CALIFORNIA'S FIFTH
CLIMATE CHANGE
ASSESSMENT



Climate Adaptation Finance

A State Agency Report for:

California's Fifth Climate Change Assessment

Prepared by:
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The California Department of Insurance led and coordinated this report and invited a multidisciplinary team from non-profit organizations, universities, state government agencies, reinsurance, and private financial sector representatives with expertise in adaptation finance to be co-authors. As a consumer protection organization and the regulatory agency overseeing the largest insurance market in the United States, the California Department of Insurance initiated this report in recognition that insurance is one important part of a larger and increasingly important system for funding and financing climate adaptation in California, and a central avenue to reducing and transferring risks.

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About California's Fifth Climate Change Assessment

California's Climate Change Assessments are designed as a portfolio of reports, research, and resources that contribute to the scientific foundation for understanding climate-related vulnerability throughout California and provide communities and decisionmakers with the tools to take action to address climate-related impacts. Prior Assessments, such as those released in 2006, 2009, 2012, and 2018, have over time increased consideration of the actions required to mitigate and adapt to climate change, and to build resilience. While the first California Climate Change Assessment focused on impacts, the Second Assessment made the case that adaptation could reduce impacts and cost, and the Third and Fourth Assessments brought those findings to a granular level focusing on localities and diving deeper into topics of statewide significance. These reports have led to significant legislation requiring California to develop and periodically update a state Adaptation Strategy (AB 1482 Gordon Chapter 603, Statutes of 2015) and consider revision of engineering standards to address changing conditions (AB 2800 Quirk; Chapter 118, Statutes of 2020), among other adaptation-related laws (SB 379 Jackson; Chapter 608, Statutes of 2015. SB 1035 Jackson; Chapter 733, Statutes of 2018.)

California's Fifth Climate Change Assessment is a cutting-edge research initiative that is comprised of climate change scenarios developed at a scale suitable for assessing vulnerability and local adaptation strategies, original core research on Energy and other climate-related issues, a tribal research program, reports from specific regions of California, topical synthesis reports on specific issues, and a statewide summary report consolidating high-level findings. New to the Fifth Assessment are a set of state-agency led topical reports on issues of significance, including this report on Climate Adaptation Finance.

This report, a novel addition to the Climate Change Assessment Framework, is intended to make the insights of other elements of the Fifth Climate Change Assessment portfolio actionable by providing an overview of how adaptation actions can be financed and funded in California with concrete examples for decisionmakers to learn from.

For the full suite of Fifth Assessment research products, please visit: www.ClimateAssessment.ca.gov.

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State Agency reports are new Assessment contributions that complement the Assessment's suite of products, which include a Statewide Summary report, Regional and Statewide Topical reports, and original research. Note that State Agency Reports are reviewed by the contributing agency and are not included in the Assessment's Editorial Board peer review process.

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About this Report

This report, for the first time in California's Climate Change Assessments, comprehensively addresses the funding and financing mechanisms to deliver adaptation projects that help communities, the environment, and our economy to adjust to the increasing and accelerating challenges of climate change. Designed for California decisionmakers and practitioners, this report provides a broad overview of adaptation funding and finance systems operating within the state—the mechanisms available, the actors involved in raising and disbursing funds, and concrete examples to learn from. In this report, adaptation finance and funding are viewed as an interconnected, reciprocal system that both derives and provides financial and non-financial benefits. This systems-level perspective highlights the broader social, ecological, health, and equity considerations that adaptation finance can deliver when evaluated beyond purely financial returns in a changing climate. It aims to provide California decisionmakers with the tools to think expansively about how to support climate adaptation and to make actionable the ideas from other California Change Assessment reports, including identifying opportunities for "blended finance" arrangements that leverage multiple sources of capital. Case studies on different finance and funding mechanisms, drawn from examples within and outside of California, serve as learning opportunities for California policymakers and practitioners developing their own approaches.

Highlights and Key Messages

California faces growing climate risks that will require a combination of policy innovation and sustained investment in adaptation and resilience across infrastructure, housing, natural systems, public health, emergency preparedness, and the economy. These investments can reduce future losses, support faster recovery, and strengthen communities and critical systems. California already has a substantial base of adaptation investment, but meeting future needs will require making effective use of a broad mix of public, private, household, philanthropic, and insurance resources as well as consideration of value beyond financial returns. Resiliency can be built in our communities and our environment by ensuring that there are the necessary means, commitment, and knowledge to deliver adaptation actions. This report consolidates current knowledge on adaptation finance, highlights innovative financial arrangements via case studies, and reimagines an adaptation finance landscape that protects and values financial and non-financial benefits.

Successful climate adaptation finance requires expansive thinking about the financial mechanisms available to address impacts and build resilience in California. These financial mechanisms range from traditional and familiar, such as government bonds for funding large infrastructure projects, to novel versions of existing mechanisms tailored to adaptation, such as catastrophe bonds with integrated disaster-resilience benefits.

There is currently no quantitative accounting of current financial flows towards adaptation finance in California. Challenges exist with tracking adaptation financial flows because they are often not distinguished from infrastructure investments, not distinguished from mitigation investments, or not broken down at a sub-national level. Additional data source development and research could improve visibility into adaptation funding and finance within the state for decisionmakers.

Investments in climate change to date have primarily focused on mitigation. It is becoming increasingly apparent that investment in mitigation alone is insufficient, and that investment in and financing for adaptation is crucial and timely (UNEP, 2026a). The health and prosperity of our state critically rely on efficient investments in adaptation.

Public funding remains the foundation of adaptation funding and finance, but other sources can expand its reach. Public funding is particularly important for projects that provide broad public benefits and lack a direct repayment source. Private investment and philanthropy can complement public resources where their financial characteristics align with project needs.

Different financial tools serve different purposes. Grants and appropriations provide non-repayable funding that can serve adaptation projects with distributed public benefits and limited repayment potential; loans and bonds provide upfront capital where repayment is feasible such as in the case of climate adaptation technology investments; insurance and other risk-transfer mechanisms provide financial protection and post-disaster liquidity that can promote more resilient rebuilding and retrofitting; and blended-finance structures can reduce barriers and attract additional investment particularly for large-scale projects. Matching the tool to the project is as important as increasing the overall volume of capital.

California can make adaptation investments more effective by improving coordination, project development, and measurement. Adaptation spending is difficult to track because it often overlaps with infrastructure and climate mitigation investments, and project outcomes are not measured consistently. Better information on costs, avoided losses, and social, economic, and ecological benefits can help decision makers compare investments and identify approaches that are effective and scalable.

Adaptation finance has important equity implications. Communities and households differ in their ability to access grants, take on debt, pay upfront costs, obtain insurance, and navigate complex application processes. Financing structures can be designed to broaden access and reduce the risk of adaptation investments shifting costs or vulnerabilities to communities with fewer resources.

Adaptation can create value beyond direct financial returns. Many resilience investments generate benefits such as improved health, ecosystem services, avoided disaster losses, and greater economic stability. These benefits often accrue across multiple beneficiaries and over long time horizons, making them difficult to capture through conventional financial analysis alone but critical to the argument for further adaptation funding and finance.

Case studies of funded or financed adaptation projects and mechanisms provide concrete examples for decision makers at all levels to emulate or learn from. This report includes 20 case studies that utilize traditional finance mechanisms and innovations occurring within and outside of California that decision makers can learn from to inform their own approaches.

A more holistic, integrated approach to adaptation finance can move the State beyond existing financial silos to a more sustainable system that reduces systemic risks and supports long-term climate resilience. This approach recognizes that economic prosperity and ecological resilience are not in opposition but rather reinforce one another as the long-term resilience of financial institutions depends on the health and vitality of the full adaptation finance system including natural ecosystems and communities.

Looking Forward

California has a strong financial foundation on which to build. Existing public programs, financial markets, insurance mechanisms, philanthropic capital, and emerging financing models provide a diverse set of tools for advancing resilience. The opportunity exists to connect these tools more effectively, match them to appropriate risks and projects, and better recognize the full range of benefits that adaptation can provide.

Taken together, the report finds that adaptation finance is best understood as an interconnected system rather than a single funding stream. Strengthening that system can help California deploy resources more effectively, broaden participation, and support durable, scalable investments that reduce climate risk and improve resilience over time.

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I. Introduction

Since 2006, California's Climate Change Assessments have catalogued the broad-scale and acute impacts of climate change on the people and ecosystems of California, contributing to the scientific foundation for understanding climate-related vulnerability and offering communities and decision makers the tools to act (California Climate Change Assessment, n.d.). The risks associated with climate change are systemic, meaning that while initial direct impacts are local, knock-on effects occur across regions and sectors through interconnected socioeconomic and financial impacts and ecosystems (King et al., 2015). In California, direct impacts such as rising temperatures, more severe wildfires, increasingly variable precipitation, and compounding hazards degrade ecosystems and come hand in hand with secondary socioeconomic and financial system impacts that cross sectors and geographies. Further information on these impacts can be found in the Fifth Assessment's "Statewide Summary Report" and the "Climate Impacts to the Economy Statewide Topical Report".

Any efforts toward building resilience to the impacts of climate change, whether at the scale of an individual or the scale of a state, require resources—financial and non-financial. Adapting to the systemic risks of climate change requires thinking expansively about the actions required and the financial tools available to implement those actions. This is especially true now in 2026, two decades after the first California Climate Change Assessment, as climate impacts continue to increase alongside rising financial pressures associated with inflation, shrinking and uncertain federal funding for adaptation, and a changing political landscape. As the fourth largest economy in the world, the largest insurance market in the US, the home of many of the largest financial institutions, and a state that has been investing in climate resilience for decades, California is uniquely positioned to be able to rise to the challenge of financing and funding climate adaptation.

Significant investment is needed to match the pace and scale of climate change. Existing financial tools and mechanisms that are well accepted and understood within the market can be deployed to address adaptation needs. Simultaneously, novel versions of existing financial structures fit-for-purpose can be developed and deployed. The innovations in adaptation happening within and outside California can help guide decision makers to identify how to make investments more effective than previously employed. A larger volume of adaptation funding and financing is needed to match growing climate risks (Wang et al., 2025), and these investments can be carefully designed to efficiently leverage resources to achieve and amplify their impacts.

This report defines climate adaptation finance as the financial flows to support adaptation and resilience activities that seek to prevent harm, reduce or transfer risk, recover from impacts, or promote economic, social, and natural systems' co-benefits, across all sectors (Hera (fka Climate and Resilience for All) and Tailwind Futures, 2025). Climate change induces long term climate risks, and adaptation helps to buffer against those climate-related impacts. While adaptation "funding" is not mentioned in the title of this report, it is a critical and distinct aspect of enabling adaptation actions and is a major component of this report. Finance refers to the process of obtaining money or capital for various purposes to pay for an asset or service and generally requires repayment with interest (Adam Hayes, 2025; California Treasurer, n.d.; Vermont Bond Bank, n.d.) whereas funding refers to the money available and provided to pay for or offset the costs of an asset or service, generally for a specific purpose without a requirement for repayment (California Treasurer, n.d.; Vermont Bond Bank, n.d.). While funding and financing are interrelated and sometimes used interchangeably, this report makes a concerted effort to distinguish this difference as appropriate.

The report is premised on three fundamental ideas:

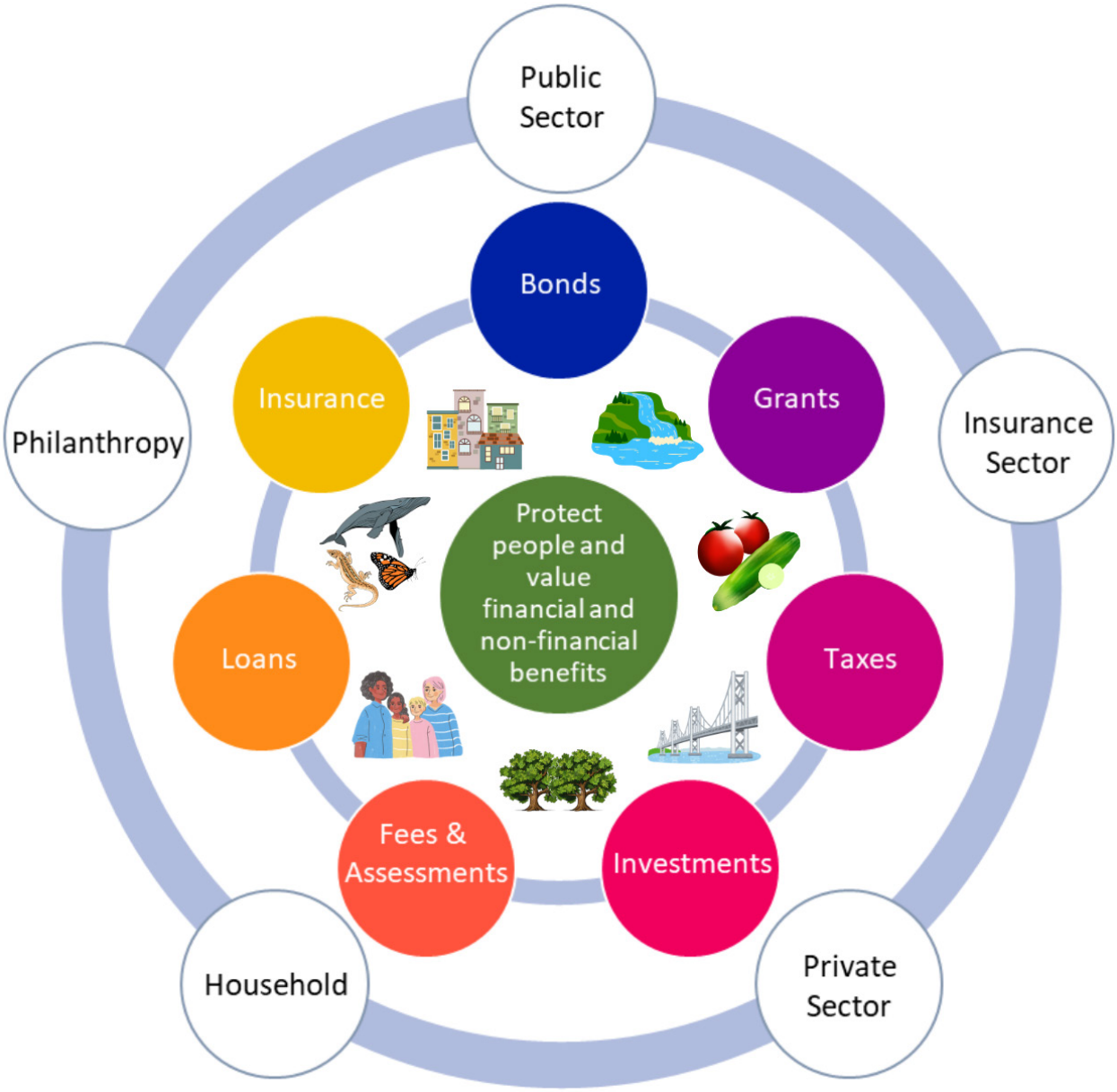
- Systems-level adaptation financing structures and mechanisms can amplify positive impacts for short- and long-term financial and non-financial benefits such as economic resilience, improved health outcomes, and restored ecosystems to support transformational adaptation.
- Existing financial mechanisms that consider purely financial outcomes can be leveraged to provide finance and funding for adaptation but, given the distributed and significant non-financial benefits of adaptation, integration of non-financial benefits and systems can more successfully make the case for investment in adaptation. Novel, fit-for-purpose versions of existing financial mechanisms can efficiently leverage capital for climate adaptation.
- Tracking innovative or early examples of adaptation finance structures and their outcomes can help California learn what is replicable, what is scalable, and what works for our people, geography, resources, and economy.

