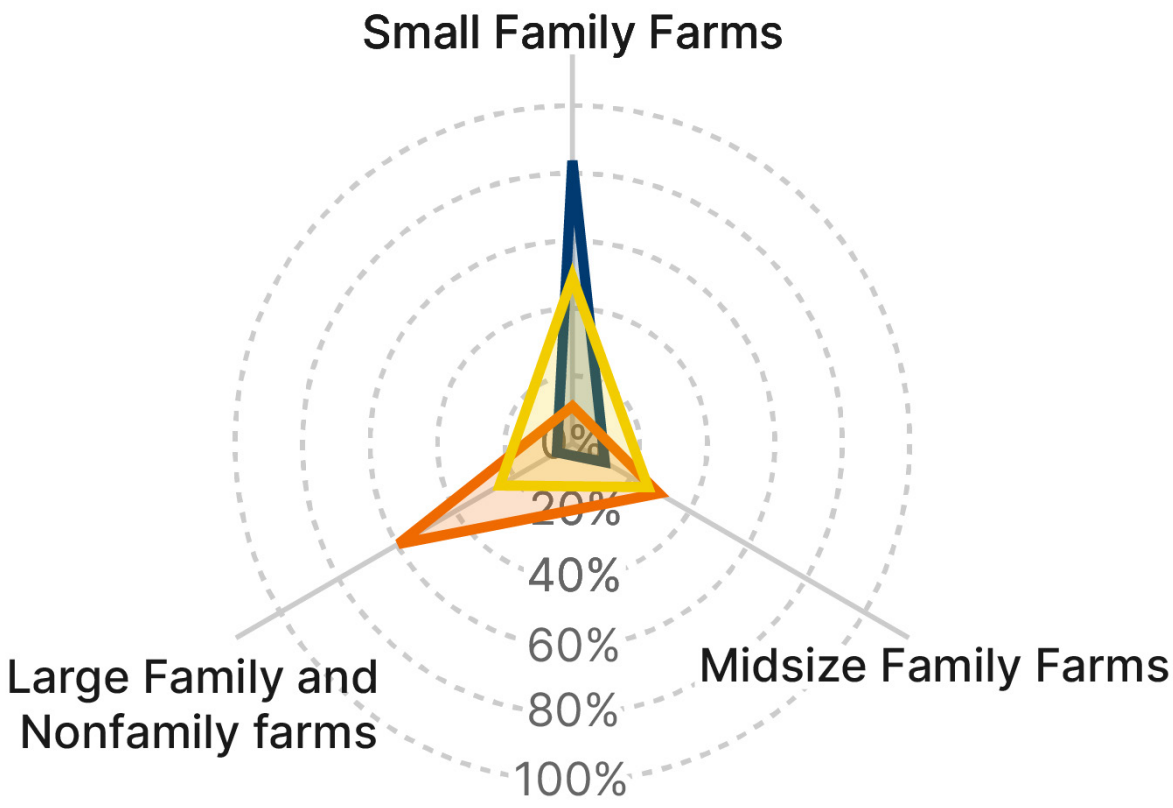
The Resilience Academies are a promising approach to overcoming the dis-economies of scale that result from fragmented property ownership in the affordable housing market. The small-cohort model creates more efficient training methods than trying to do one-on-one outreach to individual property owners, while also creating the opportunity for peer-to-peer learning. On the other hand, keeping each Regional Academy small enough to allow in-depth learning implies that Enterprise Community Partners will need to conduct many separate academies to reach a substantial share of affordable housing providers. In-person trainings are necessarily resource intensive (especially given the need for subject matter experts to teach). The supplemental materials, including online videos and written training guides, are publicly accessible and offer another channel to increase the scale and reach of the program.

Photo credit: Shutterstock

Agriculture is another industry with significant variation in actor size. While small and midsized family farms represented 95% of all U.S. farms in 2021, they produced only 36% of all agricultural value.[60] It will be much harder for agriculture-focused agencies, private lenders, and companies to reach smaller farms and communicate how climate-related risks could impact their businesses or how upfront capital expenditures—for investments like upgrading their equipment—could lead to long-term cost savings and environmental benefits. Even if small farms understand the need for climate improvements, their historically low profit margins make it challenging to afford high upfront costs.[61] Figure 6 below reaffirms just how important—in number and total assets—small farms are in the U.S.

FIGURE 6

Distribution of U.S. farms, value of production, and farm assets



SOURCE: U.S. Department of Agriculture (USDA), Economic Research Service and USDA, National Agricultural Statistics Service, 2020 Agricultural Resource Management Survey (data as of December 2021).

NOTE: Details may not add up to 100 percent due to rounding. Small family farms include those farms making $150,000 per year or less. Midsized family farms here refers to farms making between $150,000 and $999,999. Large family and non-family farms refers to farms making at least $1 million or farms where an operator and persons related to the operator do not own a majority of the business.

PAIN POINT 3: LIMITED GOVERNMENT CAPACITY INCENTIVIZES NEGATIVE OUTCOMES

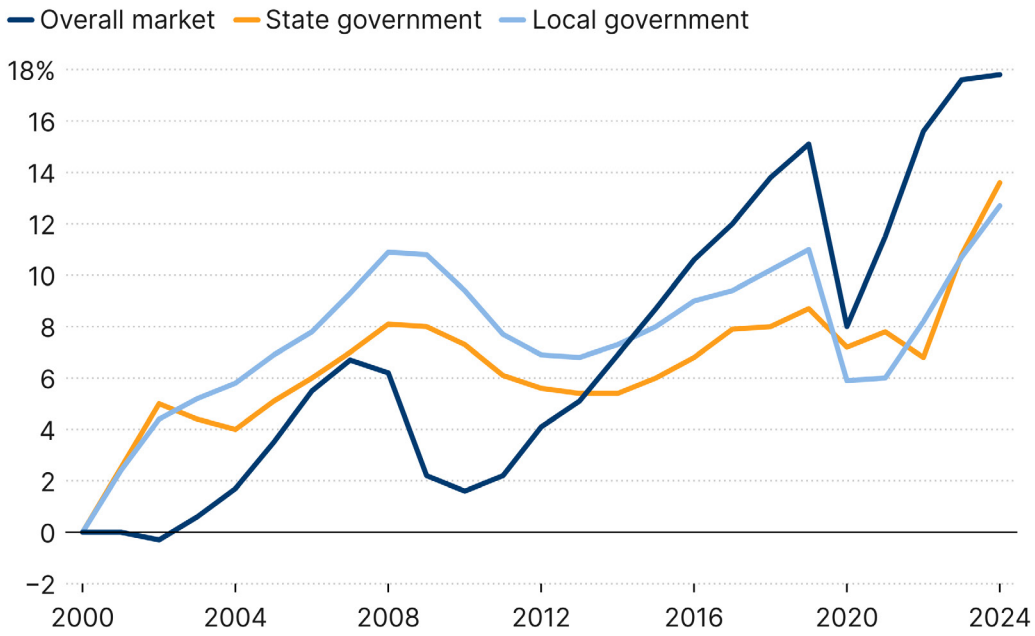
Local, state, and federal government staff are involved in all the major economic sectors that need to physically transform to address climate change. Government staff ensure regulatory compliance, amend laws where necessary, and serve as mediators (and collaborators) between civic groups and asset owners. When the public sector is also the asset owner—in cases like water utilities, transportation networks, and many buildings—staff must also be knowledgeable around engineering and fiscal affairs. All those tasks require a mix of process expertise and climate knowledge. For example, many large cities with deep benches of environmental planning staff have developed—and refined—climate action plans with detailed inventories of projects, investment needs, and funding sources.[62] Such plans are essential for keeping projects moving and financing flowing.

Yet after decades of underfunding, many public agencies are not prepared to manage more climate-focused projects, let alone to embed climate equity considerations into their financing, construction, or long-term maintenance and operation plans. Local government employment did not recover to pre–Great Recession levels until 2024, and state employment did not do the same until 2023 (see Figure 7).[63] Nor is the playing field even; many of the country's smaller municipalities or those facing specific economic disadvantages are especially short on labor. But compounding the issue is a much more specific problem: a lack of expertise working on climate-related projects, whether that entails understanding technical elements or how to score their fiscal impacts.[64]

FIGURE 7

Change in U.S. employment, including local and state government

2000-2024



SOURCE: Brookings' analysis of the Bureau of Labor Statistics' Current Employment Statistics Survey

NOTE: Value is based on annual average employment per year. National employment is series ID LNS12000000, local government is series ID CES9093000001, and state government is series ID CES9092000001A.

One of the most common examples is how inadequate staffing limits the predevelopment of best-in-class, publicly owned projects. Predevelopment is the catch-all term for the activities required to prepare a project for financing and construction, including engineering and alternatives analysis, permitting, and advance procurement.[65] While predevelopment is a relatively small share of a capital project's total costs, research regularly finds that the pace and quality of predevelopment activities have an outsized influence on which projects advance.[66] Poor predevelopment either raises costs by prolonging the time needed to deliver a project or—even worse—by causing promising projects to never be constructed.

Predevelopment can be a challenge for a variety of resilience projects.[67] Planners and other practitioners lack consistent definitions and data for climate resilience that can limit the pursuit of different projects, as is particularly the case for green infrastructure projects (such as rain gardens) that may have unfamiliar designs or may require different types of inputs and materials to complete. The varying scale of these projects—from a property level to neighborhoods to whole regions—can further compound these difficulties in planning and can require an appetite for experimentation that many government bodies—and potential private partners, including contractors—may not always be willing to entertain.[68] While planning and technical assistance grants can help local governments consider different types of projects, including in many water systems, there are still enormous cost, staffing, and information barriers.[69]

By contrast, limited staff knowledge can make it easier for maladaptive projects to advance, creating the potential for negative externalities for vulnerable groups or regions. For example, approving buildings and infrastructure to be constructed in hazardous areas is a direct reflection of staff either not understanding the climate-related risks or choosing to ignore them in pursuit of short-term goals. In Texas, for instance, the Department of Transportation is planning to expand Interstate 35 by eight lanes, in addition to pursuing several other roadway projects. These expansions are projected to generate millions of additional vehicle miles traveled, lead to substantial increases in carbon emissions, and contribute to several other potential environmental impacts on communities.[70] Yet, despite these impacts, such projects continue to move forward.[71]

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Pricing challenges

Price signals are one of the most powerful instruments that market economies use to motivate private investment. Under ideal market conditions, prices would steer capital flows to the kinds of physical assets that support environmental sustainability, wealth-building opportunities for all households, and profitable businesses.[72] As of now, though, market conditions are far from ideal.

It is easy to find flawed pricing across multiple goods and services. Fuel prices do not yet fully account for the cost of a vehicle's emissions. Insurers, homeowners, and state regulators cannot agree on acceptable property insurance premiums due to disagreements around risk. Energy utilities continue to use a regulated pricing model that over-incentivizes constructing new power plants over other alternatives. Federal subsidies on certain types of fertilizers, such as nitrogen and phosphate, are nudging farmers to continue to overuse chemicals whose manufacturing contributes to substantial GHG emissions.[73]

When prices are misaligned, investors and asset owners receive the wrong signals about what projects to develop. Rates of return from traditional accounting methods do not reflect true social value; higher-polluting projects often are undertaken without considering the costs of that pollution, and the future cost savings from adaptation projects often do not figure into project accounting. America simply does not have the right prices for the era of climate change, and this distorts many private investment decisions.

PAIN POINT 4: CLIMATE-RELATED BENEFITS AND COSTS ARE UNDERPRICED, PARTICULARLY DUE TO A LACK OF ESTABLISHED COST-OF-CARBON METRICS OR SIMILAR MEASURES

The single most frequent complaint about climate pricing—both in the literature and from expert interviews—was domestic markets' inability to formally capture positive and negative externalities. And for good reason: in the face of rapidly changing environmental conditions, many production and consumption activities within the major economic sectors have created a seemingly endless stream of ancillary benefits and costs to society and the natural world.

It would be impossible to list all the examples of climate-related externalities, but many are already mentioned in this report. Property developers and prospective buyers fail to understand the risks of building in high-hazard neighborhoods. Communities located near high-polluting manufacturing and transportation facilities publicly and privately bear higher health costs.

BOX 3

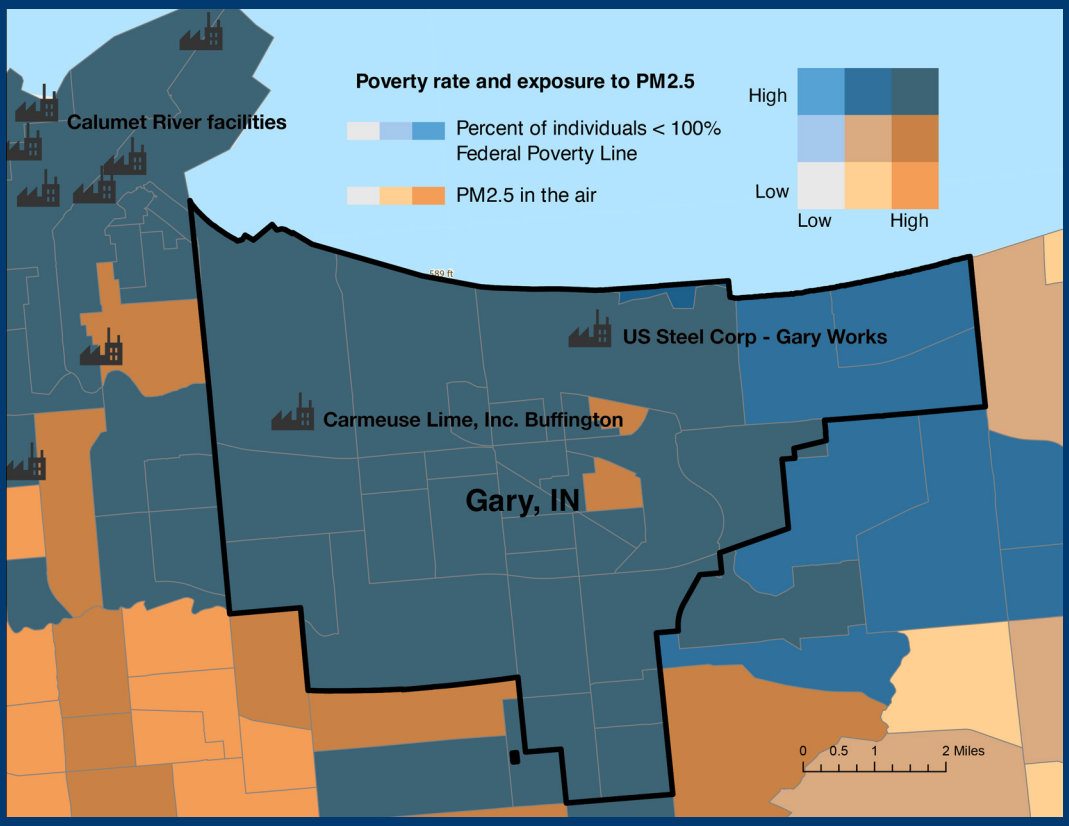
Addressing climate equity challenges in Gary, Indiana

Many U.S. communities face the twin threats of economic disinvestment and environmental degradation. But Gary, Indiana, is one of the most notable examples given its historically disadvantaged population and concentration of high-polluting industrial facilities (see Map 3).

Gary's industrial might—and subsequent decline—are closely linked to steel production. As a center for U.S. Steel, Gary Works is the company's largest manufacturing plant with a steelmaking capacity of 7.5 million net tons.[74] It is also one of the highest emitters of nitrous oxide, soot, and other pollutants, amounting to 10 million tons annually.[75] That is equivalent to the emissions of almost 2.4 million gas-powered vehicles annually.[76] Similar to other Rust Belt cities, Gary lost jobs and population over time due to shifting demand, globalization, and technological changes in manufacturing. For example, Gary Works employs about a tenth as many workers (3,700) as it did at its peak (30,000).[77] The city's population (68,000) is also less than half of its peak population in 1960 (178,000), and nearly a third of all residents now live below the poverty line.[78]

MAP 3

Poverty rates and exposure to particulate matter 2.5 in Gary, Indiana
2022



SOURCE: U.S. EPA FLIGHT and Climate and Economic Justice Screening Tool

BOX 3 CONTINUED

The combination of high poverty rates and high levels of particulate matter contribute to some of the most serious environmental justice concerns nationally. Public health assessments from the EPA and other groups have shined a light on the city's hazardous air pollution, including especially high asthma rates.[79] Additional soil and water contamination have not helped either, with polluted runoff and sewage overflow leading to exposure to water-borne illnesses.[80] The nearby Calumet River, which winds through Illinois, also houses several industrial facilities along its banks; steel and chemical manufacturing as well as other emissions-intensive production there contribute to additional air and water pollution throughout the region.[81]

The city's industrial past, present, and future point to the need for even more coordinated investment among both the polluter and the polluted.

Moreover, since more than 80% of Gary's residents are Black, the city is emblematic of the disproportionate pollution borne by low-income people and communities of color, with deeply entrenched legacy costs.[82] A dwindling tax base unable to pay for needed infrastructure improvements makes it even harder to come up with new solutions, including remediation and job training grants.[83] Nor is Gary alone. Other local governments across the country are struggling to plan and pay for upgrades—or effectively coordinate with their private industry partners on needed facility improvements and cleanup efforts.[84]