> *Climate adaptation finance is defined in this report as the financial flows that support adaptation and resilience activities, including activities that seek to prevent harm, reduce or transfer risk, recover from impacts, or promote economic, social, and natural systems' co-benefits, across all sectors. (Hera and Tailwind Futures 2025)*

Financing adaptation requires funding from a range of actors—the sectors and individuals taking action to adapt to climate change—to sustain a whole-of-system approach, to protect our economy, communities, and the natural systems that society

depends upon. As described in this report and in Figure 1, this interconnection and relationship of actors (outer ring) and various financial mechanisms they can layer and employ to finance and fund adaptation projects (inner ring) can protect not just infrastructure, but also people and ecosystems. Integrating nature more fully through a systems capital approach can build resiliency for communities and the environment.

Figure 1.



Primary mechanisms of adaptation finance and funding (inner circle) and actors (outer circle) that help to fill the gaps needed to protect and value our important assets. (Source: authors).

Developing a systems-level capital approach to adaptation finance and funding is achievable with ambitious stakeholders, strategic decisions about resources and capital, and deep consideration of impacts and benefits for people and nature. This report aims to empower key stakeholders with the latest knowledge and examples of adaptation finance in action, serving as a decision-support tool for planners, decision makers, and others, including organizations that serve vulnerable communities to apply the assessment research findings towards building resilience (CA Pub Res Code § 71341(e)). Each component of the financial sector can be instrumental in championing resilience, helping California achieve a future that, in the words of a recent UNEP FI report "safeguards the planet and ensures no one is left behind in the pursuit of a more sustainable future".

Adaptation Finance Must Curtail Maladaptation

Addressing a systemic risk like climate change requires systems-level consideration of how actions taken to build resilience may have unintended consequences that shift vulnerability elsewhere in the system. The IPCC (2023) refers to maladaptation as unintended consequences of adaptation that inadvertently increases vulnerability to climatic stimuli, such as increasing vulnerability and inequitable outcomes, increasing greenhouse gas emissions, or inhibiting necessary systemic change, now and into the future. A few illustrative examples of maladaptation include:

- A seawall that protects one stretch of coastline but leads to erosion in adjacent areas (Brucal & Lynham, 2021)
- Infrastructure improvements that are more climate-resilient but increase housing costs in a way that is not equitable (Seeteram et al., 2026)
- Fire suppression that leads to the buildup of fuels, increasing wildfire risks (Kreider et al., 2024)

To avoid maladaptation, long-term planning that incorporates a holistic approach to understanding the needs and consequences of adaptation can help projects be flexible, multi-sectoral, and inclusive. Layering equity-related factors with a long-term systems-thinking approach can help reprioritize and finance adaptation projects to deliver desired transformational adaptation for communities, businesses, and ecosystems.

To minimize maladaptation risks before project implementation, decision makers can utilize frameworks such as the Navigating the Adaptation-Maladaptation continuum (NAM) (Reckien et al., 2023) or maladaptation forecast and iterative risk analysis (Higuera Roa et al., 2025). The NAM framework encapsulates large systems-level measures such as ecosystems and their services, GHG emissions, and systemic change, and equity related measures such as low-income groups, gender, and marginalized groups, to examine how tradeoffs between these criteria impact the success of adaptation or risk of maladaptation. The maladaptation forecast

and iterative risk analysis examines risks through exploring interconnections and dependencies of the system, examining potential maladaptive outputs, analyzing the drivers of maladaptation to diagnose the maladaptation risks before refining the adaptation measure and starting the iterative process again before projects are implemented. For investor-specific examinations of maladaptation, a new toolkit is currently available for investors to actively screen for, manage, and reduce maladaptation risks to portfolios (Zhang & MacDonald, 2026).

California's Need for Adaptation Investment

California requires significant investment to ensure individuals, society, and ecosystems thrive despite increasing climate-related stresses. Immediate and continuing adaptation actions reduce risks, lower costs, and improve positive outcomes for communities and businesses. A mosaic of actions and financing streams is needed for California to adapt to combat individual and compounding perils. Learn more about prudent adaptation actions by each peril in Appendix A.

Adaptation finance is required across many facets of California's economic and societal sectors to withstand the physical impacts of climate change and deliver direct and indirect benefits to our broader society (Mazzacurati & MacDonald, 2026) (Figure 2). Financing adaptation to support projects such as forest fuel load reduction, improved communication strategies and technologies, and career transition in a changing climate prepares our communities and systems to rebound, rebuild, and relocate more efficiently and with greater equity when needed.

Figure 2.



Key sectors of the economy that need adaptation and resilience investment. (Source: Mazzacurati and MacDonald 2026).

Shifting the Framing of Adaptation Finance

Climate change is a systemic risk that affects entire communities, economies, and sectors simultaneously, rather than a discrete risk borne by a single investor or asset owner. It threatens our natural environment, health, economy, and society, with disproportionate impacts on socioeconomically disadvantaged communities (EPA, 2021). Thus, traditional finance alone, which focuses on capital allocation to maximize returns and designed to borrow against our future to maximize benefits today (Hannant et al., 2022), does not adequately support the transformational adaptation needed to deliver substantial social and economic values beyond financial returns. The IPCC refers to transformational adaptation as the adaptive actions that change the fundamental attributes of socio-ecological systems in response to expected climate change and its impacts, including structural, functional, or locational transformations, to strengthen the resilience of ecosystems and society (IPCC, 2022). To better protect communities, ecosystems, and infrastructure, a shift in framing can improve the case for adaptation investment. This includes prioritizing investments that generate widely shared benefits across multiple stakeholders over long-time horizons. Potential outcomes from this alternative framing can improve the lives and health of individuals, protect built and natural environments, and support faster recovery rates for communities most in need. This approach requires climate finance to support more than technology and infrastructure projects; it would need to incorporate the social, health, educational, and environmental impacts of projects to ensure equitable and inclusive financing outcomes (UNEP, 2024) to help the most vulnerable individuals and communities adapt to the increasingly frequent and severe impacts of climate change.

> *A more holistic way to value adaptation finance is to focus on harm prevention, loss avoidance, and the strengthening of social, ecological, physical and financial systems.*

The Structure of This Report

This report begins with a discussion of the limited available quantitative information on adaptation funding and financing in California and the importance of quantifying adaptation benefits. It continues with an overview of the actors and mechanisms, both traditional and innovative, and how blended finance can catalyze private funding. The next section focuses on the nexus of adaptation financing and funding with other social and economic priorities including Indigenous economies of care, housing & real estate, workforce & labor, and human health. Lastly, this report closes with a discussion on the future of adaptation finance and funding in California with discussion of a systems-level approach that considers benefits to nature, communities, and infrastructure. Throughout the report are case studies demonstrating examples of approaches within and outside of California that decision makers and practitioners can learn from and consider adapting to their context.

II. Gaps in Climate Adaptation Funding and Financing

Key Messages

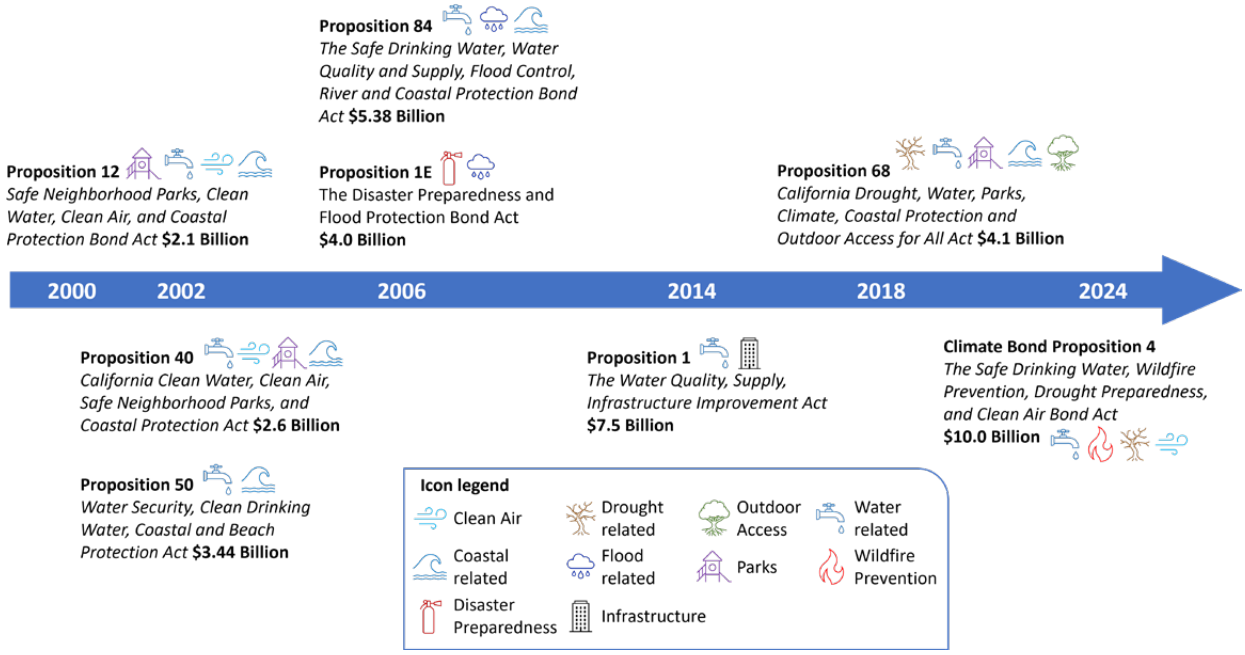
- Tracking adaptation finance is challenging in California and globally due to poor data, unclear distinctions between mitigation and adaptation funding, and lack of monitoring and evaluation of spending effectiveness
- While California has invested significantly in climate adaptation, state funding alone is insufficient to meet current and future climate needs
- Conventional financial frameworks often undervalue long-term resilience benefits, avoided losses, and public co-benefits
- Adaptation finance may require evaluative approaches that better account for harm prevention, avoided losses, equity, and the resilience of social, ecological, physical, and financial systems

Adaptation actions are integrated into the everyday operations of our state and local governments, households, and businesses. The variation in scale and duration of projects, recipients and providers of finance, and beneficiaries of the adaptation actions mean that the "how" is as important as the "how much" when it comes to adaptation finance. This report prioritizes the approach of laying out the considerations, examples, financial mechanisms, and key actors that make up the mosaic of what is needed for a climate-resilient California and does not completely enumerate the adaptation finance gap quantitatively for reasons discussed later in this section.

Historic Statewide Investment in Adaptation

California has been investing in climate adaptation for decades, long before the term climate adaptation became widely used. From 2000 to 2024, voters approved multiple statewide bonds on clean water, air, coastal protections, improving neighborhood parks, ecosystem services, wildfire resilience, and nature-based solutions (CNRA, n.d.) (Figure 3). As of 2025, the State funded $15.5 billion in implemented projects focused on climate change through the Greenhouse Gas Reduction Fund (CARB, 2025). The economic benefits of resilience spending are significant. Studies on federal mitigation grants in the United States demonstrated that every $1 spent can save up to $6 on future losses and damages (Multi-Hazard Mitigation Council, 2019). The US Chamber of Commerce places that ratio higher, with every $1 spent on resilience saving $13 in avoided economic costs, damages, and cleanup (US Chamber of Commerce et al., 2024).

Figure 3.



California has been investing in adaptation, resilience, and climate-related measures since 2000, with the largest measure to date passed in 2024 under Climate Bond Proposition 4. (Source: authors).

Adaptation Finance Gaps

Despite California's significant and ongoing investments, state funding alone cannot meet California's adaptation needs. Oversubscriptions of state adaptation grant programs provide one indication of this gap. For example, in 2024, Senate Bill 1 Sea Level Rise Adaptation Planning Grant Program and the Healthy Soils Program, both funded by the GGRF, were 183 percent oversubscribed ($11 million available; $20.2 million requested) and 1,024 percent oversubscribed ($10 million available; $102.3 million requested), respectively (CARB, 2025). Additionally, the Sierra Nevada Conservancy's Wildfire Recovery & Forest Resilience grant in 2023-24 was oversubscribed by 267 percent ($35.15 million available; $93.97 million requested) (pers communications). While grant oversubscription is not unique to adaptation, these examples highlight the breadth of competition, and opportunity, to finance adaptation projects in California. What's needed in California is broader and more diversified funding sources to keep pace with present and future climate risks.

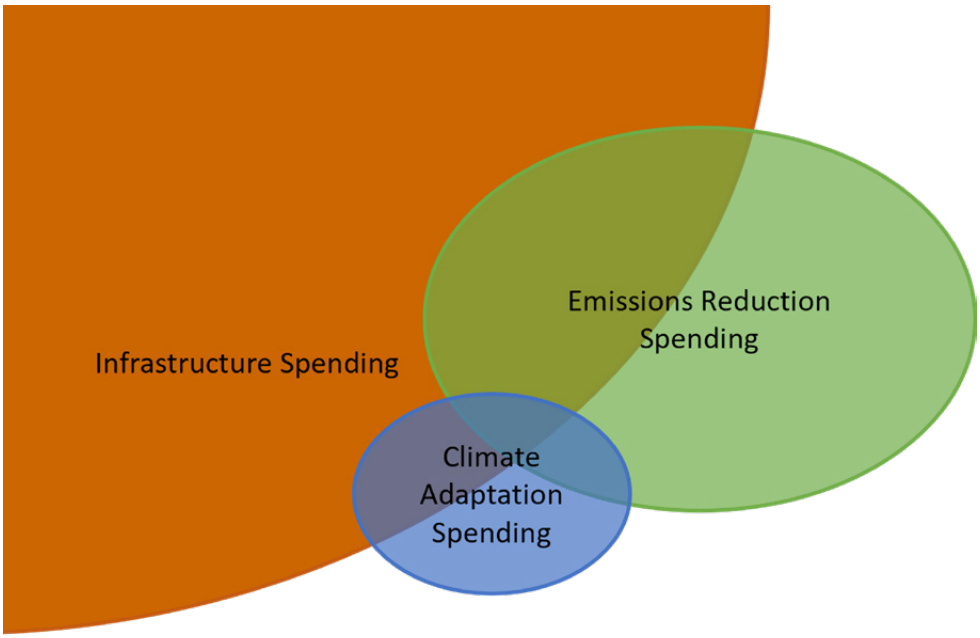
These opportunities for increasing financial flows towards adaptation are consistent with a broader national and global trend. Although global climate finance is failing to keep pace with need, the gap is even more stark for adaptation finance than for mitigation finance (financial flows towards greenhouse gas reduction). Between 2018 to 2023, global climate mitigation finance more than doubled from USD 757 billion

to USD 1.78 trillion whereas adaptation finance reached only USD 65 billion in 2023 (Climate Policy Initiative, 2025). Globally, climate finance is expected to exceed USD 2 trillion for the first time in 2024.