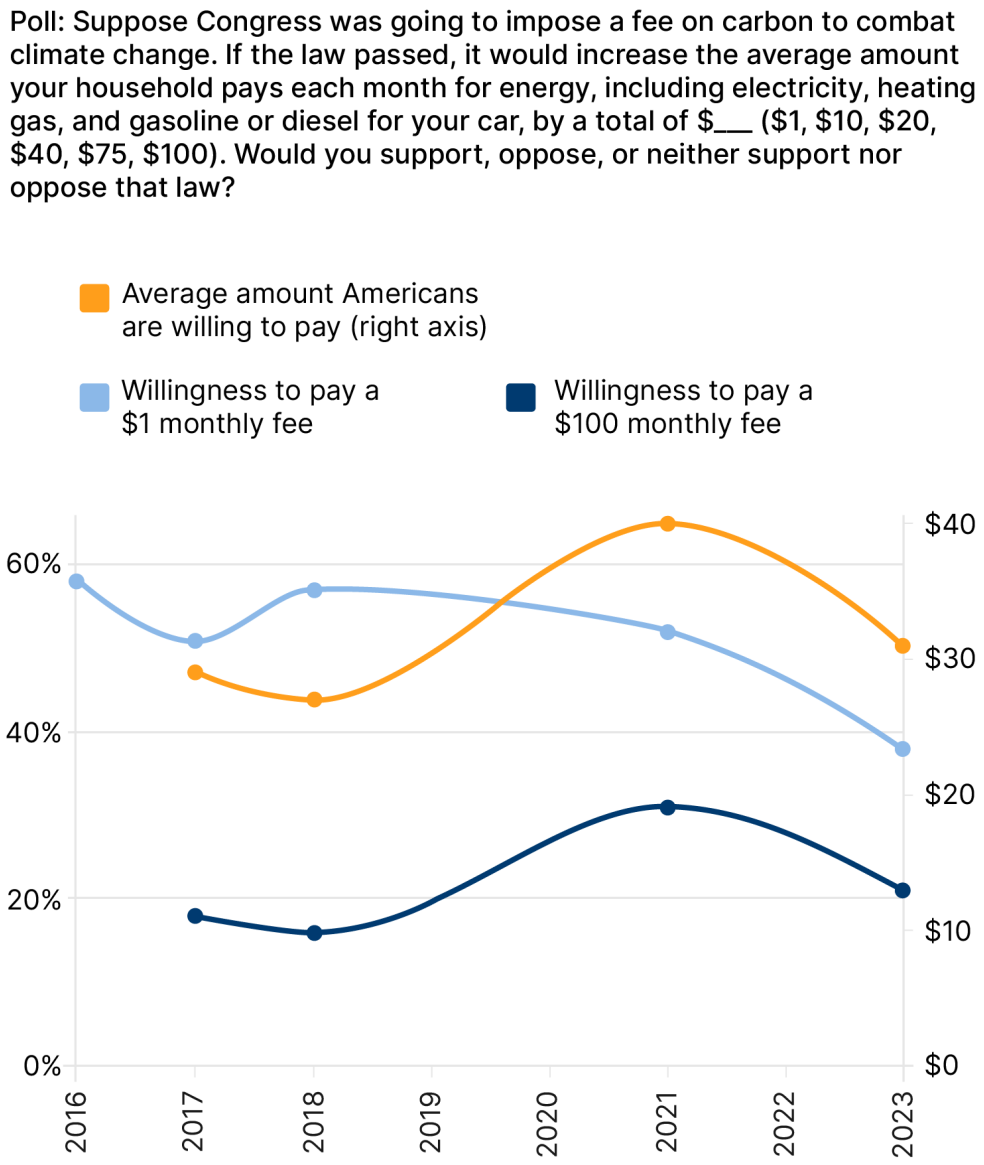
Public and private sector leaders recognize the severity of Gary's long-standing environmental justice challenges, many of which are further intensifying amid climate change. On the one hand, federal regulators have designed interventions aimed at industry, like more stringent regulations to reduce toxic emissions. Other federal funding from the IIJA and IRA aims to steer more resources toward community-owned solutions, including a variety of infrastructure improvements and environmental justice needs.[85] For instance, the state of Indiana secured $127 million in new federal transportation funding to help improve pedestrian safety and reduce congestion (and related pollution) on the nearby Borman Expressway.[86] In addition, the state of Indiana, working in concert with local leaders, has developed new climate action plans to identify pressing environmental justice concerns, better harness new federal funding, and target assistance.[87] U.S. Steel, for its part, has pursued plant upgrades and installed new carbon capture technologies to reduce pollution and other climate impacts.[88]

But despite the emergence of new plans and investments, the scale of Gary's challenges demands more sustained funding and financing. The $150 million carbon capture upgrade by U.S. Steel, for instance, is only projected to capture 0.5% of the plant's annual emissions, and additional technological upgrades (or outright replacements) are likely needed for the plant's aging blast furnaces.[89] Cleaner hydrogen-fueled furnaces can cost $1 billion or more.[90] In isolation, these industrial updates do not address all the various public health and economic concerns that continue to hit residents across the city either. Proactively identifying and addressing these climate equity needs remains an ongoing task for Gary, which cannot afford to tackle every need by itself. The city's industrial past, present, and future point to the need for even more coordinated investment among both the polluter and the polluted.

Economists, regulators, and even some private sector leaders have long argued to use pricing policies to address such market failures.[91] One option is pricing the externality—the sticks approach—like cap-and-trade schemes (see Figure 8). Another option is public incentives to promote beneficial activities—the carrots approach—like many of the tax credits within the IRA. The ideal carrot or stick policy would use an agreed-upon set of prices to reflect the social and environmental returns from a project, including metrics like the cost of carbon for emissions-reducing projects.[92]

FIGURE 8

Willingness to pay a carbon fee over time in the U.S.



SOURCE: Data from the Energy Policy Institute at the University of Chicago poll report, "Americans' Views on Climate Change and Policy in 10 Charts," (April 2023).

Adopting formal pricing policies is challenging, though. Even with ample evidence about the positive impact of pricing policies, like the trading allowances adopted under the national Acid Rain Program, political trepidation among elected officials and dissatisfaction among voters can easily spook legislators and regulators, whether due to fear of raising prices or concern over offering giveaways to preferred industries.

In the absence of formal pricing policies, developers of large climate projects often use stopgap, noncomprehensive solutions. One of the emerging instruments is first-loss capital, in which impact investors like philanthropic organizations, pension funds, and traditional banks effectively cover the difference between traditional projections of a project's profitability and the potential social returns; said differently, the impact investor pays to cover lower expected returns.[93] Yet impact investing is subject to the whims of the owners of capital; they can just as easily change their preferences, as recent public debates around ESG policies have exposed.[94] Another example is state or local green banks, which leverage their public ownership to offer lower financing costs for eligible projects. Yet green banks do not exist in every state, which effectively gives an advantage to certain states and local communities that tend to be wealthier from the start.[95]

The lack of formal pricing policies negatively affects household and business consumers, too, particularly in terms of how they measure the affordability of different products and services. The sticker price of electric vehicles (EVs) is higher than that of gasoline-powered vehicles, but that is partially because there is no way to monetize the future lower costs of energy and reductions in GHG emissions. Homeowners only see the price to weatherize their homes, but financial instruments could help capitalize future savings. Similar price distortions can even exist among industrial producers, who will need lenders to see financial upsides to new technologies that reduce GHG emissions. Without access to such climate-scoring capital, firms may instead opt for cheaper, business-as-usual fixes.

PAIN POINT 5: CURRENT FINANCING MODELS OFTEN PREFER GHG-EMITTING PROJECTS THAT USE ESTABLISHED TECHNOLOGIES

There are structural reasons for built environment investors to have a relatively risk-averse approach to what they finance. Since the results of capital investments often last for decades—and have the high upfront construction costs to match—typical financing deals last for years, if not decades. Lenders want deals where they have a high degree of confidence that the project will work as intended and that the developer can regularly repay its debt over long time periods. Steady, lower rates of return are the typical model.[96]

That kind of financing environment inherently favors projects using well-established technologies and asset owners with well-established credit. Those are understandable decisions for investors and the financial institutions that put together deals; many hesitate to finance a first-of-a-kind project. And it is especially understandable when market prices fail to signal to investors and financial institutions that asset owners that reduce an industry's carbon footprint are both better for the planet and more likely to be economically competitive in the long run.[97] The term most frequently used among insiders is bankability: emissions-saving projects typically do not have a bankability advantage over higher-polluting projects.

This is certainly the case in many manufacturing industries that make products like chemicals, cement, textiles, and steel. Even with increased investment in new technologies, new production processes, and ultimately new goods, the reality is that most U.S. consumers rely on widely available and emissions-intensive goods that tend to be cheaper. Whether in the case of single-use plastic goods or less durable fabrics, consumers do not internalize the climate costs associated with such products, especially with the lack of consistent carbon pricing schemes.[98] Changes in production processes and products are possible, but financing the additional costs associated with their adoption is a challenge.

The energy industry suffers from different structural pricing issues. Renewable sources of electricity, like wind and particularly solar, are among the cheapest sources of electricity today, and they are experiencing an investment boom, with the IRA as a driver. However, because these sources are available on nature's schedule rather than the energy sector's schedule, there are additional costs for electricity storage to ensure that power is available when firms and people need it.[99] The U.S. now needs a similar boom in storage and long-distance transmission to take maximum advantage of renewables, but transmission projects frequently run into local opposition and are thus difficult to finance and build.

PAIN POINT 6: INSURERS, COMMUNITIES, AND OTHER PARTNERS ARE NOT YET CAPTURING REVENUE STREAMS TO ACCELERATE ADAPTATION PROJECTS

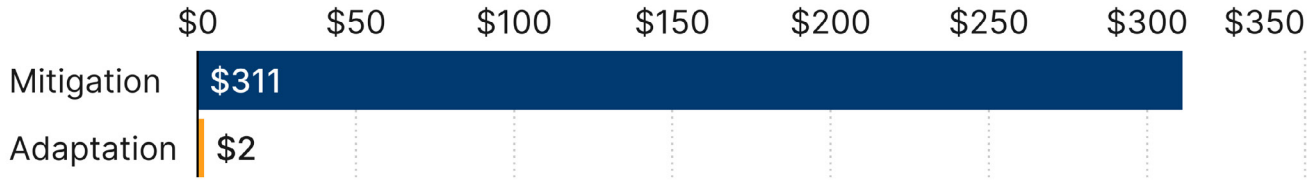
Adaptation projects are, for now, far harder to finance than mitigation projects. The core issue is a lack of revenue—or agreed-upon cost savings (revenue by another name)—associated with adaptation.[100] Such projects aim to reduce future damage via greater environmental resilience, like building a seawall for protecting citywide property or adding air conditioning to reduce emergency medical events during prolonged, extreme heatwaves. But avoiding future damage is not the same as creating new, present-day revenue—and investors need long-term revenue streams to finance projects.[101]

This structural challenge is clear within investment data. Many financial institutions continue to favor tried-and-tested decarbonization projects, including clean energy technologies and other improvements, as opposed to more nascent adaptation projects focused on flood reduction, wildfire protection, and other upgrades.[102] Globally, only about 1.6% of adaptation investment comes from the private sector, even though this market could be worth up to $2 trillion in the coming years.[103] Estimates for the U.S. alone comparing total private investment in mitigation and adaptation are harder to come by, but combined estimates for North America show a similar lag. In 2021 and 2022, $311.2 billion in private investment went toward mitigation projects—or more than 99% of all private climate investment—compared to nearly $2 billion for adaptation projects (see Figures 9 and 10).[104]

FIGURE 9

Total private finance flows for climate mitigation and adaptation in the U.S. and Canada

In billions of dollars, 2021-2022

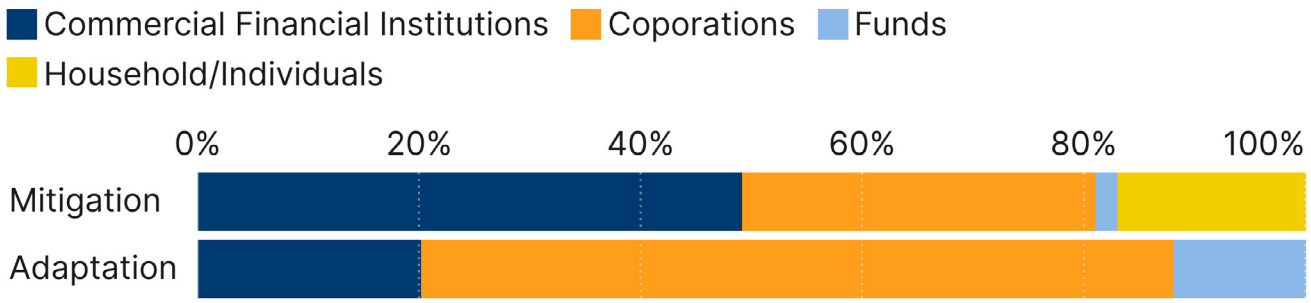


SOURCE: Brookings' analysis of Climate Policy Initiative data.

FIGURE 10

Total private finance flows for climate mitigation and adaptation by investor type in the U.S. and Canada

2021-2022



SOURCE: Brookings' analysis of Climate Policy Initiative data.

Instead, governments and insurers wait until damage occurs and then fund rebuilding efforts. Particularly in the case of government insurance—whether through a formal program like the National Flood Insurance Program or emergency spending authorized by legislators—the proceeds will disproportionally flow to the wealthiest households and businesses (since they experience the greatest on-paper losses) while socializing the long-term repayment burden.[105]Asset owners have come to expect such public interventions, setting up a clear moral hazard. Low-income communities are often the most at-risk, and their residents are less likely to be able to afford insurance.[106]

This dilemma is currently playing out in the country's real estate markets. Federal, state, and local elected officials are wary of allowing, let alone requiring, the prices or availability of mortgages and insurance to reflect variations in climate risk, especially in owner-occupied homes.[107] The net effect is to underprice long-term, serious financial risk for both property developers and owners in neighborhoods facing greater likelihood of storm surges, wildfires, or other extreme weather events.

Local governments that own transportation and water assets face similar issues. Municipal bond markets do not have clearly established methods to account for future costs avoided, limiting local governments' and water utilities' ability to prioritize private financing of innovative, resilience-focused projects. Water utilities, for instance, are increasingly running up against tight budgets, debt obligations, and other barriers to investment as user charges, municipal bonds, and traditional financing tools fail to keep up with the level of need; the pace of needed repairs and replacements often exceeds the ability of utilities to test new designs and technologies, even if these improvements result in cost savings over time.[108]

Photo credit: Shutterstock

Governance challenges

The American public is well aware of how contentious climate change is within national politics. Even though polls now consistently find that most U.S. residents believe that human-caused climate change is occurring, there are enormous splits, especially over causes and implications, across partisan affiliations at the individual, community, and state levels.[109] Advertisements by stakeholders on each side of the issue ensure that media consumers hear stridently different opinions on issues like oil drilling and sustainable farming.

Yet in a federal democratic system like that of the U.S., political contention can quickly translate into governing dysfunction. Whenever elections cause a switch in partisan control—from a mayoral office or city council chamber up through the presidency and Congress—newly elected officials will be tempted to revise the climate-related laws and regulations their predecessors adopted. Regardless of their prior assumptions, elected officials are also lobbied hard by each side to adopt more or less stringent environmental laws. Permitting issues have increasingly attracted more attention among project developers and policymakers, for instance. And with local, state, and federal government units all having their own authorities, it is easy for climate-related policies to compete against one another.

All these governance challenges combine to create a high-risk environment for private investors. It is simply more expensive to put together project financing when rules are excessively complex and could change in unpredictable ways.

PAIN POINT 7: FRAGMENTED POLITICAL AUTHORITY OVER PROJECTS OFTEN LEADS TO CLASHES, CREATING UNCERTAINTY AMONG PRIVATE INVESTORS

The U.S. federal system allows localities and states to operate as "the laboratories of democracy," where new ideas are tested and, in principle, where good ones can spread and scale.[110] In climate policy, states like Washington and Massachusetts can implement more aggressive carbon reduction strategies than other states with different political leanings or resources. But with the need to reduce emissions everywhere, patchwork policies make it harder to deploy private financing in all, and increasingly in the most, in-need locations. The variety of climate impacts hitting different regions and the fragmentation of where climate investment occurs can further stress how different policies (and projects) emerge. For instance, the distributed nature of many resilience projects, including networks of rain gardens and other green infrastructure, make it hard for multiple jurisdictions to coordinate.

Regulating emissions is one area of legal contention between levels of government. For example, California has long had authority to set air quality standards that exceed those in the federal Clean Air Act. Other states have the option of opting into the California program. This authority extends to the Corporate Average Fuel Economy standards, which regulate fuel economy and GHG emissions for new vehicles sold.[111] An uneven regulatory environment seeds uncertainty among automakers and their long-run capital plans, and the federal government has worked with California to establish consistent standards.[112]

Real estate markets suffer from a different set of regulatory and policy complexities, with each level of government having distinct yet interacting responsibilities. The federal government regulates mortgage markets for owner-occupied residential properties. State governments oversee property insurance for both residential and commercial real estate. Local governments regulate land use, construction, building performance, and safety. Finally, some financing for commercial real estate is regulated by federal and state banking regulators concerned with banks' safety and soundness. Local control over land use results in wide variation among places with regard to where structures can be developed, what the quality of buildings can be, and who will be responsible in the face of environmental damage.

PAIN POINT 8: PUBLIC DEBATES HAVE STRUGGLED TO BALANCE THE NEED FOR NEW CLIMATE INVESTMENTS WITH THE ONGOING DEMANDS TO FINANCE ESTABLISHED ECONOMIC ACTIVITIES WHERE CLEAN TECHNOLOGIES ARE NOT YET AVAILABLE

Too often, America's climate change debates have framed the speed by which the country makes climate investments as a binary choice. On the sustainability and resilience side, advocates of green policies argue in favor of eliminating GHG-emitting activities and boosting resilience immediately or else risk facing debilitating economic and environmental losses everywhere. The opposing view frames clean energy and resilience mandates as ways to quickly bankrupt companies and communities.[113] These arguments are overly reductive, missing critical nuances in the phasing and location of climate-related project financing as well as the potential for co-benefits from investments in climate-resilient infrastructure and renewable technologies.[114]

An example of this pain point comes from the oil and gas industry. Even if the entire country agreed on an aggressive vehicle- and home-electrification strategy—which is not the case in 2024—the economy still needs investment in oil and gas. Oil and gas are needed for use in sectors as they transition and for some uses that may never transition, such as feedstocks for chemicals.[115] The entire national economy needs working refineries, pipelines, and similar capital assets to ensure adequate supply and prevent damaging price spikes. Nor is technology yet ready to transition some industries away from fossil fuel use, particularly seaborne trade and aviation.

BOX 4

Remaking America's fueling infrastructure

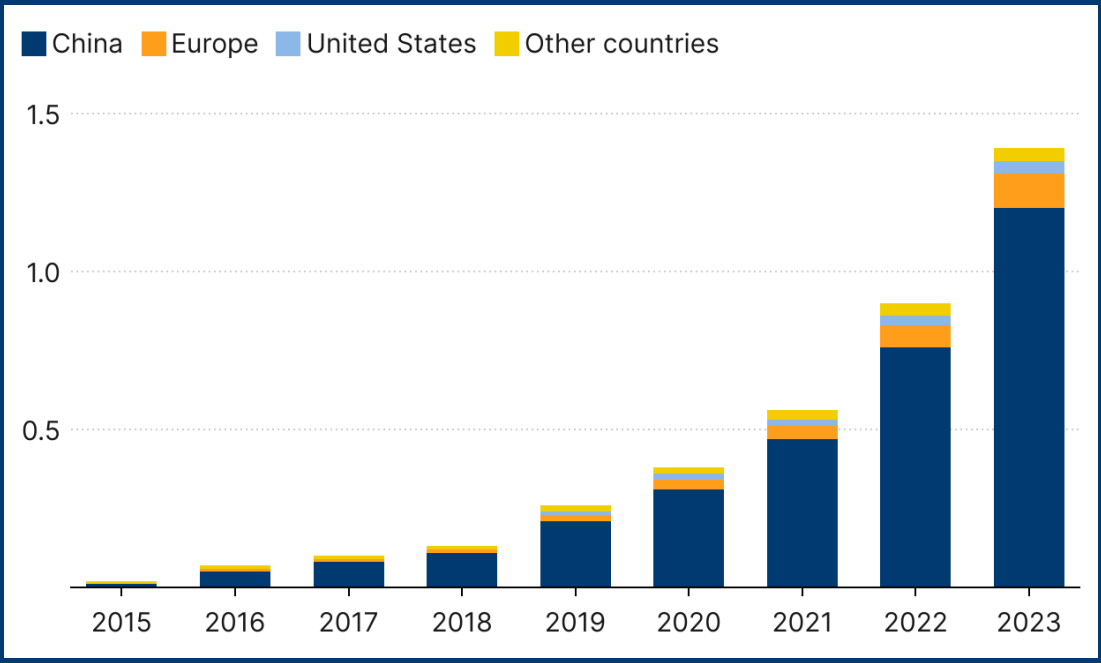
Gas stations are synonymous with America's automobile age—and for good reason. Over 111,000 gas stations were open for business across the country in 2020, and they employed almost 1 million workers.[116] Yet for all their convenience in terms of keeping cars on the go and satisfying snack cravings, today's gas stations are ill-equipped to fill the same role in the EV era. It currently takes longer to charge an EV battery than it does to fill a gas tank. Many households will prefer to refuel their EVs at home. With so many gas stations in every community, America needs a grand rethink around the quantity, design, and financing of vehicle fueling infrastructure.