Adaptation Finance Provides Critical Resources But is Not Adequately Tracked

While adaptation finance and funding are gaining more traction, quantification and tracking of these financial flows is difficult for a multitude of reasons. Among them is the inherent question of where to draw the line between spending on activities solely initiated to respond to and prepare for climate change impacts versus general spending on infrastructure, natural systems, housing, government programs, and other projects with resilience co-benefits. Even when adaptation finance is explicitly devoted to climate, it is often closely entwined with and difficult to differentiate from funding for greenhouse gas reduction (mitigation) (Figure 4 and Figure 5). Private adaptation finance is even more difficult to track as there are no mandatory reporting mechanisms around adaptation and resilience, but newer methods are being developed to obtain a clearer signal (Climate Policy Initiative, 2024).

Figure 4.

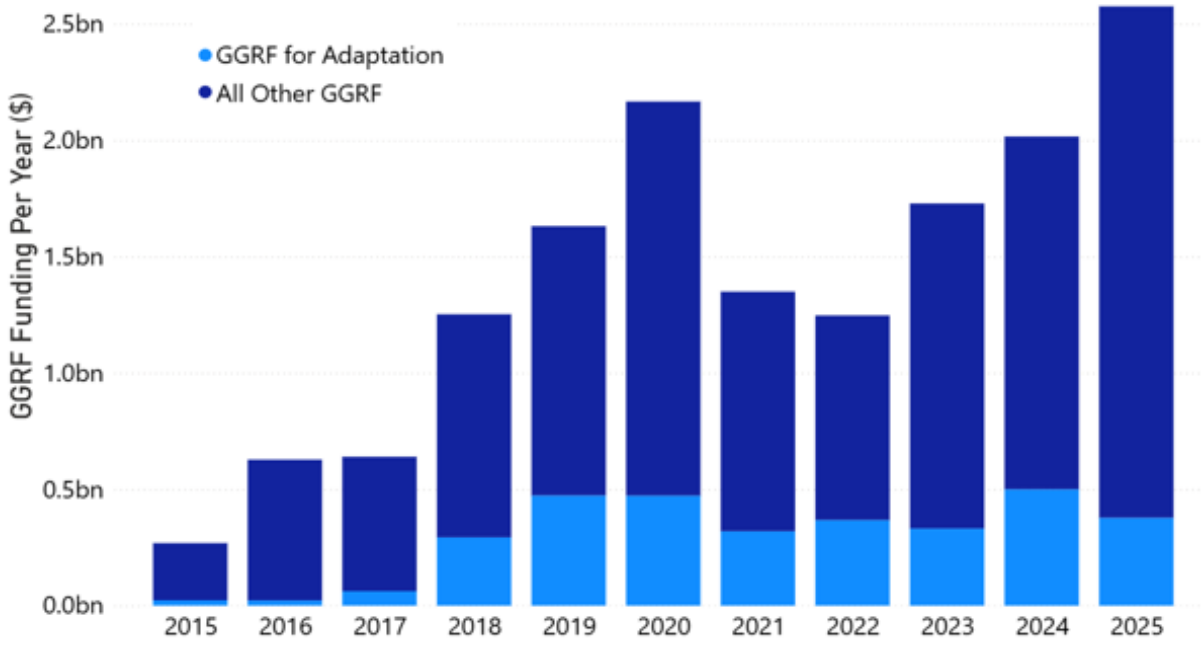


Schematic of the expenditure across three key resilience and climate-related sectors which showcases interlinked spending and that infrastructure spending largely outweighs emissions reduction and adaptation spending. (Source: authors).

Even though a statewide figure is difficult to quantify, data from California Climate Investments provide one subset of the amount of funding spent on adaptation from a major source (Figure 5). California Climate Investments is the branding used for the portfolio of programs funded by the state's Cap-and-Invest revenues. These revenues

are deposited into the Greenhouse Gas Reduction Fund (GGRF) and support over 100 climate-focused programs administered by over 20 state agencies that focus on climate mitigation, adaptation, and resilience. The light blue portion of the bars in Figure 5 represent projects which broadly match definitions of climate adaptation used in this report, including funding for climate smart agriculture, coastal resilience, wetlands restoration, conservation, forest management and fuel reduction, and climate-focused workforce development. Many projects simultaneously address mitigation and adaptation, and there is recognition that supporting mitigation and adaptation activities simultaneously can deliver win-win outcomes (Adaptation Committee UNFCCC, 2022). However, this complicates the process of tracking dedicated adaptation funding and finance.

Figure 5.



Greenhouse Gas Reduction Fund (GGRF) annual funding expenditure. (Source: California Climate Investment).

Lastly, there isn't a singular database that pulls together information on adaptation

related project outcomes and benefits funded by California state. Below are three examples that track projects for different purposes such as spending, implementation, and outcomes:

- FI$Cal is the statewide financial system that allows the state of California to track budgeting, procurement, cash management and accounting information transparently and efficiently. This system tracks the state's spending but does not track information on project outcomes and benefits. Public agencies track these details through separate reporting databases.
- California Climate Investments Reporting and Tracking System (CCIRTS) tracks project details and outcomes across 27 state agencies receiving funding from GGRF.
- California Natural Resources Agency's (CNRA) centralized project management and reporting system called Resources Agency Project Tracking and Reporting (RAPTR) was built to aggregate project data from more than 26 distinct departments, boards, conservancies, and commissions overseen and supported by CNRA. While not all entities are currently reporting within RAPTR, this system is project centric and designed to collect data that will allow for tracking implementation and outcomes of projects related to the stewardship of California's natural, cultural, and historical resources.

In some cases, local Californian entities implemented publicly available systems for tracking the progress of projects that have been funded. For example, the North Coast Resource Partnership hosts a project tracker with project descriptions, estimated costs, and progress metrics (NCRP Project Tracker, n.d.).

Quantifying Benefits of Adaptation

A challenge in tracking adaptation finance is the lack of resources to monitor and evaluate the effectiveness of spending and set the stage for even more effective and impactful financing in the future. An inherent issue with monitoring and evaluation is that successful adaptation is often the absence of a bad outcome, and project performance comes in the form of a loss avoidance, thus success is difficult to recognize and quantify. Evaluating these types of benefits requires a broad-based approach that looks across large areas and multiple beneficiaries over longer time scales unlike typical project-based monitoring associated with adaptation projects.

Quantitative estimation of the economic benefits of adaptation plays a critical role in prioritizing investments. This typically involves projecting economic damages with or without a project under specific emissions scenarios and timeframes (USGCRP, 2023). While uncertainty exists, such as with emissions trajectories; non-monetary or difficult-to-quantify costs, and solutions, of climate change; discount rates; and indeterminate tipping points in the climate system (IPCC, 2023; USGCRP, 2023), these analyses are essential in motivating and scaling adaptation project finance, especially for risk-

transfer finance mechanisms. (See ***Case Study 1: Valuing flood reduction benefits***). Recent advances in capabilities for modeling flood adaptation actions with tools such as CoSMoS-Adapt are poised to help decisionmakers consider local factors and estimate tradeoffs between early and delayed investments in adaptation (Reguero et al., 2026). Advancements in computational power and artificial intelligence have also initiated new efforts towards modeling the impact of mitigation including Digital Twin experiments to look at alternative outcomes with and without mitigation (Dale et al., 2023; Destination Earth, n.d.).

(1) Valuing flood reduction benefits of marsh restoration in the San Francisco Bay

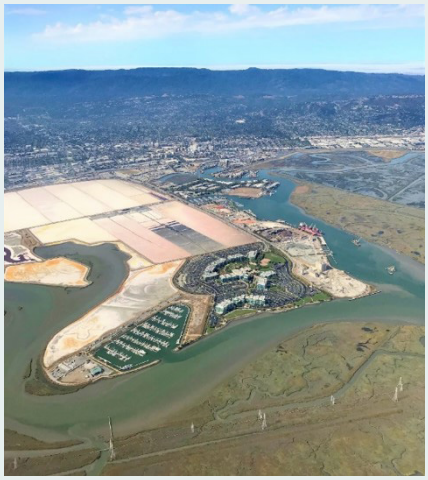
Location: San Mateo County, California

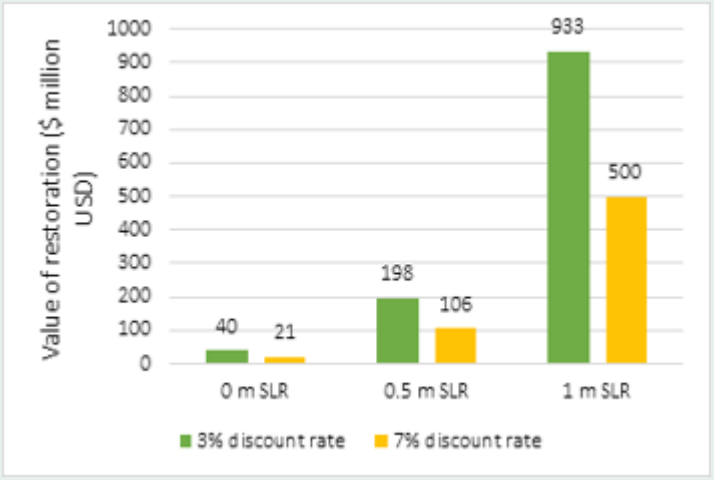
Background: There is growing evidence for the beneficial role that wetlands can play in reducing flood risk. However, in many urban estuaries, coastal development has resulted in dramatic habitat loss and fragmentation. Researchers at UC Santa Cruz performed a high-resolution study to quantify the social and economic flood risk reduction benefits of salt marsh restoration currently and with climate-driven changes in storms and sea levels as a nature-based flood defense for the bay side of San Mateo County. The study confirms where stakeholder-identified potential salt marsh restoration could have the greatest socioeconomic impacts in reducing flood risk and the role that habitat restoration may play in building community resilience to climate change.

Economic Benefits: The benefits of marsh restoration vary across San Mateo County, based in a large part on locations of existing defenses (levees), marsh size and location, and social and economic assets. Overall, marsh restoration decreases flooding but has stronger effects on flood depths than flood extents. By reducing flood extents, marsh restoration reduces the number of people impacted by flooding. With projected sea level rise, the benefits of marsh restoration increase, particularly around Foster City and Redwood Shores, as regional levees are increasingly overtopped. Under current conditions, the risk reduction afforded by 7,200 acres of marsh restoration countywide is over $21 million (gross benefits). The value of marsh restoration countywide increases five-fold to $106 million with just 0.5 meters of sea level rise and by a factor of more than 20 to $499 million with 1 meter of sea level rise. The marsh with the greatest potential restoration benefits per acre covers 36.3 acres near San Francisco International Airport and provides over $350,000 per acre in benefits under current conditions. With a 0.5-meter rise in sea level, the flood reduction benefits of marsh restoration near San Francisco International Airport increase to more than $3.75 million per acre.

Key challenges and opportunities for California: As climate change progresses, and sea level rise and flooding put communities at increasing risk, protecting and restoring wetlands can ameliorate the social and economic impacts to coastal communities in San Mateo County and beyond. While this study was focused on a single site and county, this approach may be applied to a diverse array of communities in estuaries in California and worldwide. Quantifying the benefits of nature-based solutions, such as salt marsh restoration, will allow for greater opportunities for incorporating them into a holistic set of climate resilience investments.

More information: Rae Taylor-Burns et al. 2024. Nature Scientific Reports





Aerial image of part of the San Mateo County shoreline, showing healthy and degraded marsh habitat. Restoring degraded marsh habitat can reduce flood risk (Left). Summary of total benefits (present value) of flood reduction provided by marsh restoration in San Mateo County under 3 different sea level rise (SLR) scenarios. Present value is calculated for 7,200 acres assuming a 50-year lifespan, with discount rates of 3 percent and 7 percent (Right).

III. Adaptation Funding and Financing Mechanisms and Actors

Key Messages

California uses multiple finance mechanisms for adaptation and resilience projects, each with its own strengths and limitations

Finance mechanisms can result in socioeconomic equity impacts depending on how they function or who can access them, making it essential to consider equity when raising and disbursing funds

This report highlights five key groups of actors involved in adaptation finance—public sector, private sector including, but not limited to, insurance and financial institutions, household, and philanthropy

Distinguishing Funding versus Financing

Funding and financing are both critical pieces of enabling climate adaptation projects. Funding, generally provided in the form of grants, is important in enabling climate adaptation projects with broad public benefits and limited opportunity for repayment. Financing, rather than funding, can be appropriate when any of the following conditions are met (Georgetown Climate Center, n.d.-b):

1. The climate adaptation measure requires more capital than is readily available at that time
2. An asset can be identified that is able to generate revenues which can be used to pay for at least some of the project costs
3. The project is expensive and the resulting asset has a long lifetime over which costs can be spread to future users
4. Financial incentives exist for other entities, including private companies, to participate in a financing approach in a way that reduces or eliminates costs, and/or
5. Policies or laws provide incentives for investors to participate in the financing approach, such as tax credits.

This climate adaptation finance report includes examples that demonstrate "blended finance" models for adaptation projects that combine funding and financing from multiple actors as sources of capital.

Existing Financial Mechanisms Can Be Deployed to Address Adaptation

The actions required to build a climate-resilient California range from small to monumental, touch every sector, and require a host of key actors. Capital is required for implementation of these actions and is raised and dispersed through a variety

of mechanisms. These mechanisms are grouped into 7 categories including bonds, grants, taxes, investments, fees and assessments, loans, and insurance (Figure 6). In this report, the unique strengths and weaknesses that make mechanisms better suited for some contexts than others (e.g., project sizes, sectors) are explored. In some instances, combinations of funding, such as blended finance, and finance tools can be layered to drive enhanced investment. There is not a singular solution for funding and financing adaptation actions. Public funding remains particularly important for projects with broad public benefits and limited direct repayment potential. The choices of decision makers in the selection of finance and funding structures affect who bears the costs and risks of projects and can sometimes shift vulnerability to other stakeholders which highlights the importance of viewing climate adaptation finance and funding as an interconnected system.

This section distinguishes among four related but different functions within adaptation finance. As previously mentioned, funding refers to money that does not need to be repaid, such as grants, taxes, appropriations, fees, or philanthropic support. Financing refers to repayable capital, such as loans or bonds, which requires a revenue source, savings stream, tax base, rate base, or other repayment mechanism. Risk transfer refers to tools such as insurance, reinsurance, risk pools, parametric coverage, or catastrophe bonds that move residual financial risk but do not, by themselves, reduce underlying physical risk. Investment in risk reduction refers to spending on measures that reduce expected losses, such as home hardening, flood protection, ecosystem restoration, heat resilience, or wildfire mitigation. These functions often interact, solve different problems, and should not be treated as interchangeable.

Each mechanism is relevant to raising and dispersing capital for climate adaptation. Finding the right finance mechanism depends on a range of factors including the project size or maturity, timing, repayment source, data requirements, risk allocation, equity impacts, and durability of funding over the project lifecycle. Examples of these different considerations include:

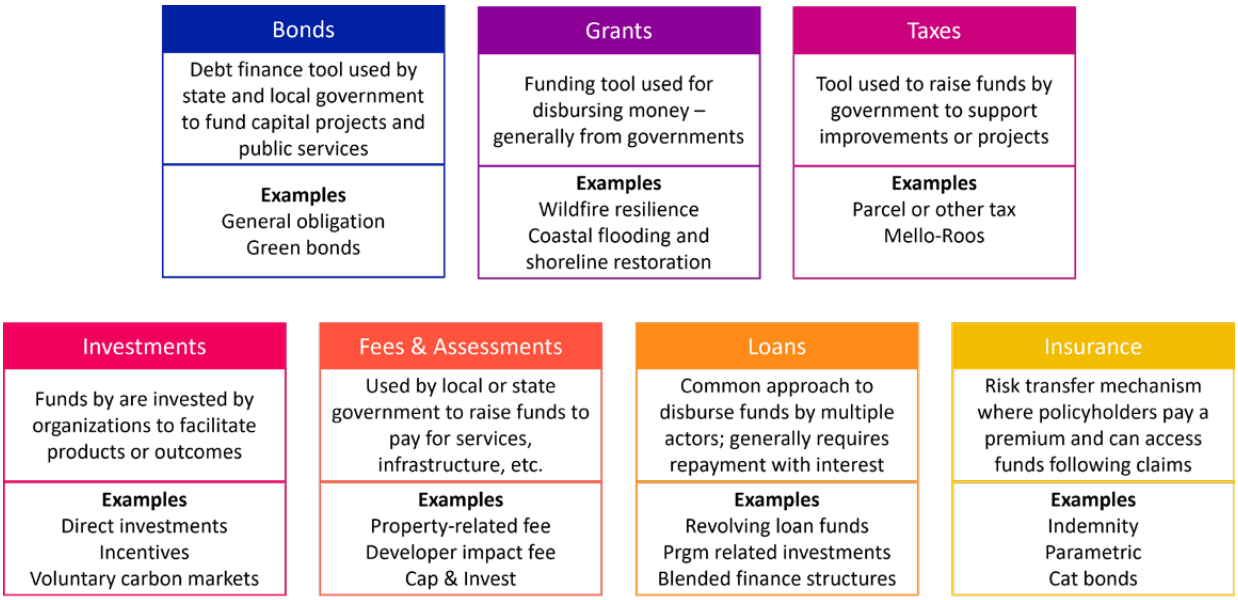
- Large infrastructure projects were historically funded through bonds and taxes and can be leveraged for infrastructure projects that integrate climate adaptation considerations. Investors tend to be familiar with, and fairly comfortable with, these secure investments, particularly for projects with high upfront costs and long-term benefits. However, bonds and taxes require voter approval and gaining engagement in voting on ballot measures can be challenging. In addition, ballot measures to pass bonds can trigger concerns of affordability or prioritization compared to other measures. Additionally, these capital sources often do not fund planning or monitoring.
- Smaller climate adaptation projects that are not eligible for financing through bonds and taxes may employ other mechanisms such as outcome-based

financing and microinsurance. These are more flexible but may have less investor confidence.

- One-time funding versus continuous funding can be an important factor in deciding which type of mechanism is appropriate for funding climate adaptation projects. Tax and fee programs (e.g. sales tax increases or fees on water bills) to fund climate change adaptation provide continuous funding sources. In contrast, rebates and grants, including from government and philanthropy, provide one-time funding.

Appendix B provides a comprehensive overview of finance mechanisms and their strengths and challenges.

Figure 6.



Categories of mechanisms that practitioners can assess to identify funding and financing pathways.

Socioeconomic Equity Considerations Can Impact Access to Adaptation Finance

Climate change disproportionately affects vulnerable and socioeconomically disadvantaged individuals and communities. Policy and planning efforts often exacerbated the inequitable impacts of climate change by overlooking the social, economic, and environmental consequences (Eriksen et al., 2021; Prall et al., 2023). A history of racial discrimination in finance and housing policies has left socioeconomically disadvantaged communities less equipped to prepare for and recover from extreme weather disasters (Fenlock et al., 2024). Some researchers have found initial evidence that financial institutions like banks and insurance companies are increasing prices or withdrawing services from regions they perceive to be

at high environmental risk—regions that tend to be where communities of color and low-income communities have been driven to as a result of historic redlining, discrimination, and disinvestment (Montgomery & Palmeira, 2023). This practice, known as "bluelining," can undermine adaptation efforts by reducing access to credit, insurance, and investment in vulnerable areas and increase financial barriers to resilience-building projects, thus reinforcing existing disparities in climate resilience capacity (Montgomery & Palmeira, 2023).

Beyond bluelining, socioeconomically disadvantaged communities face structural barriers that make adaptation finance difficult to access. These barriers include complex and burdensome processes; limited capacity and expertise; high debt burdens, restricted access to credit and homeownership, and discriminatory development and land use decision-making (Georgetown Climate Center, n.d.-b).

Public financing presents its own set of challenges. While public financing can build socioeconomic equity through targeted spending for under-resourced communities, many public funds are competitive, one off, and focus on new projects rather than long-term planning, maintenance, and monitoring. For example, FEMA's Building Resilient Infrastructure and Communities (BRIC) grants explicitly do not cover the long-term operations, routine maintenance, or ongoing monitoring of a project (TEMA, n.d.). As a result, climate adaptation projects awarded short-term funding may run out of resources before project completion, have difficulty capturing success metrics to apply for future funding rounds, or fail to provide underserved communities with the resources needed to enable long-term success of the adaptation measure. This is particularly important in underserved communities as they may not be able to sustain projects long-term without dedicated funds, given limited resources to meet immediate needs.

While not specifically focused on adaptation finance, research on the accessibility of federal funding programs to underserved communities highlight key barriers including, difficulty in applying for funds due to complex application processes with limited support; stringent eligibility requirements to include matching funds or history of good financial standing; and state and federal funding policy misalignment (Foster, 2026). Litigation risks and unintended impacts of anti-fraud provisions alongside persistent historical disparities rooted in discriminatory funding practices further compound the challenges these communities face (Foster, 2026).

Special taxes by local governments—which can be employed to fund local climate adaptation projects—present challenges as an equitable adaptation funding instrument. Special taxes can be regressive in nature and therefore place a higher burden on low-income communities (ITEP, n.d.). Special taxes are regressive when they apply the same tax rate to all taxpayers, resulting in low-income earners paying

a larger share of their income than high-income earners. Additionally, special taxes in wealthy jurisdictions may raise more funds compared to under-resourced communities, leading to adaptation inequities between local communities.

Exploration of other mechanisms for funding adaptation can be used to alleviate some of these concerns. For example, new special districts called Climate Resilience Districts (CRDs), recommended in the Climate Insurance Report (Climate Insurance Working Group, 2021) and enabled through recent changes in California law (*California Code, GOV 62301,* n.d.), allow for tax and other financing districts to be formed based on boundaries that are not constrained to city, county, or other local jurisdictional boundaries. The concept for these districts is derived from a suite of other financing districts that have been successful in California for accomplishing large public-benefit projects including Geological Hazard Abatement Districts (GHADs) and Infrastructure Financing Districts. CRDs present opportunities to strategically ensure tax burdens are shared more equitably and smaller areas affected by climate-related hazards can fund resilience projects. However, CRDs have been underutilized to date. While CRDs offer flexibility to address climate risks, challenges remain in creating, filling, and implementing these districts (CA FWD, 2026).

Several other financial structures are designed to distribute costs with equity in mind. Bonds can be structured so that interest is repaid from the cost savings of risk reduction measures, lowering the likelihood that socioeconomically disadvantaged communities bear a disproportionate share of bond repayment burden (Georgetown Climate Center, n.d.-a). Community Development Financial Institutions (CDFIs) were created to offer financial services to low-income and disadvantaged communities. In addition, Public-Private Partnerships (PPPs) can extend the public dollars by leveraging private sector expertise and resources to assist underserved communities to secure grants or implement projects (Adaptation Clearinghouse, 2014).

For more insights to social and socioeconomic equity, see the Fifth Assessment's "Racial Equity and Climate Justice Statewide Topical Report".

A. Key Actors and Strategies for Adaptation Finance, By Sector

Supporting climate finance and funding requires a range of capital from actors across the investment ecosystem (Hera (fka Climate and Resilience for All) and Tailwind Futures, 2025). Each investment actor has a distinct role in their contributions to adaptation finance. Identifying mechanisms to bring them together via different financial stacks can help ensure synergistic finance and funding to deliver adaptation projects at scale. This report focuses on five key actors, including public, insurance, private, household, and philanthropy (Figure 7).

Figure 7.

The Adaptation Finance Capital Stack



Key domestic capital actors that contribute to adaptation finance. (Source: Adapted from Hera and Tailwind Futures).

Adaptation finance mechanisms can also be understood by the function they perform, not only by the actor that deploys them. This distinction is useful because public grants, municipal debt, insurance, BIDsCommunity Development Financial Institution (CDFI) lending, outcome payments, and philanthropic capital solve different financial problems. Some provide non-repayable funding, while others provide upfront capital that must be repaid, transfer residual risk, reduce the cost of capital, or create incentives for verified outcomes or risk reduction. Framing mechanisms by function can help decision-makers match tools to adaptation needs, rather than assuming that all forms of capital are interchangeable. (Table 1).

Table 1.

Finance function	Examples	What problem it helps solve	Main limitation
Non-repayable funding	Public grants, philanthropy, federal/state programs	Supports public-good adaptation where no direct revenue stream exists	Often limited, competitive, and not always durable
Upfront repayable capital	Municipal bonds, loans, infrastructure banks, CDFI lending	Provides capital for projects with a repayment source, tax base, rate base, or other revenue stream	Requires repayment capacity and may increase debt burden
Risk transfer/ liquidity	Insurance, parametric insurance, risk pools, catastrophe bonds	Provides post-event funding and transfers residual financial risk	Does not reduce underlying physical risk unless paired with risk-reduction measures
Credit enhancement/ concessional support	Guarantees, first-loss capital, subsidized loans, blended finance	Improves terms or reduces risk for other investors	Does not create a repayment source on its own
Outcome-based payments	Pay-for-success models, resilience credits, performance-based grants	Links funding to verified outcomes or avoided losses	Requires credible measurement, a payer, and durable payment mechanism
Enabling/ project preparation capital	Technical assistance, feasibility grants, community capacity funding	Helps projects become financeable or implementation-ready	Often underfunded and hard to sustain

Overview of finance mechanisms by their functions, key examples, use and limitation. (Source: authors).

1. Public Financing Provides the Most Capital in the Adaptation Financial Stack

Key Messages

- The public sector plays a significant role in funding and financing climate adaptation in California, but needs are outpacing available resources
- Transparency and statutory requirements to provide benefits to disadvantaged communities are strengths of public sector funding
- Federal, state, and local governments share responsibility for adaptation finance and funding
- Federal funding uncertainties can affect state and local adaptation planning, implementation capacity, and long-term project pipelines
- California's adaptation finance landscape is shaped in part by the availability and stability of federal support

The role of the public sector in funding and financing climate adaptation in California is significant—the majority of climate adaptation finance comes from public sources (Climate Policy Initiative, 2024, 2025; Mazzacurati & MacDonald, 2024). Federal, state, and local governments raise funds primarily through taxes and bonds, and disburse them, primarily in the interest of public benefits and priorities established through democratic processes rather than private interests. Furthermore, public funding for climate finance has historically been stable compared to other actors' contributions. For these reasons it can have a multiplicative effect of stimulating additional investment from other actors.

Historically, public funding has been the bedrock of adaptation finance in California and is particularly well suited for climate adaptation in underserved communities. Statutory requirements exist for some public sector funding to support specific populations based on social vulnerability and other metrics. For example, Proposition 4, also known as Climate Bond and passed in 2024, specifies that at least 40 percent of the funding must help communities that are most vulnerable to climate-fueled disasters and are least able to deal with the impacts (LAO, 2025c). California Climate Investments programs, which is the branding used for the portfolio of programs funded by the state's Cap-and-Invest revenues, are required to provide benefits to California's disadvantaged communities and low-income communities and households, collectively referred to as priority populations (California Climate Investments, n.d.). Revenues deposited into GGRF support a range of climate-focused programs. As of October 2025, 76 percent, or $11.4 billion+, of implemented California Climate Investments project funding is benefiting priority populations, greatly exceeding the statutory requirement of 35 percent (CARB, 2025). Cap-and-Invest was reauthorized in 2025 with some changes to funding breakdowns which will

affect funding flows due to California's budget deficit. Proposition 4 and GGRF helped sustain existing programs previously funded through the general fund but did not significantly expand overall adaptation funding or finance from the state.

Another strength of public sector funding is the requirement to be transparent, which improves accountability. For example, California Climate Investments programs are required to provide clear and consistent public access to information on program activities, conducting oversight and audits, tracking project status, and reporting the estimated benefits, including GHG emissions reductions, co-benefits, and benefits to priority populations.

Despite the strengths of public funding, adaptation needs vastly outstrip the funding capacity of California, necessitating other forms of climate finance. Furthermore, public spending on climate adaptation competes against other socioeconomic priorities (e.g., education, housing, social services, and disaster response). It can be challenging to prioritize climate adaptation when the risks may be (or perceived to be) long term and in competition against more immediate priorities.

Adaptation finance and funding traditionally have been shared responsibilities among the federal, state, and local governments (Badding, 2021). This shared responsibility is demonstrated and operationalized through matching fund requirements, intergovernmental partnerships, and cross jurisdictional coordination. This shared role is primarily the result of historical joint responsibility for infrastructure and roles in disaster response and recovery. For example, responsibility for the financing and management of critical water infrastructure (e.g., dams, reservoirs) in California is shared between the US Army Corps of Engineers, the California Department of Water Resources, and local water agencies with unique arrangements in each location within the state. As another example, under the Coastal Zone Management Act, the National Oceanic and Atmospheric Administration is responsible for administering the Act, but states can set laws beyond borders to protect and develop their coast, with federal, state, and local governments coordinating one review.

The US Federal government, in particular the Federal Emergency Management Agency (FEMA), historically played the largest role in disaster recovery funding with matching funds often coming from state agencies and local governments sometimes linked to participation in mitigation programs for reducing future losses. FEMA traditionally provided billions of dollars in funding for adaptation and resilience to states and local communities through programs such as the Hazard Mitigation Grant Program (HMGP), Flood Mitigation Assistance (FMA) and Building Resilient Infrastructure and Communities (BRIC) Grants usually with a three-to-one cost share between the federal government and state and local agencies (Atkinson, 2025). Local jurisdictions often used taxes or bonds to raise funds to meet FEMA's grant local match requirements which were generally 25 percent of the total project cost

(Atkinson, 2025). Many smaller and low-resourced jurisdictions are unable to meet this match requirement and therefore cannot apply for these funding sources, though local matching can have broad implications depending on the jurisdiction. The BRIC program was a significant shift in FEMA's approach to mitigation funding, as it provides funding for resilience and upgrades to infrastructure and planning before a disaster, while the Hazard Mitigation Program only provides funding after a disaster (though it is often used for future resilience planning efforts in the wake of disasters). Over the past year, however, federal priorities shifted away from providing this assistance and there has been increasing pressure for states and local governments to fill the void left behind. While the federal administration launched the BRIC program in 2020, all BRIC grant applications were canceled from fiscal years 2020 to 2023, returning $3 billion in undisbursed grant funds to the Treasury or the Disaster Relief Fund (Table 2).