One massive set of questions revolve around what to do with all the current stations. Many will close due to less demand, but serious environmental remediation will be needed to safely prepare the land for future development.[117] Municipalities and even states will want to know who is financially exposed to the business losses, what properties can self-finance their redevelopment (like those at high-demand intersections), and where the public may need to intervene.

The other major area of need is how to deploy charging infrastructure at scale. While the public sector is leading some investment—most notably through $7.5 billion in federal funding through the IIJA—financial markets are a more dependable, long-term capital source. As it stands, the U.S. trails Europe and China in terms of fast, public charging installations and public charging capacity per vehicle (see Figure 11).

FIGURE 11

Publicly installed, accessible charging points for light-duty vehicles
Fast chargers only, million of charging points



SOURCE: Brookings' analysis of International Energy Agency data.

BOX 4 CONTINUED

Financing at scale, though, requires dependable revenue streams, and this is where information gaps become problematic. How many EV users will charge at home? What prices are people willing to pay to charge their EVs in public, and who should regulate the rates? What should be the relationship between electric utilities, charging station owners, and vehicle manufacturers? What station amenities are necessary to keep people occupied while their vehicles are charging—or will better battery technology keep current gas stations designs competitive?

Progress is underway. Banks, other consumer lenders, and even some utilities now offer products to help multiunit developers and homeowners install chargers. Current charging is helping providers collect a universe of data points on the customer experience. Companies, including startups, are testing EV charging stations designed from the ground up. As long as EV adoption keeps growing, investors and their partners are likely to keep trying new interventions to help answer these questions.

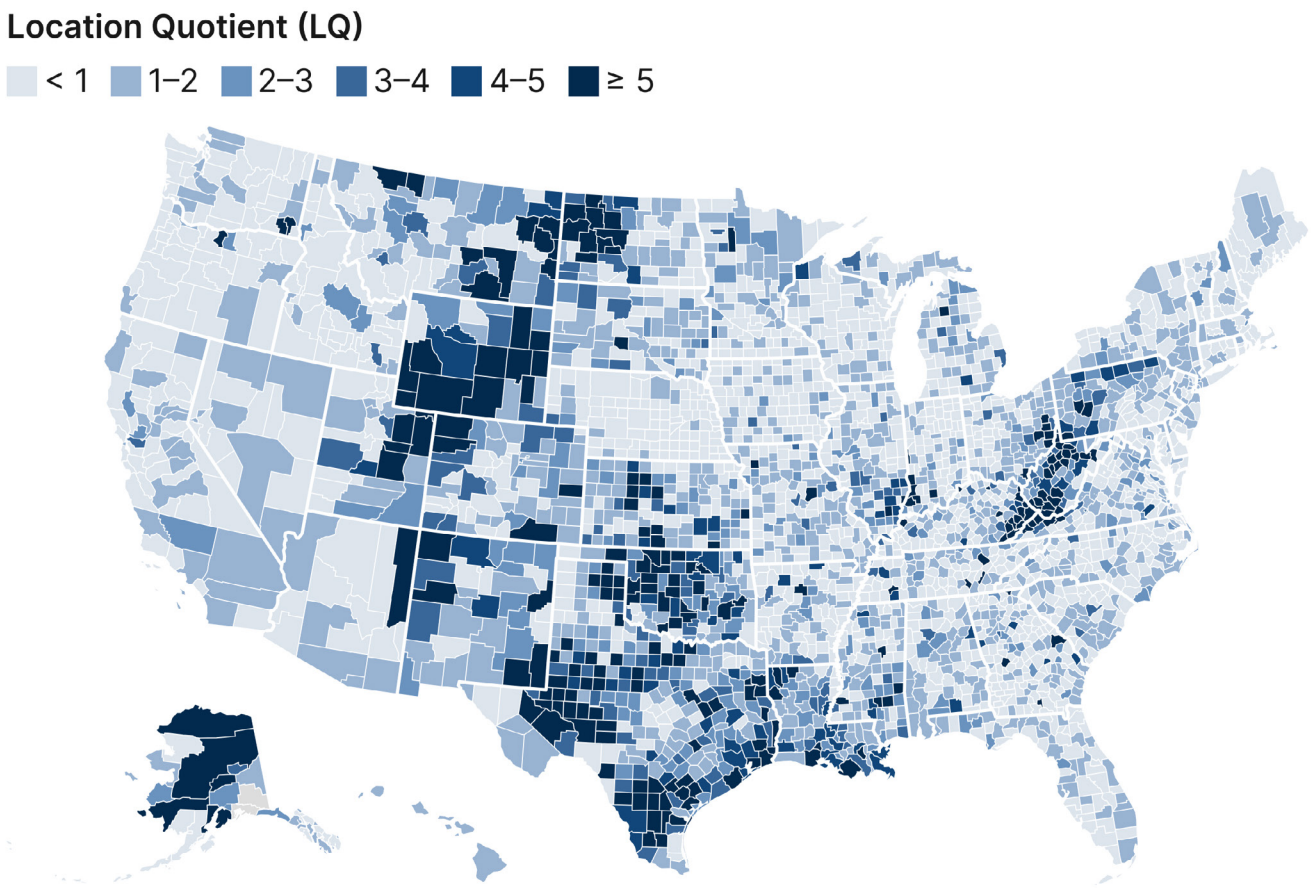
Photo credit: Shutterstock

Further complicating the debates are local equity issues around oil and gas production, especially since production is concentrated in certain geographic areas (see Map 4). While national sustainability advocates may argue for reducing oil and gas production, communities who host the facilities may argue in favor of keeping facilities operating since they are a source of steady, well-compensated employment. The political uncertainty around how to help such places transition—whether by offering alternative job opportunities (including jobs in clean energy industries) or by compensating residents for legacy pollution impacts—introduces significant risk into how oil and gas companies and their investors approach project planning and execution.

MAP 4

Concentration of fossil fuel employment by county

2023



SOURCE: Brookings' analysis of Lightcast data.

PAIN POINT 9: POLITICAL TIMELINES—WHETHER RELATED TO ELECTION RESULTS OR TERMS OF OFFICE—OFTEN MISALIGN WITH PROJECT DELIVERY TIMELINES

It will take decades to physically rebuild an American community that wants to pursue a clean and resilient economy. Yet that is not a timeline that aligns with terms of political office. Officials win elections by promising to solve problems, and they stay in office—or earn higher offices—when they have a clear record of achievement. Addressing climate change, then, becomes a vexing political problem: how does one convince elected officials to adopt programs that will not see results until years after they have left office? At the same time, these lengthier timelines for some projects do not always square with the reality for other projects, such as energy-efficiency upgrades, that may take less time; officials can use these time lags as an excuse for action as well. It is little wonder that elected officials are far more likely to deliver climate pledges than commit serious public dollars to build or finance projects.[118] This political short termism, or disinclination to act, in U.S. public life has sometimes been labeled not-in-my-term-of-office opposition.

Exacerbating the problem is the threat of policy reversals, like those from newly elected officials who oppose their predecessor's climate agenda. There is always potential for such new officials to unwind existing policies or adopt their own. This has already been the case across the last three presidential administrations, while shifts in congressional power threaten the IRA. Cities and states have seen similar swings after elections, and many lack the nongovernmental capacity to help support policy continuity.[119] Such political volatility introduces market uncertainty and volatility, forcing investors to question whether they should adhere to today's policy environment or imagine future scenarios.