In July 2025, California and 19 other states filed a lawsuit against FEMA accusing the agency of unlawfully canceling the program (Lieb, 2025). In December 2025, a federal court found the termination of the program to be unlawful. In March 2026, the court ordered FEMA to reinstate the program. As a result, BRIC was reinstated in March 2026 (Lieb, 2025). FEMA published a combined FY2024-2025 opportunity on March 25, 2026, with $1 billion available.

FEMA also attempted to cancel the Flood Mitigation Assistance (FMA) grants for 2025 and stopped approving new allocations for the Hazard Mitigation Grant Program (HMGP) in April of 2025 (Atkinson, 2025). FEMA eventually reopened the FMA of its own accord, describing the changes as aligning the opportunity with national priorities, with an amended FY2024 opportunity up to $600 million on April 30, 2026.

Two federal wildfire-related funding opportunities are of particular importance for California's adaptation funding. The Fire Management Assistance Grant (FMAG) is emergency funding that FEMA approves while a fire is still burning, covering firefighting costs on state and private land (FEMA, 2026). While this grant itself is a response tool rather than a mitigation grant, receiving FMAG also unlocks a separate pool of mitigation resources called HMGP Post Fire, which funds defensible space, fuels reduction, and ignition resistant construction. No presidential disaster declaration is required. California regularly uses this channel, and there were 67 FMAG declarations nationally in FY2025. In 2025 and 2026, there have been reports of delays or nonpayment of post fire funding after FMAGs.

The federal government advocated that state and local governments take on more responsibility to mitigate hazards, including climate hazards. President Trump proposed "fundamentally overhauling or reforming" FEMA, or "maybe getting rid" of it entirely (Yilek, 2025). However the FEMA Review Council's final report published in March 2026 does not support ending FEMA (FEMA Review Council,

2026). Furthermore, a federal bill seeking to reform FEMA is focused more on improving coordination with states rather than placing the burden on states and local jurisdictions (GovTrack.us, n.d.).

According to the San Francisco Bay Area Planning and Urban Research Association (SPUR), in the Bay Area alone, more than $270 million in federal funding for resilience and adaptation projects was cancelled between January and July of 2025. The previously mentioned court orders have reversed some of these cancellations, but delays and gaps in funding persisted.

Steep budget and staff cuts are also being experienced by federal agencies that historically played critical roles in hazard research and mitigation, including the National Weather Service, the National Oceanic and Atmospheric Administration, the US Geological Survey, National Institute of Standards and Technology, and the US Army Corps of Engineers. Under the current Trump administration, funding also froze for climate and ecosystem research, including the US Geological Survey's Climate Adaptation Science Centers. These nine regional centers assist ecosystems and communities in adapting to climate change. Their work includes tracking invasive species, protecting water supplies, and improving wildfire forecasting. Funding cuts will likely impact projects related to sustainable agriculture, shoreline protection, and the preservation of species, among others (Wootten et al., 2025).

In summary, while the Federal government historically has provided the largest share of funding and finance to support adaptation, this funding has become less reliable moving states to innovate how they acquire finance to meet this gap. This ebb of capital flows from the federal government for climate adaptation also impacts the foundational data and staff needed to understand the changing climate and how those risks are being transformed.

Table 2.

Grant Program:	Hazard Mitigation Grant Program
Enabling Legislation	Stafford Disaster Relief & Emergency Assistance Act of 1988 (Stafford Act)
Year Started	1989
Available Only After a Presidential-ly Declared Disaster?	Yes
Funding Source	Disaster Relief Fund (DRF)
Funding Approved FY 2023/2024	2023: $140.7 million No HMGP funding approved for declarations since March 18th, 2025
Current Status	Not cancelled but not flowing

Table 2. (Continued)

Grant Program:	Flood Mitigation Assistance
Enabling Legislation	National Flood Insurance Reform Act of 1994
Year Started	1997
Available Only After a Presidential-ly Declared Disaster?	No
Funding Source	NFIP policy-holders and Infrastruc-ture Investment and Jobs Act
Funding Approved FY 2023/2024	2023: $800 million (NOFO) 2024: $600 million
Current Status	Active

Table 2. (Continued)

Grant Program:	Pre-Disaster Mitigation (PDM)
Enabling Legislation	Disaster Mitigation Act of 2000
Year Started	2003
Available Only After a Presidential-ly Declared Disaster?	No
Funding Source	DRF
Funding Approved FY 2023/2024	2023: ~$233 million made available for 100 Congression-ally directed projects
Current Status	Inactive after 2023; BRIC replaced part of PDM in 2018

Table 2. (Continued)

Grant Program:	Building Resilient Infrastructure and Communities (replaced PDM)
Enabling Legislation	Stafford Act, Disaster Recovery Reform Act of 2018
Year Started	2020
Available Only After a Presidential-ly Declared Disaster?	No
Funding Source	6 percent set-aside from DRF
Funding Approved FY 2023/2024	2023: $1 billion; 2024 & 2025: $1 billion
Current Status	Active (returned by court order)

Table 2. (Continued)

Grant Program:	HMGP Post Fire
Enabling Legislation	Stafford Act Section 404 and 420, both amended by DRRA Section 1204 (2018)
Year Started	2019 (FMAGs on or after Oct. 5, 2018)
Available Only After a Presidential-ly Declared Disaster?	No – triggered by a Fire Management Assistance Grand declaration
Funding Source	Disaster Relief Fund
Funding Approved FY 2023/2024	Funded per FMAG on a sliding scale
Current Status	Authorized; many FY2025-26 FMAGs without awards

Federal funding programs cuts affected by changes in administration and priorities adapted from 'Financing climate adaptation and hazard mitigation, part 1: Federal cuts increase bay area's risk' (Source: Atkinson 2025).

2. Insurance and Disaster Risk Finance Sector

Key Messages

- Insurance and disaster risk finance are important components of California's adaptation finance landscape because they transfer residual risk, support recovery, and in some cases, reinforce risk-reduction behavior
- Insurance is not a substitute for physical adaptation investment; its effectiveness depends on underlying risk reduction, affordability, availability, and coverage clarity
- Insurers and re-insurers are major institutional investors, giving the sector influence on adaptation beyond the actions of their policyholders
- The residential insurance market has historically been the largest source of post-event financing but reduced availability, higher costs, and non-renewals are reshaping this role; new regulatory reforms and policy initiatives aim to stabilize the residential insurance market, improve access to coverage, and protect consumers

Why Insurance Matters for Adaptation Finance

While insurance operates within the private market, here it is addressed separately because it plays a distinct role in adaptation finance through its risk transfer mechanism. Insurance is offered and purchased in differing capacities by private and public entities which are independently discussed in this section. Research has found that people with insurance tend to recover faster and more completely than those without insurance and are more likely to rebuild after a disaster (Kousky, 2019; Turnham et al., 2011). These benefits extend beyond the insurance policyholder, as uninsured losses from disasters can harm economic output but when disasters are well-insured, economic growth is less likely to be impacted and the overall economy recovers more quickly (von Peter et al., 2012). A healthy insurance market in the face of rising climate-related risks is critically dependent on risk reduction and adaptation. At the same time, innovation in insurance mechanisms and incentives can catalyze this transformation, especially when they are layered with other financing as will be discussed further in this report. Insurance companies can incentivize resilient building and retrofitting decisions by including resilience improvements in risk assessments and insurance pricing. Insurers can also support faster recoveries after disaster by underwriting policies that provide critical, rapid payouts to help individuals, businesses, and communities get back on their feet (Climate Insurance Working Group, 2021).

Insurance and disaster risk finance are important pieces of California's broader adaptation and recovery landscape, helping households, businesses, and public entities manage residual risk that cannot be fully avoided, access post-disaster liquidity, and in some cases strengthen incentives for risk reduction (Kousky, 2019). The extent to which the insurance sector can offer this supporting role in adaptation finance depends on the extent to which it is demanded of insurers by policyholders and regulators, interactions with land-use and other policy decisions, and market conditions. While insurance is an important solution as part of a larger system for risk reduction, recovery finance, and long-term resilience investment, an important limitation is that risk-transfer cannot solve repeated high frequency loss without underlying risk reduction or retreat from high-risk areas.

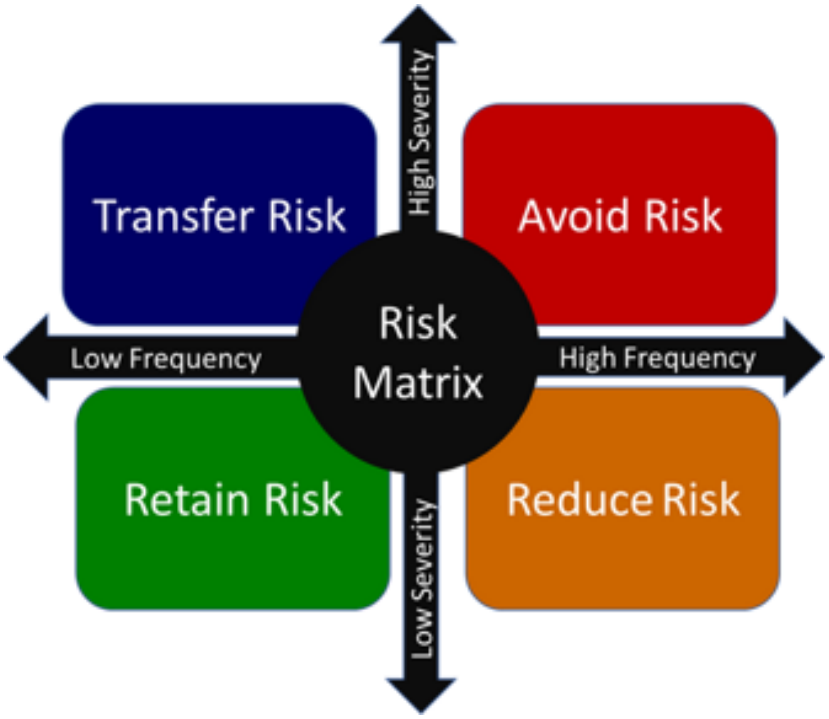
In addition to their role in recovery, insurance and re-insurance companies have become some of the largest institutional investors by investing their collected premiums to raise capital to pay claims, cover costs, and earn a return (Wong, 2023). The scale of California's insurance market gives the sector influence over both post-disaster recovery and broader capital allocation towards adaptation. Within California, the total property-casualty market across all lines reached $124.2 billion in 2024 and homeowners' multiple peril insurance premiums reached $15.4 billion (NAIC, 2025).

For many Californians, changes in insurance availability, pricing, and coverage terms are among the earliest financial signals of growing climate risks. Further information on these impacts can be found in the Fifth Assessment's "Climate Impacts to the Economy Statewide Topical Report." Impacts to insurance affordability and availability may be experienced by individuals and businesses long before they experience a clear climate-related loss. Depending on how it is structured and priced, insurance can create incentives for adaptation where underwriting, pricing, or access to coverage recognizes verified risk reduction. Conversely, if insurance enables continued exposure in high-risk areas without corresponding risk reduction, it can reinforce, rather than reduce, vulnerability (Conway, 2026a).

Figure 8 offers a simplified approach to consider risk management strategies. Faced with a probable impact from climate change, such as potential loss of a commercial facility to a destructive flood, an entity has several choices in how they manage that risk. They may retain the risk, accepting the damage that may occur to the facility and the financial consequences of that damage. They may avoid the risk, for example by moving that facility out of the area that may flood. They may reduce that risk through a strategy like raising the elevation of the facility. Lastly, they may transfer that risk by purchasing insurance to cover any financial losses should damage occur, which transfers that risk to the insurance company. Each of these strategies have tradeoffs and entities often employ a combination of strategies to manage climate-related risks.

In general, risk transfer tools (e.g. insurance) are best used to manage low frequency, high severity residual risks that cannot be cost-effectively avoided or reduced and are expensive to retain, while high frequency and/or high severity risks generally require risk reduction (e.g. home hardening) or avoidance (e.g. relocation) rather than insurance alone. Lastly, individuals and businesses may want to retain that risk if the risks occurring are often at low frequency and low severity. In practice however, many adaptation strategies combine all four of these management options. Californians need a robust insurance market and the ability of that market to provide the service of risk transfer is dependent on the stability and size of that risk. As climate change impacts intensify and risks become too large for the insurance sector to "own", a sustainable insurance market is predicated on collectively managing risks through risk avoidance, risk reduction, and risk transfer in a way that is mutually beneficial.

Figure 8.



Illustrative risk management options by event frequency and severity, including where risk transfer may be most appropriate. (Source: authors).

How Insurance Works for Adaptation Finance

Two broad insurance structures are specifically discussed here for adaptation and disaster risk finance: indemnity and parametric insurance. The indemnity insurance model can be effective at "making people whole", albeit slowly, and improve recovery outcomes when consumers are informed and purchase the appropriate coverage to fully insure the property, and a competitive marketplace exists. The parametric model of insurance involves structuring a policy around a pre-defined claims payment amount with a predefined trigger for payment following a loss to provide fast and reliable capital for recovery.

The rising frequency of losses and acknowledgment of additional vulnerabilities has spurred interest in more novel models of insurance to fill the gaps in coverage that indemnity insurance lacks, including parametric insurance models. A Climate Insurance Working Group assembled by Insurance Commissioner Lara recommended exploration of parametric insurance structures in California to address climate-related perils (Climate Insurance Working Group, 2021). While insurance and parametric tools mainly manage residual financial risk and post-event liquidity, they support adaptation most directly when paired with investments or incentives that reduce the underlying physical risk.

Indemnity model of insurance *pays based on actual covered loss, up to the policy limit. This is the familiar model used in most homeowners, renters, and auto insurance policies. It can support recovery by helping policyholders repair or replace damaged property, although claims adjustments and payment may take time.*

Parametric model of insurance *pays a pre-defined amount when a measurable event meets an agreed threshold, such as flood depth, wind speed, or temperature. Because payment does not depend on adjustment of the actual loss, parametric products can provide faster liquidity after a disaster. However, the payout may not match a policyholder's actual losses.*

Emerging approaches include products designed to provide rapid post-event liquidity, address protection gaps for underinsured perils like extreme heat, or provide coverage to restore natural systems. California is becoming a testbed for these new models of insurance in the US (***See Case Study 2: Accounting for forest management, Case Study 3: Community-based flood insurance, and Case Study 4: Parametric flood insurance for a California municipality***). As climate-related losses increase and coverage gaps become more visible, interest is growing in products that combine elements of indemnity insurance with the speed or flexibility of parametric structures.

(2) Accounting for forest management in pricing and underwriting

Location: Truckee, CA

Financial structure and collaborators: The UC Berkeley Center for Law, Energy & the Environment (CLEE), The Nature Conservancy (TNC), and Willis Towers Watson (WTW), collaborated to design, develop, and place a $2.5 million wildfire resilience insurance policy for the Tahoe Donner Association (Tahoe Donner), a 6,500-home community in forested northern California, underwritten by Globe Underwriting and Liberty. This parametric insurance policy triggers a payout up to $2.5 million, at a predetermined amount per acre to Tahoe Donner if any of their 1,345 insured forested acres are burned. The payout is flexible and can be used to restore recreational use on burned land, or directly support affected homeowners (Insurance for Good). As a result of Tahoe Donner's established forest management efforts using prescribed fire and thinning, it secured a 39 percent lower premium and an 89 percent lower deductible for the community (The Nature Conservancy). Importantly, the wildfire resilience insurance policy was written in a heavily forested area where other insurers are not renewing or writing insurance, because the insurer took the risk reduction benefit of landscape-scale fuel reduction through forest management into account in its modeling of wildfire risk.