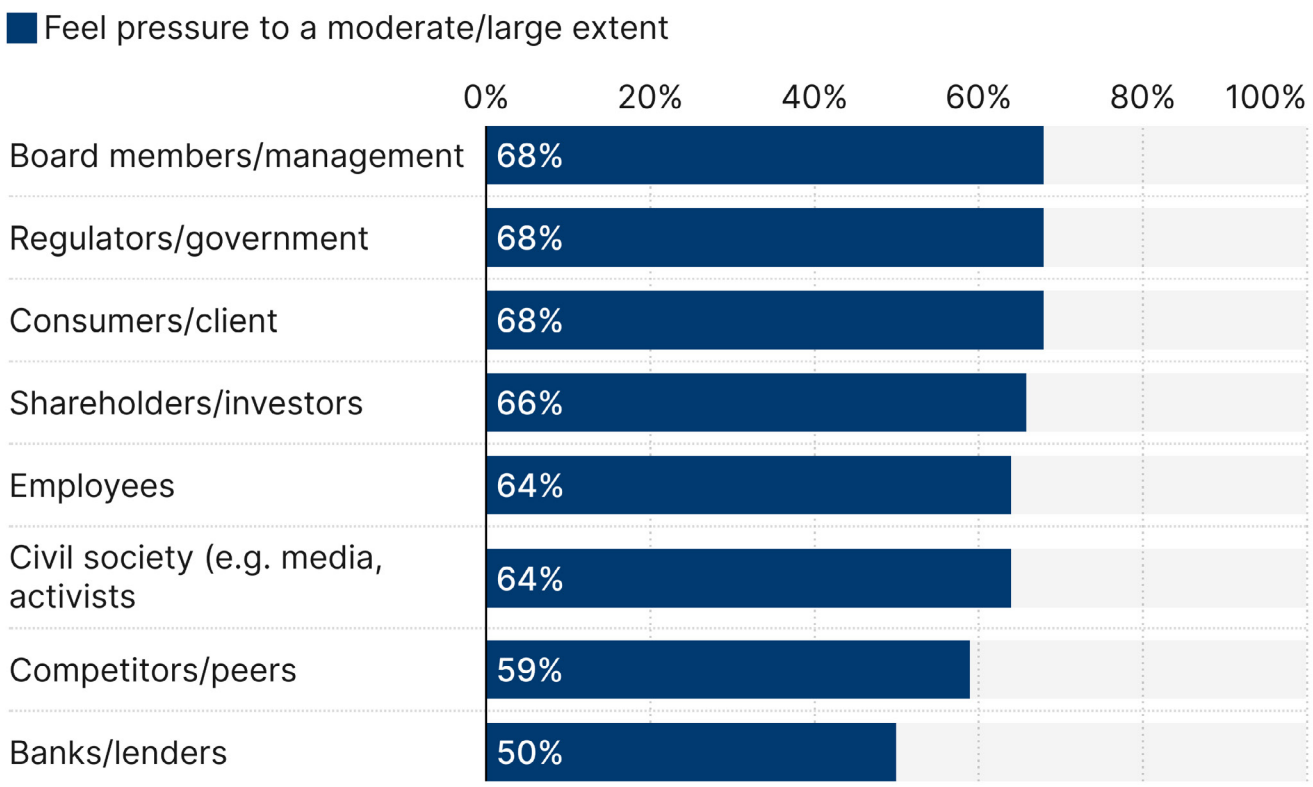
Combined, these factors amplify the need for public rules and policies that can stand apart from dramatic political swings. For instance, according to C-suite surveys, business leaders are stressing the need to consider climate needs impacting their companies over time. A total of 42% of CEOs believe that regulatory and political uncertainty is a top climate issue impacting their companies, and 32% of companies have taken action to incorporate climate considerations in lobbying and political donations (see Figure 12).[120] Meanwhile, 70% of investors see strong governance as a top priority when making a sustainable investment.[121] Concerns persist among these leaders that shifting political winds may also reduce (or reverse) support for climate programs jumpstarted by the IRA.[122] Companies around the world have a similar concern.

Photo credit: Sheila Fitzgerald / Shutterstock

FIGURE 12

Company CEOs around the globe feel pressure from a broad range of stakeholders

To what extent does your company feel pressure to act on climate change from your stakeholders?



SOURCE: Data from Deloitte, 2023 CxO Sustainability Report.

BOX 5

Implications of these climate policy pain points

These nine pain points underscore the level of action it will take to better align risk tolerances among project developers, private investors, and public officials. And just like climate change's inequitable impacts, the responsibility to respond will not be equitable among different actors and within different economic sectors.

Public officials will need to lead with courage and honesty. As the designated stewards of public goods—in this case, environmental stability and public safety—elected leaders and the civil service will need to make difficult decisions about what defines climate progress and will have to use those designations to inform policy reforms. There should be transparent debates about the costs and benefits of public actions that may increase tax burdens, whether such actions include subsidizing green energy or financially accounting for industrial firms' pollution impacts. In other cases, officials will need to explain to the public why certain people and places are receiving a greater share of public dollars, or why entire neighborhoods will no longer merit public investment to protect public safety. Those actions will not be for the faint of heart.

Those same public officials, industry leaders, and shareholders will need to find ways to work together to manage legacy businesses with poor pollution records. The urge among businesses with outdated technologies will be to fight regulations if these measures leave their intellectual property and physical assets stranded, whether that involves the gas station owner on the corner or a massive chemical-making facility. Compensating the industrial losers will be necessary at some level, but it cannot be so expensive that it impedes progress, whether in terms of addressing past harms or advancing investment in cleaner and more resilient projects.

All key parties must move past virtue signaling, too. Climate pledges do not reform regulations or bring capital off the sidelines. Instead, pledges can often provide cover for a government or company to say one thing and do another. The same goes for civic groups that earnestly call for significant capital investments but then refuse to say where the dollars will come from to build the projects and decline to engage in discussions about tradeoffs and other hard choices. Households must be ready to pay more upfront to build safer and more affordable communities for the future.

Finally, all stakeholders must do a better job monitoring progress in terms of climate-related investment flows. It is still incredibly difficult to track climate-related investments at the national level, and it is even harder to do so at the local and neighborhood scales. There is a reason much of the data in this report and similar efforts rely on global data sources; researchers simply do not know exactly what is happening within the U.S. The lack of investment data also holds back the public's collective ability to evaluate progress: while environmental monitoring continues to improve at a dramatic pace, it is difficult to cross-compare how specific projects may be improving climate conditions in certain places. To keep the public motivated and knowledgeable, the broader investment community must do a better job at reporting what they are investing in and where.

Photo credit: Shutterstock

Conclusion

Climate change is a truly wicked problem. It is not enough that it will cost trillions of dollars to retrofit entire economic sectors, or that the dollars should be mobilized within a relatively tight time frame to avoid or manage climate change's most dramatic impacts. The entire effort is made far more difficult because climate change is not just one problem to solve, nor one set of public policies or market failures to address. Instead, an amalgamation of factors—including the nine pain points presented in this report—vary significantly depending on the economic sector being assessed and the community confronting risks.

Still, there is reason for optimism. Over the past decade, America's levers of powers have shifted into an era of action. A majority of the public recognizes the threats that climate change poses and the urgent need to respond. The financial upside of mitigation and adaptation projects is much clearer, crowding more researchers, entrepreneurs, and investors into key sectors. Governments at all levels continue to establish formal climate targets and adopt climate action strategies, many of which include significant commitments of public dollars.

It is now incumbent on key stakeholders to accelerate the progress underway—and that calls for a sober assessment of what the moment demands. First, financial markets can quickly scale up construction of all the modern buildings, industrial facilities, physical infrastructure, and similar capital projects that communities need. And second, left to current regulations, the pursuit of profit will allow private dollars to continue to overlook the people and places most in need. It is incumbent on investors and government officials to do more to tap the power of well-regulated markets. The nine pain points offer a rough blueprint for what it will take to embrace systemwide solutions. The next step is to address them head on.

Appendix A: Glossary

BOX 6

Key terms

CLIMATE MITIGATION refers to actions and activities that limit or prevent GHG emissions, including removal of these gases from the atmosphere, thereby reducing the rate of climate change. These actions and activities can include a variety of industrial and built environment improvements, ranging from the installation of solar panels to the purchase and deployment of EVs.[123]

CLIMATE ADAPTATION refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic impacts.[124] It refers to changes in processes, practices, and structures to moderate potential damage or to benefit from opportunities associated with climate change. Examples include the construction of flood barriers or the conservation and protection of forests, wetlands, and other natural assets that reduce the effects of floods, storms, and other weather events.

CLIMATE IMPACTS include the costs and consequences of realized risks on natural and human systems, which result from a combination of acute events (such as major storms and wildfires) and chronic events (such as daily flooding and heat risks).

CLIMATE RESILIENCE refers to the capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance; responding or reorganizing in ways that maintain their essential function, identity, and structure; and maintaining the capacity for adaptation, learning, and transformation.[125]

NET ZERO refers to acts designed to reduce GHG emissions to the lowest feasible amount—generally considered to be a reduction of between 90% and 95% relative to baseline emissions levels—and offsetting any remainder using carbon removal technologies. Net-zero targets are often a stated goal for many policymakers and practitioners.[126]

CLIMATE FINANCE refers to the process of securing the money needed to cover an investment or project cost aimed at supporting greater climate mitigation and/or adaptation. Financing can consist of debt (secured through bond issuance or loan subscription), equity issuances (including listed or unlisted shares), and own funds (savings) as well as grants and subsidies.[127] While both public and private sector entities—including government agencies and financial institutions, respectively—are responsible for such financing, this report focuses on the latter.

CLIMATE (OR CLIMATE-RELATED) INVESTMENTS refer to the purchase of physical assets (notably infrastructure, buildings, materials, or equipment) used over time to support great climate mitigation and adaptation. These assets are found across a variety of industrial and built environment sectors, described more extensively below.

BOX 6 CONTINUED

SECTORS refer to a set of industries that share common climate action pathways—technological upgrades, design improvements, process changes, and more—to help reduce GHG emissions, minimize future climate impacts, and adapt to those impacts.[128] These sectors include human-made or natural assets, and this report focuses on five distinct sectors: (1) energy, including electricity generation, transmission, and distribution facilities; (2) transportation, including personal and freight transportation systems; (3) water infrastructure, including drinking water, wastewater, and stormwater systems; (4) buildings, including residential and commercial real estate; and (5) industrial facilities, including those responsible for manufacturing.

FINANCIAL INSTITUTIONS invest, lend, and/or oversee other transactions related to specific industrial or built environment projects that can support more equitable climate outcomes. Examples include private equity firms, corporate banks, insurance companies, and other investors.