Mechanism for resilience: This project leverages risk reduction and risk transfer strategies to increase climate adaptation and resilience. It provides a financial incentive for the property owners to proactively invest in risk reduction while also working to increase forest resistance to future high-severity fire (Tamm review; Thinning with follow-up burning treatments). By quantifying the wildfire risk reduction actions, this insurance policy increases insurance availability and affordability. The policyholder's resilience to disaster is increased through forest management and the insurance payout, which may be used to rebuild or support recovery.

Implementation/project status: This policy was announced in 2025 and has not been triggered to payout. The Nature Conservancy paid the first year's premium.

Key challenges and opportunities for California: This project demonstrates the technical feasibility of incorporating forest management into existing insurance modeling for underwriting and pricing and is replicable in other large commercial property owners or Homeowners Association (HOA) contexts. Because they realize efficiencies of scale, HOAs can serve as early adopters and testers of innovative risk transfer and finance strategies. This project has not yet demonstrated HOA willingness to pay for an insurance premium, which could be a barrier to scaling. In the future, home and small business property insurers can take forest management into account in their writing, renewing, and pricing of insurance. States, including Colorado and California, have also taken additional steps to require insurers to take property and community mitigation, including landscape-scale forest management, into account in the models they use for insurance rate making (Colorado: HB25-1182|2025; California: Safer from Wildfire, Catastrophe modeling and ratemaking).

More information: Technical report: Risk reduction from forest management accounted for in first-of-its-kind wildfire resilience insurance; Wildfire Resilience Insurance: Quantifying the Risk Reduction of Ecological Forestry with Insurance



(3) Community-based flood insurance

Location: Isleton, CA

Financial structure and collaborators: In 2024, the Isleton pilot launched an innovative community-based and parametric flood insurance program spearheaded by the California Department of Insurance (CDI) and backed by a contributed to flood modeling. The Delta Geologic Hazard Abatement District (GHAD), a special district formed by the City of Isleton in 2023, acts as the policyholder and will disburse funds to residents (California Department of Insurance). The policy provides a maximum aggregate payout of $2.5 million to the GHAD, which will then disburse up to $10,000 to each property owner upon a trigger event. The parametric trigger for the policy is a "pre-determined height" of floodwaters, measured by a sensor at the town's wastewater pumping station.

Mechanism for resilience: The project leverages layered, community-based risk transfer to improve economic resilience for a region that is highly vulnerable to floods, and to close the insurance protection gap (less than 50 percent of Isleton residents have flood insurance). The parametric structure provides rapid, flexible payouts intended to cover immediate post-flood needs, such as evacuation and temporary lodging, where indemnity insurance is limited or delayed (Insurance for Good – Lessons from Isleton). The community-based approach aims to promote equity by providing a "safety net" for all residents, particularly those without traditional flood insurance, or by meeting the high $10,000 deductible for property owners who do have traditional flood insurance.

Implementation/project status: The policy is in place, and a public grant covers the insurance premium until 2026. A second DWR funded grant is focused on expanding the GHAD to other islands in the Delta. Future funding for the premium is unclear, although a voter-approved property tax assessment to fund premiums is being considered. The policy has not yet been triggered for payout.

Challenges and opportunities for California: This is an innovative structure that demonstrates the value of special districts (e.g., GHADs or Climate Resilience Districts) in supporting climate adaptation in under-resourced communities. It also shows the potential of layering indemnity and parametric insurance coverages and risk pooling at the community level. Community-based insurance strategies hold great potential, although identifying long-term funding streams for the premiums is a barrier to adoption. This project was incubated by CDI and DWR, in collaboration with many others, demonstrating the government's role in catalyzing innovative insurance strategies.

More information: Small Delta town piloting first-in-the-state flood insurance initiative (ABC10 News); This tiny California town is flooded, broke—and reimagining climate insurance (KQED)

(4) Parametric flood insurance for a California municipality: rapid and flexible payouts for cities after disaster

Location: Fremont, CA

Financial structure and collaborators: In 2024, the City of Fremont in the Bay Area purchased a parametric flood product that leverages continuous, near-real-time flood monitoring data from Floodbase, brokered by Alliant Insurance Services Inc. and Amwins Group Inc., and backed by SwissRe. A payout to the City is triggered when a certain percentage (8.7 percent) of the City's limits is flooded. The payout can be spent according to the City's needs. Had the policy been placed at the time, a Floodbase estimates that a 2017 flood would have triggered a payout over $700,000 (InsTech).

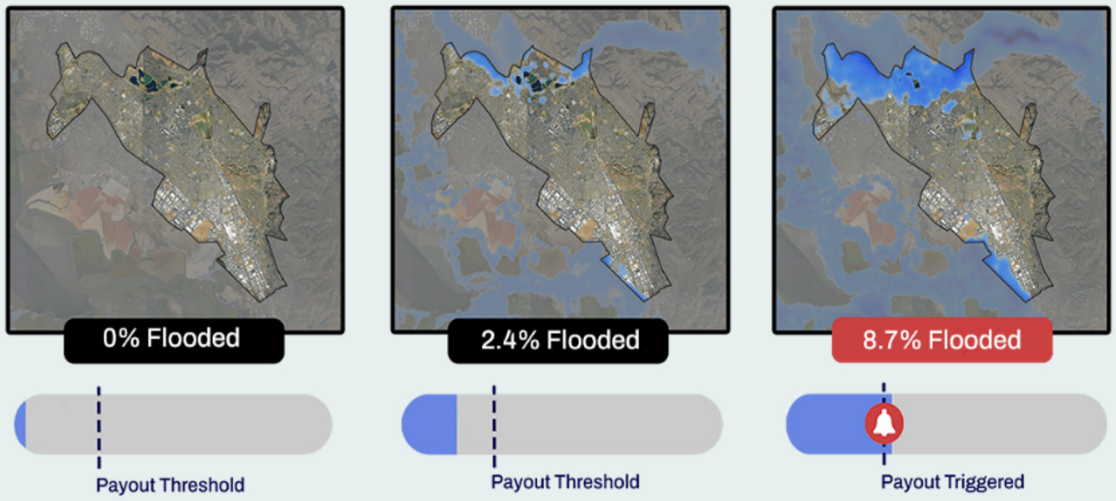
Mechanism for resilience: This case study uses risk transfer to increase resilience after a qualifying flood. Unlike traditional insurance or FEMA aid, which can be slow, a clear, objective trigger provides certainty and ensures the city has immediate access to liquidity after an emergency. The city has complete flexibility to allocate the funds as needed, e.g., towards emergency response, rebuilding infrastructure, or even covering uninsurable economic losses, such as lost tax revenue (Bloomberg).

Implementation/project status: This policy was announced in 2024, renewed in 2025 and 2026, and has not been triggered to payout. The customer and policy holder is the City of Fremont, which also pays the premium. Other California cities joined Fremont in buying a similar policy in 2025 and 2026. This flood data and insurance is available for all local governments and businesses across California. Floodbase maps flooding every hour across the state in real time and goes back every day for decades.

Key challenges and opportunities for California: Identifying "who pays" is a significant barrier to scaling innovative risk transfer policies, but this case study demonstrates that California municipalities are willing to pay for parametric insurance. This suggests that scalability is possible for California municipalities with the interest in and capital to pay a premium. Municipalities currently rely on FEMA and/or state-level aid to recover from disasters, which provides a powerful disincentive against purchasing disaster insurance. If uncertainty in federal disaster

aid persists or grows, this could change. Parametric policies can also be structured to direct payouts to incentivize building back better or support other efficiencies, further enhancing community climate resilience.

More information: Floodbase



Demonstrative trigger levels for the City of Fremont. Image Credit: FLOODBASE

Insurance by Customer Segment: Households, Public Entities, and Commercial Actors

Homeowners

For many mortgaged homeowners, maintaining property insurance is effectively required as a condition of financing, making homeowners' insurance a central form of household disaster risk finance. While the share of owner-occupied mortgage-free homes in California has been increasing in recent decades, resulting in fewer homes subject to this requirement, homeowners' insurance remains an important source of post-disaster funds (US Census Bureau, 2026). Flood insurance is excluded from most homeowners' insurance and is primarily provided by the federal government's National Flood Insurance Program (NFIP). Yet, less than 2 percent of Californians have flood coverage. Research has shown that flood insurance uptake is low even when premiums are substantially lower than average payouts per coverage amount and that the relationship between NFIP flood insurance price and uptake is relatively inelastic (Bradt et al., 2021; Wagner, 2022). Informational gaps and behavior biases can be important determinants of flood insurance uptake. Low flood insurance uptake and growing coverage gaps indicate that many households effectively retain a substantial share of disaster risk themselves, whether by choice or by constraint. Further discussion of these expenses will take place in a later section on household spend.

Recent insurance related laws within the last decade provide financial relief in ways that support climate adaptation leveraging the risk management options as illustrated in the risk matrix of Figure 8. One option to manage climate-related risks is to avoid the risk by moving people, property, or infrastructure out of harm's way.

In California, in the case of a "total loss" on a homeowner's insurance policy, insurance companies may not limit or deny the ability for insurance payouts to be used for rebuilding in a new location or for purchase of an already built home at a new location (California Insurance Code section 2051.5(c)(1)). In the event that the policyholder chooses to rebuild or purchase in a new location, the payout is required to remain the same without any deduction for the value of land at the new location (California Insurance Code section 2051.5(c)(2)) (California Legislature, n.d.-a). These policies allow homeowners to use their payout following a wildfire to migrate to less risky areas.

When climate-related risks cannot be avoided entirely by removing structures from harm's way, another strategy for adaptation is reducing risk by retrofitting or rebuilding with more resilient construction and landscaping. Some aspects of a traditional home insurance policy can be leveraged to encourage this behavior. Law and ordinance coverage is a supplemental coverage that can be added to an insurance policy that allows the insured to receive additional funds after a loss in order to bring the building into compliance with current building codes. If building codes have been strengthened to address climate-related risks over time, this can allow individuals to adapt their property to be more resilient as they recover from a disaster (Kousky, 2024). In California, insurers are required by statute to include in their homeowners' insurance some additional coverage for building code upgrades, no less than 10% of the dwelling coverage policy limit, allowing policyholders to improve the resilience and efficiency of their home when rebuilding (California Insurance Code section 10103(c)).

If a residential property insurance policyholder in California experiences a loss during a declared state of emergency, they are legally allowed to combine the coverage limits from their primary dwelling and other insured structures in order to cover expenses reasonably necessary to rebuild or replace the damaged or destroyed dwelling (California Insurance Code section 10103.7(a)) (California Legislature, n.d.-b). This allows homeowners the funds needed to recover more completely. Regulations on the insurance industry within the state also require insurers to offer premium discounts for properties that undertake wildfire home hardening actions (CDI, 2022). These laws remove barriers for homeowners to adapt to climate change and maintain a healthier housing and real estate sector. While costs of hardening homes or meeting zone zero compliance are high relative to discount costs, as the discounts are derived from amortization of the risk-reduction benefit over many years,

these adaptation measures are key to reducing long-term wildfire risks. Supporting homeowners to meet these costs and reduce their financial burden and risks will require state and other financing mechanisms.

Some examples of these policies exist for flood insurance. The National Flood Insurance Program includes an option for Increased Cost of Compliance (ICC) coverage that provides up to $30,000 to help bring the home into compliance with any current floodplain management regulations in the event of a loss. However, this option has limited uptake given limited awareness of the program and the relatively low cap compared to the cost of elevating a home, the primary mechanisms for fortifying homes against flood (Kousky, 2024).

For wildfires, homeowners who cannot secure private insurance from the admitted market can acquire insurance through the FAIR plan, which is a syndicated fire insurance pool comprised of all insurers licensed to conduct property/casualty business in California. The FAIR Plan was established to meet the needs of California homeowners unable to find insurance in the traditional marketplace. It is not a state agency or public entity, and there is no public or taxpayer funding (California Fair Plan, n.d.-a). The FAIR Plan is funded primarily through premiums paid by policyholders. This program has experienced tremendous growth over the past two years as private insurers have reduced growth within the state. As of September 2025, the FAIR Plan's total exposure reached $696 billion, a 52 percent increase in one year, or a 317 percent increase over the past four years (California Fair Plan, n.d.-b). This growth indicates the increasing importance of residual market mechanisms in California's property insurance landscape and highlights how private market availability became a central adaptation finance concern.

Another source of private insurance is the excess and surplus lines market, a less-regulated market for buyers typically not covered by secure standard admitted coverage. Separate from the FAIR plan, excess and surplus lines generally are meant to cover risks that are too high or complex compared to traditional standard insurance and unique to the policyholder (e.g., art collections, exceptionally high-value homes). With several major insurers restricting or withdrawing capacity from the California market, California's surplus lines homeowners' insurance market expanded dramatically from about 50,000 policies in 2023 to 320,000 in 2025 (SLACAL, 2025).

The insurance market and consumers in California face pressing issues in a changing insurance landscape. Consumers and insurers have been affected by the increasing and accelerating risks of climate change with impacts particularly acute in areas at risk of wildfire. Referring back to the risk matrix of Figure 8, as the frequency and severity of wildfire increases, risk reduction becomes an increasingly important piece of managing climate-related risks, in addition to the risk transfer that insurance provides. CDI is helping policyholders reduce and transfer that risk by implementing

a Sustainable Insurance Strategy, the most significant insurance reform in three decades. This strategy aims to enhance market stability, improve consumer access to coverage, and reduce reliance on the FAIR Plan (CDI, n.d.). A key element of the Sustainable Insurance Strategy includes greater use of catastrophe models that incorporate risk reduction actions and consideration of reinsurance costs for insurers who commit to increasing writing policies in areas experiencing significant insurance accessibility issues. In contrast to approaches that rely primarily on historical losses, catastrophe models simulate a wide range of plausible future events and can better reflect changing hazard conditions and risk reduction practices. Access to advanced modeling should spur investments in wildfire risk reduction as the models quantify the impact of these risk reduction actions in a way that creates clearer signals for underwriting, pricing, and long-term resilience and mitigation planning. Recent research on California's homeowner's insurance market suggests that access to high-resolution data may allow more granular classification of wildfire risks, which could lead to more insurance availability and lower prices for many customers (Boomhower et al., 2025). At the time of writing, the full impacts of the Sustainable Insurance Strategy on affordability and availability are not yet able to be assessed, but at least nine major insurer groups have submitted filings to increase writing because of these reforms.

In the flood cat modeling space, the California Ocean Science Trust and researchers from UC San Diego's Scripps Institution of Oceanography, explored opportunities for better incorporation of flood risk-reduction actions into modeling and insurance decisions in a report developed for CDI (Pinto & Corringham, 2026). This report provides recommendations to deliver improved cat modeling for floods and better incentivize risk reduction.

Commercial Insurance and Corporate Entities

For larger corporate entities, insurance is also a major source of disaster risk financing. Many companies establish a captive, generally defined as an insurance company that is wholly owned and controlled by its insureds, to facilitate internal risk management strategies and provide coverages where it is otherwise unavailable. Captive insurance provides an alternative risk transfer mechanism used to finance risk. Similarly, corporate entities regularly deploy parametric insurance, catastrophe bond programs which are investable financial instruments that pay out after a major natural disaster, strategic retention levels and other sophisticated risk finance tools. Some firms are experimenting with approaches that connect insurance purchasing to broader climate goals, including efforts to direct premium-related capital from commercial or corporate entities towards climate-positive investments (e.g., Premiums for a Planet B corporation).

One commercial insurance segment that has experienced enormous growth recently, and is placing unique strains on insurance systems, is insurance for large data centers. Data centers present unique challenges for insurance companies as billions of dollars of equipment and infrastructure must be insured at a single location, concentrating the potential for large losses. These data centers are being built in locations across the country that are exposed to climate-related hazards. For Zurich, a leading commercial insurer, severe weather was the leading cause of loss in their Data Center Builder's Risk portfolio in the last three years. Insurers are encouraging data center builders to adopt more resilient construction practices due to their concentration risks (ZurichNA, 2026).

Public Entities

Public entities, including municipalities, schools, transit authorities and other government agencies, also face growing climate-related financial exposure. Traditionally, some have relied on a combination of insurance coverage options that may include property-casualty coverage through municipal risk pools and private insurers. (***See Case Study 5: Climate insurance facility for urban infrastructure***). Most public entities have traditionally relied on FEMA to provide substantial reimbursements for property losses caused by federally declared disasters, but this reliance is precarious given the funding cuts to FEMA and changes in federal priorities. FEMA implements certain terms in which lack of insurance for a public building that experiences a loss can reduce the available recovery dollars or trigger insurance requirements for that building moving forward as a condition of future funding access. Recently, interest among public entities in non-traditional models for insurance has grown alongside recognition that state and local governments may be made increasingly responsible for disaster recovery costs (Amwins, 2025). (***See Case Study 6: Parametric flood insurance***).

(5) Climate insurance facility for urban infrastructure: pooling risk across multiple cities

Location: Latin America

Financial structure and collaborators: In 2024, Local Governments for Sustainability (ICLEI), collaborated to create the Urban Infrastructure Insurance Facility (UIIF). The project is funded by the KfW Development Bank on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ) and involves a risk pool funded by the participating cities themselves. UIIF helps cities assess their individual climate risk, which will inform the development of bespoke insurance products. (In this context, a 'Facility' is an entity that organizes and facilitates access to specific types of risk information and insurance.)

Mechanism for resilience: By pooling risk across cities, this effort leverages economies of scale to increase insurance availability and affordability for urban regions with high natural disaster risk. In the event of a natural disaster, the insurance payout provides a mechanism for the rapid delivery of financial resources for infrastructure and to support vulnerable residents, preventing a single event from derailing long-term development goals.

Implementation/project status: In 2024, with support from ICLEI and other experts, 10 Latin American cities initiated urban risk assessments and are now progressing towards procuring risk transfer solutions through public tender processes. The Facility subsidizes the premium for the first three years, and afterwards, it is implied that the participating cities will bear the full cost.

Challenges and opportunities for California: The multi-city, collaborative Facility model for pooling risk across multiple municipalities could be replicated in California to improve access and affordability of insurance solutions for infrastructure and vulnerable communities. Climate Resilience Districts and Geological Hazard Abatement Districts are cross-municipality/special district financing tools that might be used for this type of coordination. The program is in its early days and benefits to the cities have not yet been demonstrated. While municipalities in the US are disincentivized from purchasing insurance by government disaster aid programs, increased uncertainty in federal disaster aid are likely to make strategies like this more compelling.

More information: Urban Infrastructure Insurance Facility; Seven Latin American cities pioneering climate insurance with Urban Infrastructure Insurance Facility - ICLEI

(6) Flood protection and insurance solutions

Location: Imperial Beach, California

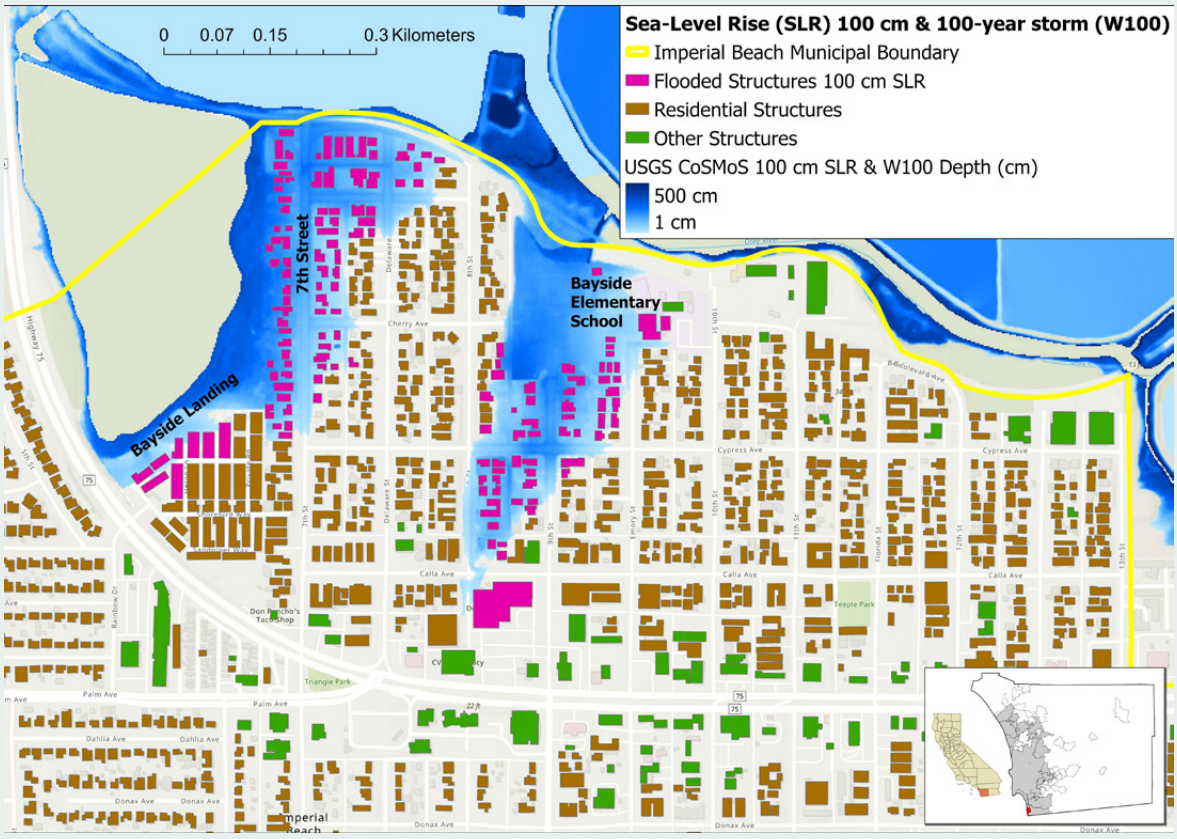
Background: Imperial Beach, the southernmost city in California, faces flood risk from the Pacific Ocean, San Diego Bay, the Tijuana River Estuary, and extreme onshore precipitation events. Under current conditions, nuisance flooding already occurs when storm drains overflow during high tides and storm events. Modeled losses to the Bayside community (adjacent to San Diego Bay) increase sharply under projected sea level rise, signaling growing exposure for households and public agencies. To address this flood risk from San Diego Bay, the City of Imperial Beach proposed an ecotone (horizontal) levee paired with stormwater system upgrades, a stormwater detention basin with tidal gate, and vaulted pump station (City of Imperial Beach, 2025). If implemented and FEMA-accredited, the project could reduce expected flood losses to residents and to the City and support floodplain remapping through a FEMA Letter of Map Revision. Remapping could remove protected areas from the Special Flood Hazard Area, eliminating mandatory National Flood Insurance Program (NFIP) purchase requirements for properties with federally backed mortgages.

Economic Benefits: By reducing nuisance flooding, standing water, and storm-driven inundation, the project has the potential to lower public cleanup costs, reduce damage to local infrastructure, and improve day-to-day community conditions. Thxe project also delivers secondary co-benefits, including a safer bikeway for multiple users, restoration of coastal habitats, additional and enhanced recreational space, and a stormwater detention basin that function as recreational open space during dry periods. These benefits may generate cost savings and new economic opportunities, creating a net positive impact for both the Bayside community and the City of Imperial Beach's General Fund. The NFIP remapping provides an insurance-related incentive to invest in proactive flood mitigation.

Key challenges and opportunities for California: Imperial Beach is not unique in its need to address existing and future flooding that impacts community character and economic sustainability. With projected sea level rise, coastal communities across California must decide how to mitigate their risks and which strategy to implement (grey, green, and/or hybrid). These strategies provide differing levels of flood protection and imply differing levels of residual financial risk. When paired with appropriate risk-transfer mechanisms, flood reduction investments can improve post-disaster liquidity, reduce fiscal uncertainty, and increase public agencies' capacity to pursue innovative flood-protection strategies. Options products triggered by measurable storm or water-level thresholds, insurance-

linked securities that transfer risk to capital markets, and performance-based coverage tied to infrastructure performance.

Implementation challenges identified in Imperial Beach—which are likely applicable to other coastal communities—include aligning insurance products with municipal needs, fiscal capacity, and the community's level of risk aversion. Stable funding and community trust are critical, as introducing innovative insurance tools without long-term financing, market partners, or resident buy-in risks can create unsustainable programs or unmet expectations. Important information gaps exist regarding the differences between NFIP and private homeowners' insurance, including uncertainty about coverage and the implications of flood-protection investments. Clearer communication about how these products interact is critical, particularly as the public and private flood insurance landscape evolves.



SLR 0 cm (2010): Exposure 27 structures, $12.3 million; Event Loss $2.9 million; AAL ~$40 thousand
SLR 25 cm (2050): Exposure 72 structures, $49.1 million; Event Loss $13 million; AAL ~1.6 million
SLR 100 cm (2069): Exposure 193 structures, $158 million; Event Loss $51 million; AAL ~$16 million

Figure caption: Modeled changes in average annual loss from coastal flooding in Imperial Beach under a no-action scenario, using USGS CoSMoS projections. Results show escalating expected annual damages, underscoring the potential value of combining flood-risk reduction with financial risk-transfer strategies.

More information: City of Imperial Beach Notice

The Role of Agents and Brokers

As resilience standards, mitigation measures, and specialized products become more important in California, insurance agents, brokers, and managing general agents (MGAs) may play a larger role in adaptation finance. These intermediaries help translate knowledge between insurers, policyholders, developers, and public entities. They can influence whether risk-reduction actions are recognized in underwriting, help policyholders navigate changing coverage options, and support the design and placement of specialized products such as community-based, parametric coverage, or municipal products.

Their role is especially important where products are novel or unique, where resilience features need to be documented and valued, or where multiple parties need to be coordinated. In that sense, distribution and intermediation are not peripheral to adaptation finance; they affect whether innovative insurance structures are understandable, accessible, and scalable.

Brokers: *represent consumers and help them find the best insurance policies but do not have the authority to underwrite or bind coverage*

Independent Agents: *represents multiple insurance companies with the authority to underwrite or bind coverage for consumers*

Managing General Agents: *specialized type of agent vested with underwriting authority by one or more insurance companies who take on the risk when a policy is written*

3. Private Capital

Key Messages

- Private capital can scale adaptation when there is a repayment source, revenue stream, cost saving, asset-value benefit, or contractual payer to help reduce climate-related disruptions
- Key barriers to private sector finance include uncertain value and use of adaptation measures, unclear returns, lack of readily available investment or lending vehicles, and benefits that may not become investable cash flows

- Investments and lending are the primary private sector financing mechanisms
- Carbon credits with adaptation co-benefits can provide an avenue for private investment in adaptation but can have uncertain or highly variable outcomes; new "coastal resilience assets" provide a mechanism for valuing nature-based risk reduction

Private finance can play an important role in climate adaptation both for public and private benefits. The private sector can support adaptation finance and funding by directing capital towards green technologies, projects, and businesses that can help address growing risks and adaptation challenges. Banks can help businesses transform their operations to become more resilient through incentives. Investors can help businesses and communities adapt their housing and infrastructure by investing in bonds that finance adaptation projects or in companies that provide products and services that enable adaptation efforts. In the US, public equity markets are 2.3 times larger than the US GDP (as of June 16, 2026), illustrating the depth of the pools of private capital (Longterm Trends, n.d.). Directing even a small fraction of private capital towards adaptation could unlock meaningful resources to supplement public funding.

Funding and finance from private actors can help scale adaptation and resilience to provide new business opportunities, reduce costs, and/or avoid losses from climate impacts and related business disruptions. This can occur with the existence of a repayment source, revenue stream, cost saving, asset-value benefit, and contractual payer. Beyond managing their own exposure to risks, businesses need local communities to be resilient as they depend on public infrastructure and employees coming to work to operate. More broadly, economic resilience is part of community resilience. Communities thrive with resilient local businesses, which provide jobs and are part of the fabric of local communities. Last but not least, the private sector can be a source of innovation, bringing to market products and services that make adaptation "cheaper, faster, better" (Steyer, 2024).

However, there are barriers to directing private capital towards adaptation. A lack of awareness of adaptation needs and a limited understanding of the specific adaptation measures required remain prevalent outside pockets of expertise. Many adaptation financing needs do not generate revenue or returns within the required mandates of various stakeholders, the primary driver of private financing. Even when projects meet the criteria to generate interest from private institutions, the lack of readily available investments or lending opportunities also limits the ability to deploy large amounts of private capital into adaptation projects. In addition, a repayment source, revenue stream, cost saving, asset-value benefit, and contractual payer need to be identified before private finance occurs. And while adaptation benefits are economically real, such as flood attenuation with mangroves, these benefits are not automatically investable cash flows, making the risks higher for private investors.

New "coastal resilience assets", which will be described further in the carbon credits component of this section, have been developed to make these risk-reduction solutions investible.

Private capital is often used to finance public projects. For example, municipalities commonly issue bonds purchased by private investors. The capital raised from the bonds can be used to finance public infrastructure projects which are repaid later with either taxes and/or revenues from the infrastructure. One example is Proposition 4 which authorizes $10 billion in general obligation bonds for water, wildfire prevention, and protection of communities and lands, with a requirement for annual audits (LAO, 2025c). Similarly, governments can borrow from private banks. While both raise money for projects, they differ in who is involved, how funds are raised (selling bonds or loan agreement), and tax implications.

Private Finance Can Generally Be Classified into Two Large Buckets: Investing and Lending

Investments are transactions where the investor provides money in exchange for the expectation of a later gain. An investor may purchase part or all of an asset with the goal of earning returns from the asset and/or reselling the asset later at a higher price. (***See Case Study 7: Venture Investment***). The expectations on the returns vary by the type of investment and its risk profile. Private investments in adaptation can include, for example:

- Purchasing shares in a company that sells adaptation products or services (e.g., an engineering firm that does coastal resilience projects)
- Purchasing bonds from a local water utility to finance an upgrade of the system in the face of uncertain water supply
- Investing in an infrastructure project that provides resilience services to others and/or is built to withstand the impacts of climate change that generates revenues to pay back the investment
- Investing in a startup that is developing an innovative adaptation product or service like a new fire-retardant coating for houses or local flood sensors

Lending refers to the provision of money in exchange for interest and future return of the capital. Lenders are typically banks or other credit institutions (e.g., credit unions, CDFI) which can loan funds for various reasons, including for climate and adaptation projects. For example, these loans can finance home upgrades to become more resilient (e.g., fire-resistant roof and windows), improve business efficiency (e.g., installation of a more water efficient process), mitigate risks (e.g., move its facility away from a floodplain), or start a new business that provides resilience products and services to others. (***See Case Study 8: CDFI funded resilience building***).