FINANCIAL REGULATORS AND POLICYMAKERS create laws and policy guidelines to manage climate-related investments. Examples include: (a) personnel in federal agencies, such as the U.S. Treasury Department and the SEC; (b) ratings firms, such as Moody's, Fitch Ratings, and S&P Global Ratings; and (c) state and local government leaders.

CLIMATE EQUITY is the principle of fairness in burden sharing and is a basis for understanding how the impacts and responses to climate change, including costs and benefits, are distributed in and by society in more or less equal ways.[129] It is often aligned with ideas of equality, fairness, and justice in the responsibility for, and distribution of, climate impacts and policies across society, generations, and gender, and it also considers who participates and controls related decisionmaking processes.

CLIMATE COSTS refer to the environmental and economic costs associated with acute and chronic climate impacts. While many studies focus on environmental costs in isolation (such as rising pollution or stormwater runoff), this report also concentrates on the economic costs associated with climate change (including lost jobs, lost production, or property destruction). From an investor's point of view, quantifying these costs in dollar figures can make it easier to measure financial impacts.[130]

CLIMATE BENEFITS refer to the environmental and economic returns from greater climate mitigation and adaptation. Similar to this report's treatment of climate costs, this research concentrates on benefits that can be quantified in dollar figures. For example, increased protection and certainty amid climate change can boost resource efficiency, property values, and recreation, as well as workforce and industrial development. Likewise, reducing GHG emissions can reduce the cost of operations and bring about multiple co-benefits to human health from improved air quality.[131]

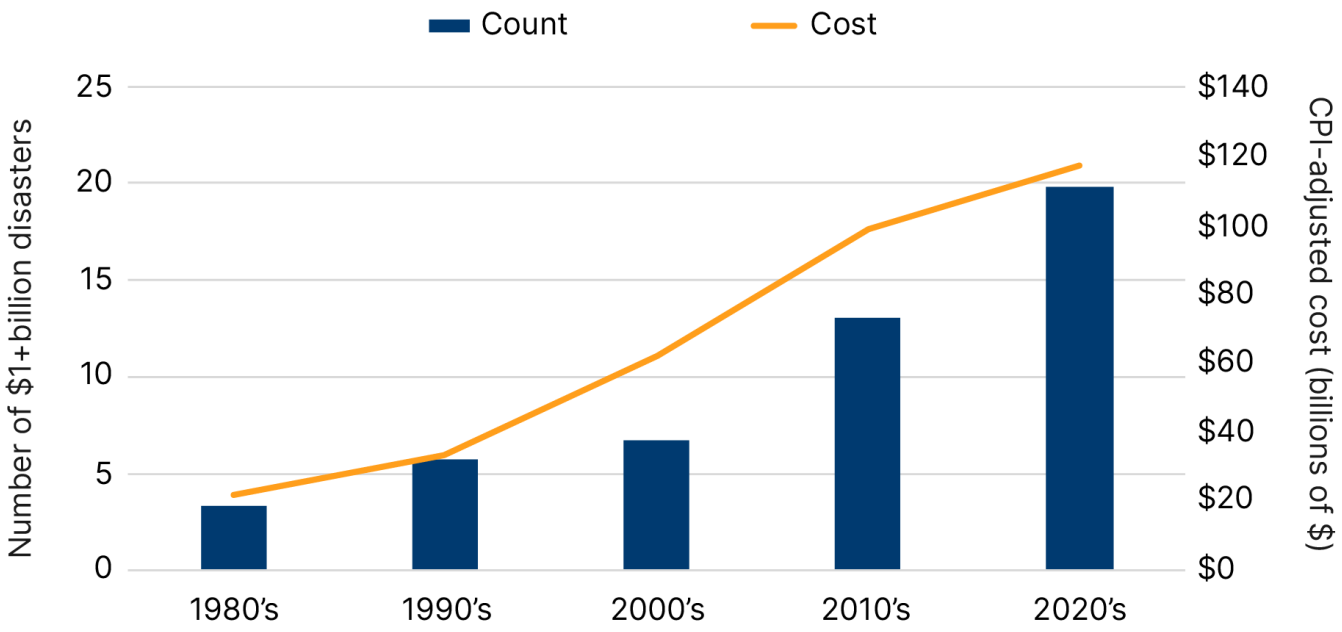
Appendix B: Additional climate investment context

SCOPING THE VARIOUS NEEDS FOR CLIMATE INVESTMENTS

Climate change is causing more frequent and widespread destruction across the country. Floods, fires, and other acute climate impacts are on the rise—and they come with a growing price tag. From 1980 to the time this piece was published, the U.S. has endured 387 climate-related disasters costing at least $1 billion in damage each, amounting to almost $3 trillion total. These not only include massive storms and flood events, such as Hurricane Katrina, but also widespread droughts and wildfires. Compared to the 1980s—when there was an average of three such disasters per year, on average costing $21.8 billion annually—the 2010s saw an average of thirteen such disasters per year, costing the U.S. economy $99 billion annually.[132] The 2020s have seen an even higher uptick in such events—an average of 20 per year costing $117 billion (see Figure 13). And these costs come on top of more chronic impacts like rising heatwaves and droughts that also hurt communities every day.

FIGURE 13

Average number and cost of U.S. climate disasters per year by decade
1980s to 2020s



SOURCE: Brookings' analysis of NOAA National Centers for Environmental Information (NCEI) data.

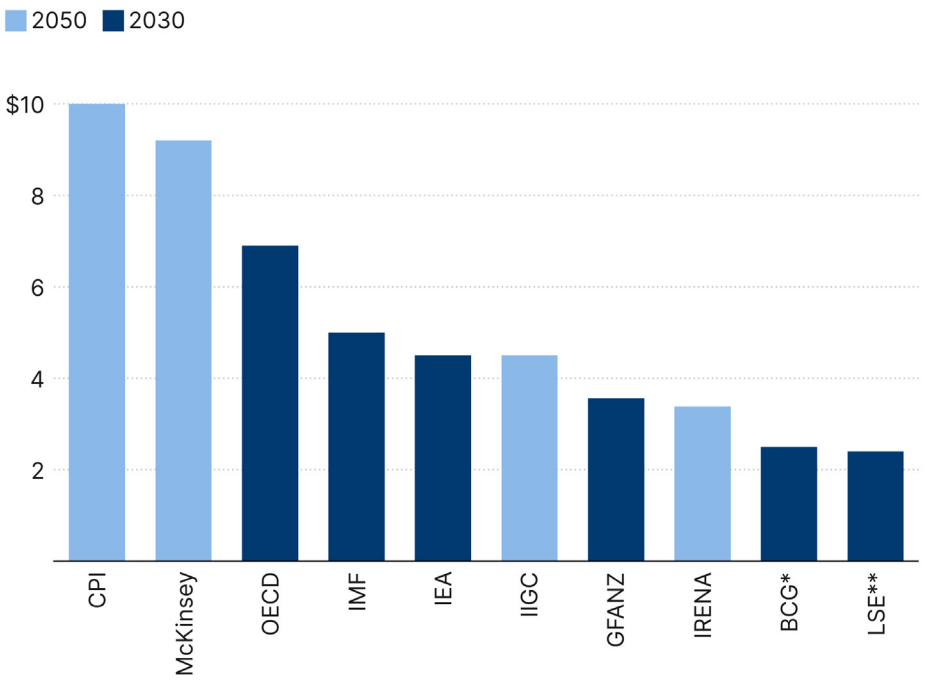
As climate impacts hit more communities across the country, public and private sector leaders face a mounting need to launch more accelerated, sustained, and equitable climate investment. The public sector often receives the most press coverage over what it is doing. A surge in federal infrastructure funding, particularly through the IIJA and IRA, is now contributing $1 trillion in climate-related transportation, energy, and other built environment projects.[133] Such public funding is necessary, but the totals pale in comparison to the full extent of the country's total capital needs.

Finding consistent U.S.-specific estimates on needed spending are few and far between, but global estimates provide some clues. For instance,[134] estimates from McKinsey indicate that worldwide capital spending will need to reach $9.2 trillion *per year* to achieve net-zero emissions by 2050.[135] Additional global estimates point to other large annual totals, ranging from a $2.4 trillion estimate by the London School of Economics to a $6.9 trillion estimate by the Organization for Economic Co-operation and Development (see Figure 14).[136] And many of these are just mitigation-focused estimates; they do not capture all the various adaptation-focused investments that are also needed.[137] As evidenced by comparing global estimates, it is simply hard to find a common target or approach to measuring aggregate need.

FIGURE 14

Estimates of needed global climate investment, by year and information source

Climate investment needed per year, trillion of dollars



SOURCE: Brookings' analysis of climate investment needs.

NOTE: Definitions for global climate investment vary by information source, but estimates include needs from all sources (private, public, etc.).
*Annual average calculated based on $18 trillion gap from 2023 to 2030.
** Based on totals needed for emerging markets and developing countries specifically.

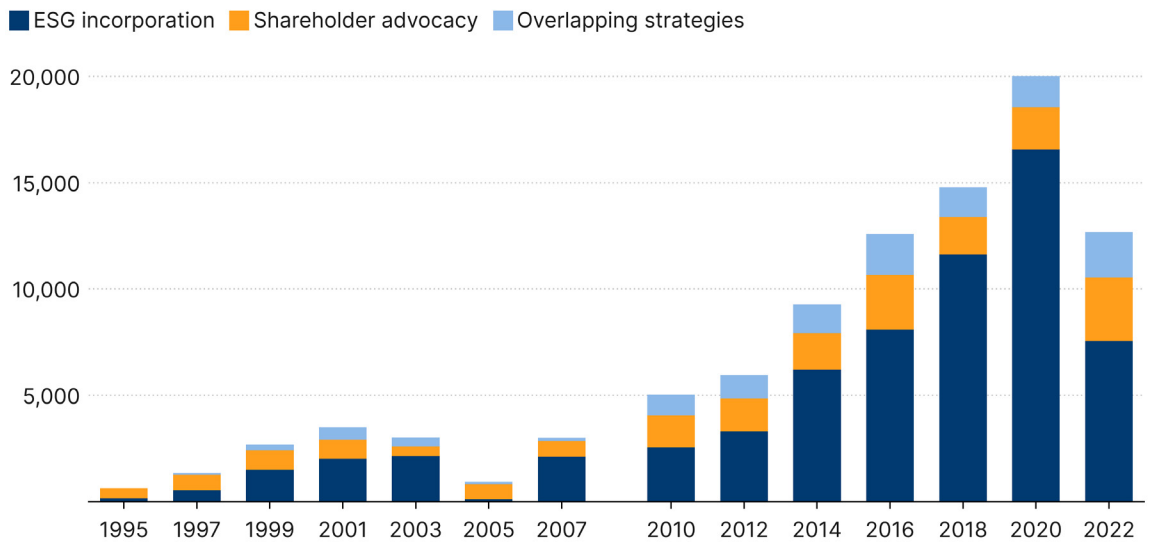
Still, there are reasons to accept rough and incomplete estimates. There are multiple technological pathways to minimizing emissions or securing physical assets, but each has different short- and long-term price tags and implications for justice and equity across different regions, sectors, and demographic groups. There also are no commonly agreed-upon standards of what resilient physical systems may mean, including among the state and local governments that own most roads and water systems. Nor is there universal agreement around timeframes and targets; some groups may favor a goal of net-zero GHG emissions by 2050, while others may prefer to consider a more ambitious target by 2035.

The private sector is increasingly eyeing more climate investment and helping to fill this gap. In particular, the rise of ESG investing demonstrates a large and growing market for funds and companies that reduce GHG emissions and promote other environmental or social benefits—even if recent attacks on ESG claims and practices have led to ups and downs in this market (see Figure 15).[138] For instance, an estimated $8.4 trillion of professionally managed assets in the U.S. involved some type of ESG criteria in 2022, which represents 12.6% of professionally managed assets (based on a total of $66.6 trillion).[139] This total soared 42% from 2018 to 2020, before falling due to methodological changes in the collection of data. These methodological changes reflect, in part, the widespread debate among the business community and policymakers about the exact scope of ESG investing, its measurable impacts, and potential greenwashing that exaggerates the reach of such efforts.[140] These mounting questions also raise concerns about whether and how these ESG investments are specifically addressing issues around climate equity.[141]

FIGURE 15

Sustainable investing in the U.S.

1995-2022



SOURCE: Brookings' analysis of U.S. Sustainable Investment Forum Foundation data.

NOTE: Overlapping assets involved some combination of ESG incorporation (including community investing) and shareholder advocacy and are subtracted to avoid potential effects of double counting. Prior to 2010, assets subject to ESG incorporation were limited to socially and environmentally screened assets and did not include assets that considered only governance criteria.

Appendix C: The major economic sectors

As previously mentioned, specific climate investment decisions—and the specific climate finance instruments used—ultimately depend on the specific sector (or sub-sector) where a project takes place. Mitigation- and adaptation-focused investments vary widely, as do those tied to different technologies. This report examines five specific sectors to better understand how climate finance currently works in the U.S. and the major barriers to unlocking more equitable climate investment in the years to come.

- **Energy:** The combustion of fossil fuels for energy generates three-quarters of U.S. GHG emissions.[142] Transitioning electricity generation away from fossil fuels toward zero-carbon sources and substituting electricity for direct combustion of fossil fuels are the central components of a net-zero transition. Nevertheless, this transition will take time, and continued investments in oil and gas production will be necessary during the transition and for sectors where oil and gas are used as feedstocks rather than fuels. The U.S. does not just need a zero-carbon electricity system: it needs a bigger electricity system to supply the needs of newly electrified energy uses along with entirely new and rapidly growing sources of electricity demand, like computing centers for artificial intelligence. Delivering the clean electricity transition will cost trillions of dollars.[143]

  Communities near energy facilities, both for electricity generation and oil and gas production, face burdens of pollution from past activities. They also benefit from jobs and tax revenues. Equity in the energy transition involves considering how to ensure that these communities benefit from the energy future instead of suffering as the country's energy sources change. Additionally, even though projects such as solar farms or transmission lines can provide great benefits to the climate overall, they sometimes prompt objections among local communities. Early and frequent consultation with local residents can ensure that projects benefit local communities as well as the greater good in terms of climate-related benefits.

- **Buildings:** Real estate markets have complex interactions with climate change. Homes, offices, stores, and other buildings are major contributors to GHG emissions. The breadth and complexity of the real estate industry means that climate investments are likely to emerge unevenly, particularly as buildings are governed under a patchwork of local, state, and federal policies. Key challenges to broader climate investment include highly decentralized ownership and decisionmaking, a lack of information by property owners and managers, fragmented funding sources, and inconsistent policies from public agencies.

  The prospects for climate investments in both owner-occupied homes and commercial properties depend heavily on the resources of property owners, raising serious concerns about social equity. For example, affluent homeowners can upgrade their properties by tapping into their savings or borrowing against accumulated home equity—options that will be difficult for homeowners with tight budget constraints. Rental housing raises even greater concerns, both because renters have lower average incomes than homeowners and because low- and moderate-income renters tend to live in older, poorer-quality buildings that are less likely to meet more stringent building codes or energy-performance standards.

- **Transportation:** The transportation sector—including the construction of physical infrastructure like highways and ports, the manufacturing of equipment like trucks and aircraft, warehouse operations, and other services—is an immense component of the national economy, accounting for 9% of total U.S. GDP in 2022.[144] However, the sector's current reliance on fossil fuels continues to harm the

natural environment and public health. Adopting cleaner transportation will require sizable private investment in manufacturing facilities, vehicles, and even neighborhood and community design to help households and businesses reduce their environmental impacts.

An overarching challenge for the transportation sector is to find a way to limit emissions without restricting economic activity in the process, including widespread investments in vehicle electrification, new technologies, neighborhood redesigns, and other modal shifts. The ability of individual businesses and households to pay for such upgrades raises pressing climate equity concerns, including ones related to affordability and accessibility. For example, the significant amount of upfront investment in R&D, plant equipment, and workforce development needed to build new cars, trains, ships, and aircraft may create bigger barriers to financing for smaller manufacturers. And low-income households, already contending with sizable auto loans, may find it difficult to afford and access new vehicles or other forms of cleaner technologies.

- **Industry:** The U.S. relies on a variety of industries that generate GHG emissions in their production processes but that are essential to driving economic growth in terms of inputs to other industries, final goods, and a source of employment. Certain primary industrial processes— steel, cement, chemicals, and refined fuels—are the largest industrial emitters of GHG emissions. Moreover, the location of industrial facilities can directly harm certain communities, while industrial transitions via new technologies and other innovations can threaten to leave many workers behind.

  Reducing GHG emissions in these primary industries can be difficult, as emissions come from both fuel use and the chemistry of the processes themselves. Incremental improvements in efficiency can help, but deep reductions often require fundamental process changes, some of them as yet untested or not economical. A combination of venture capital, sustainable funds, and private debt—including SLBs and SLLs—is helping accelerate such investments. Yet there will need to be a fundamental "reorientation" from incremental improvements to "transformational changes" in energy sourcing, materials efficiency, and more.[145] The costs of such structural shifts will increasingly pressure producers, consumers, and investors with escalating price tags and affordability concerns.

- **Agriculture:** The agricultural sector—including crop production and livestock farming—is a major component of the domestic economy, even if total employment figures are far lower than they were a century prior. From dairy and meat products to grains and beverages, annual agricultural output amounts to $204 billion and supplies grocery stores, provisions in restaurants, and exports for foreign markets.[146] However, all this production has significant climate impacts, with the sector responsible for a tenth of the country's GHG emissions. The sector also has direct environmental impacts, including soil and water quality challenges resulting from pesticide application and land cultivation.[147] Climate changes, including evolving temperatures, rainfall levels, and extreme weather, threaten farm production, posing risks to farmers' profit margins and their ability to maintain their operations.

  Addressing these climate challenges will require significant investment nationally, with access to private financing depending on the size of a given farm, what it is producing, and how it is operating. When it comes to climate equity, socially disadvantaged farmers and ranchers (SDFRs) face considerable struggles, including low-income and more racially diverse communities. Since SDFRs tend to operate small family farms that have lower revenues or weaker credit histories, they may find it difficult to secure loans and drive needed climate improvements.[148] Without targeted financial support, it may consequently be difficult to scale improvements across all types of farms in all types of places.

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ACKNOWLEDGEMENTS

This research series was made possible by an incredible group of colleagues within and outside the Brookings Institution. The authors would especially like to thank Samantha Gross, Alan Berube, and the over 30 external experts who provided guidance and input throughout the project. The authors also would like to thank Carie Muscatello for her web and print design and the rest of the Brookings Metro communications team for their support.

Funding for this research was provided by HSBC Bank USA, N.A. The program is also grateful to the Metropolitan Council, a network of business, civic, and philanthropic leaders that provides both financial and intellectual support to the program. The views expressed in this report are solely those of its authors and do not represent the views of the donors, their officers, or employees.

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1775 Massachusetts Ave NW,
Washington, DC 20036
(202) 797-6000
www.brookings.edu