(7) Venture investment in adaptation solutions and services

Location: California, State-wide

Financial structure and collaborators: Venture capital firms generally raise funds from institutional investors (e.g., foundations, pension funds, and insurers) and are usually structured with general partners that manage the fund and limited partners that contribute capital to the fund. Many companies who develop solutions and services to respond to physical climate risk in California receive venture capital investment. For example, Pano AI, based in San Francisco, developed early wildfire detection solutions using cameras and computer vision and raised $44 million in Series B funding. Rain, based in Alameda, raised close to $20 million to date, including a $9.7 million seed round led by DBL Partners, to build wildfire mission autonomy software that enables aircraft to suppress fires within minutes of ignition.

Mechanism for resilience: Venture capital funds represent a critical segment of investors that focus on early-stage and high-risk investments, including in firms offering climate adaptation solutions. These investments can fill a unique niche by taking on risks that other capital providers may not be willing to take. They effectively become baseline capital for innovative adaptation solutions to attract broader financial support if and when they reach full commercial scale.

Implementation/project status: Not applicable as this case study is about a type of financing.

Challenges and opportunities for California: Development of adaptation solutions and services grows ever more important as climate hazards increase. California has a robust venture capital market and investors are increasingly focused on climate technology. The ecosystem for climate adaptation solutions and services is supported by strong research institutions driving technological development and by a corporate and public sector increasingly demanding tools and solutions for climate risk reduction. Venture capital is one critical component of the broader universe of capital needed to support innovative adaptation-relevant businesses with funding and secure revenue streams to grow and scale deployable technology and solutions rapidly.

More information: The Adaptation and Resilience Innovation Playbook

(8) BIDsCommunity Development Financial Institution (CDFI) funded resilience building–CCRC

Location: Los Angeles County, CA

Financial structure and collaborators: California Community Reinvestment Corporation (CCRC) is a California-based CDFI focused on financing multifamily affordable housing. In April 2025, CCRC donated $25,000, matched by the Federal Home Loan Bank of San Francisco (FHLBank SF) through its Disaster Relief Member Matching Contribution Program to support Neighborhood Housing Services of Los Angeles County, a nonprofit serving low- and moderate-income homeowners in wildfire-impacted communities like Altadena. CCRC channeled funds to a partner already working on the ground, making this less a strategic shift and more of a potentially replicable model for how a lender can route funding into disaster recovery.

Mechanism for resilience: Beyond this specific grant-based funding, CDFIs play a critical role in the finance landscape in the US given their focus on underserved communities and ability to deploy diverse capital including low-interest loans, credit enhancements, bonds, and tax credit financing. The diversity of financing mechanisms available to CDFIs makes them uniquely able to reduce the overall cost of capital for projects and to therefore draw in commercial capital.

Implementation/project status: Not applicable as this case study is about a type of financing.

Challenges and opportunities for California: California has more than 100 certified CDFIs. This makes CDFIs well situated to structure low cost of capital resilience investments at the nexus of philanthropic capital, grants, and private debt. CDFIs generally have relatively small loan portfolios, and many are not yet specialized in climate risk and adaptation, so they function best as part of a broader financial ecosystem for investment in risk reduction and resilience.

More information: CCRC Partners with FHLBank San Francisco to support wildfire recovery; 2023 Federal Reserve CDFI Survey

Carbon Credits

Carbon credits provide an avenue to price climate change into investment decision making and have been leveraged for adaptation finance with uncertain or highly variable outcomes. Carbon credits are tradable financial instruments with each credit unit nominally representing a commitment to remove one ton of carbon dioxide from the atmosphere or avoid emitting one ton of carbon dioxide that would have

otherwise entered the atmosphere. Carbon markets are conceptually divided into mandatory programs, such as California's Cap-and-Invest Program and Voluntary Carbon Markets (VCM), which are decentralized marketplaces used by organizations and individuals to offset their emissions voluntarily to meet their own targets or objectives. (***See Case Study 9: Non-recourse project financing***).

Proceeds from carbon markets can be used to fund adaptation projects, such as those funded by California's Cap-and-Invest Program as highlighted in Figure 5. While carbon credits themselves have traditionally focused on mitigation of greenhouse gas reductions, rather than adaptation to climate change, some carbon credits include adaptation co-benefits. This is illustrated by the Delta Conservancy wetlands restoration projects in the Sacramento-San Joaquin Delta. For this project, carbon credits are certified through the American Carbon Registry (ACR) and made available for trading with the proceeds funding restoration projects that protect against flooding, enhance biodiversity, and reduce emissions (ACR, 2017). Recent research on ACR carbon accounting methodology demonstrated that the quality of the offset (i.e., the ability to deliver on reduced emissions) produced under this methodology is highly dependent on the project type and risk of reversal (e.g., through forest fire or sea level rise) (Taylor-Burns et al., in review). Carbon credits with adaptation co-benefits can provide an avenue for investment in adaptation by private entities that may not otherwise be drawn to the issue of adaptation but have business or regulatory need to offset their emissions.

Carbon markets have also emerged as a tool for funding "blue carbon" ocean conservation and restoration projects with adaptation co-benefits. Blue carbon credits have not suffered the same degradation of investor trust as forest credits and have additional value attributed to them because of co-benefits. Therefore, they are more likely sold at a premium in voluntary carbon markets. While blue carbon market integration is still in its infancy in California, efforts are underway to understand the monetary value of blue carbon sequestration in California estuaries spanning the coast including Humboldt Bay, the Elkhorn Slough and the Tijuana River estuary (Wedding et al., 2021). State agencies in California are beginning to incorporate blue carbon sequestration into statewide carbon inventories and climate mitigation and adaptation plans (CARB, n.d.). At the same time, the future and public benefit of this adaptation financing mechanism will continue to be highly dependent on the evolution of carbon accounting methodologies, carbon markets, and maintaining the storage of offset carbon.

Recently, the Center for Coastal Climate Resilience (CCCR) at the University of California, Santa Cruz partnered with The Nature Conservancy in developing a methodology for creating verifiable, investible "Coastal Resilience Assets" for wetlands. These assets are valued based on the flood protection provided by the wetland and provide an avenue for upfront investment in nature-based solutions.

The methodology was evaluated and published by Verra, the manager of a major voluntary carbon-market program in April 2026 (TNC et al., 2026).

(9) Non-recourse project financing for US afforestation in the voluntary carbon market

Location: Southeastern US

Financial structure and collaborators: In 2025, BMO Capital Markets acted as Joint Lead Arranger alongside JP Morgan Chase Bank, N.A., CoBank ACB and East West Bank in a landmark transaction for voluntary carbon removal credits, consisting of a $200 million Construction-to-Term Loan Facility, and a $10 million Letter of Credit facility. Chestnut Carbon, LLC, ("Chestnut") is a nature-based carbon credit project developer located in the United States. Through a wholly owned subsidiary, Chestnut has developed afforestation, reforestation and revegetation projects. The Project seeks to acquire and restore 60,000+ acres of land to native and biodiverse forest by planting millions of trees across the Southeastern US. The Project will generate and ultimately sell carbon removal units ("**CRU**"s) pursuant to a 25-year fixed price and volume Carbon Removal Units Purchase Agreement with Microsoft Corporation. The contract is one of the largest carbon removal agreements in the United States. CRUs generated by the Project will be registered with the Gold Standard, an internationally recognized standard and registry in the voluntary carbon market. The Project will also be certified with Forest Stewardship Council, a global non-profit leader in sustainable forestry operating the world's most trusted forest certification system. These certifications aim to guarantee that the Project meets the highest environmental and social standards, providing assurance to buyers who seek to purchase high quality carbon offsets.

Mechanism for resilience: This landmark transaction leverages future high quality carbon removal units to fund practices that contribute to ecosystem resilience, improved soil quality, and reduced erosion through afforestation, restoration, and revegetation.

Implementation/project status: Finance secured in 2025

Challenges and opportunities for California: No immediate clear barriers to this structure in California

More information: PR Newswire: Chestnut Carbon announces pioneering non-recourse project financing for US afforestation in the voluntary carbon market

4. Household Spend

Key Messages

- Household spend on adaptation varies with household income. Wealthier households and those that encounter lower adaptation costs can increase adaptation measures to offset higher insurance premiums whereas lower-income households and those with higher adaptation costs tend to reduce adaptation when insurance premiums rise
- The divergence in responses can lead to inequities in the spatial distribution of adaptation and widen the gap in climate resilience
- Community level home hardening is more cost effective than post-disaster rebuilding

Individuals and families are financing climate adaptation directly through household budgets. About $48-$60 billion USD is spent by households on adaptation globally (Hera (fka Climate and Resilience for All) and Tailwind Futures, 2025). They purchase products like storm roofs and doors, fire-resistant landscaping, flood management equipment, and specialized financial products that facilitate adaptation. Household buy-in to resilience building interventions is one pillar of advancing broader community resilience, alongside, but much smaller in proportion, to public support and institutional private investment. However, there are differences in how low-income and high-income households respond to adaptation. Wealthier households and those that face lower adaptation costs can increase adaptation spend to respond to higher insurance premiums whereas lower-income households and those that face higher adaptation costs tend to reduce adaptation spend when premiums rise (Ge et al., 2026). Thus, lower-income households and those facing higher adaptation costs would benefit from obtaining subsidies, low-cost finance, technical assistance, consumer protection, and insurance or regulatory incentives to enable them to reduce climate risks. Without these support mechanisms, adaptation costs may be shifted onto households least able to pay, thus increasing affordability inequities in the consumers who need assistance the most. Moreover, the financial capacity to adapt can shape the spatial distribution of reduced risks across the landscape between communities or homeowners (Anderson et al., 2023).

An Earth Economics analysis identified 616,000 to 770,000 California homes are at risk from wildfire and $16 billion to $20 billion is needed to moderately harden all homes in wildfire zones (Risner & Delaney, 2025). Headwater Economics assessed hardening costs for a two-story, 2,000 square-foot single family home and found it would cost between $2,000 for minimal retrofits and more than $100,000 for the highest protection level (Barrett & Quarles, 2024). In 2025, Headwater Economics and the Insurance for Business and Home Safety (IBHS) estimates that building to IBHS' "Wildfire Prepared Home Plus" standard, which incorporates protective construction

characteristics and defensible spaces, adds only 2-3 percent for constructions costs on a $500,000 home (Barrett & Hawks, 2025). Investment in residential resilience often comes directly from household budgets, alongside public funding from municipal, state, and federal programs, and instances of incentives from banks and insurers. Of the projected $3.6 billion in state dollars invested in wildfire resilience from 2020 through 2029, only $38 million was earmarked for home hardening (LAO, 2025b).

Many home hardening measures cost much less than post-disaster rebuilding and increasingly public grants and rebate programs and insurance structures can enable household investment in resilience building (Frost, 2025). Still, retrofits and other hardening measures are prohibitively expensive for many families and households and many homeowners underestimate risk or lack information about risk mitigation strategies. The California Department of Insurance's 2026 Strengthening California Homes Grant Program is being designed to help residents reduce wildfire risk, build more resilient communities, and gain better access to homeowners insurance options. When successfully implemented at a community level, individual residential resilience investments can reduce community wide risk.

5. Philanthropy

Key Messages

- Philanthropic capital, ranging from small, individual donations, to large organizational foundations, is often for the benefit of society and specific public causes of interest
- Grants, donations, and low or no-interest loans are common uses of philanthropic funds
- Access to philanthropic capital relies on networks which may lead to equity issues, but an important strength of this finance type is its flexibility

Philanthropy can provide direct funding for projects or provide catalytic capital to attract other actors and finance mechanisms. Their funds are especially important for project preparation, data, technical assistance, community capacity, first-loss layers, or outcome payments. However, philanthropic funds are rarely a durable substitute for recurring public budgets, ratepayer systems, insurance premiums, or other payment sources.

Philanthropic capital refers to donations and grants made by organizations (businesses and non-profits) and individuals who have accumulated wealth and are choosing to give away some of their assets for the benefit of society and specific public causes of interest. These donations can be small, individual donations, such as online donations to neighbors after a local disaster, or large grants of millions of

dollars distributed through structured processes run by large foundations. Together with public funding, philanthropic grants are a critical source of capital for non-profit organizations that can be spent on adaptation activities. These include raising awareness of climate impacts, helping communities develop adaptation plans, or supporting outreach from local community groups to prevent heat illness during heat waves. While most philanthropic capital is distributed as grants, some philanthropies also provide low- or no-interest loans and/or risk tolerant investments to achieve their goals. For example, some philanthropies will use their capital to support social businesses or invest in high risk, early-stage startups working on technologies that could have large positive impacts on society if they succeed.

Philanthropies can also participate in funds or infrastructure funding, provide guarantees for an investment or loan perceived as too risky by private actors, or enhance the return profile of an investment. Following Los Angeles wildfires in January 2025, BMO bank, which has a strong footprint in California, pledged $3 million to support wildfire relief, recovery, and rebuilding efforts to those impacted by the catastrophic fires. Their donation aligns with their philanthropic goals to support mitigation and adaptation to strengthen infrastructure and communities that underpin their operations for the community they serve, and their employees, living in southern California. Philanthropic capital used this way is 'catalytic', as it can attract larger sums of private capital into projects or initiatives that may not otherwise meet the risk/return expectations of private investors and lenders.

That said, access to philanthropic capital often relies on strong networks with visibility and/or resources to support funding applications. Organizations seeking grant funding or impact capital should carefully consider which types of funders best match the scale of their project and need. For example, community foundations may be easier to engage directly than large national philanthropies or impact investors.

What philanthropic capital may lack in volume, it can deliver in flexibility. Without the bureaucracy of public funds or the expectation of a higher financial return, philanthropic capital can be injected quickly and relatively freely, making it a powerful strategic tool for jumpstarting projects, filling gaps (See section on Blended Finance), or planning before implementation grants. Philanthropies are rapidly gaining interest in funding a wide range of adaptation-related activities and exploring ways to leverage their investments into traditional funding priorities such as water, public health, and conservation.

B. Blended Finance

Key Messages

- Transformational adaptation requires financing that accommodates funders with varying risk levels, delivers long term realized benefits, and creates positive social and environmental benefits

- Blended finance leverages public or philanthropic funds to lower risks or reduce the cost of capital for private funders but on its own does not create a repayment source
- Blended finance attracts catalytic investment but faces challenges such as aligning incentives and risk appetite and navigating shifting funding priorities across all finance actors
- By de-risking projects and creating viable returns and positive outcomes, blended finance can unlock new opportunities for shared risks, costs, and rewards

Blended finance typically refers to the use of public or philanthropic funds to leverage or lower the risks associated with commercial financing, or to reduce the cost of capital. Although the term blended finance is often associated with projects in emerging and developing economies (Horrocks et al., 2020; OECD, 2025), the approach has been successfully applied to projects in California. For example, the California Pollution Control Financing Authority (CPCFA) provides public capital access funds to incentivize private capital investment in climate-friendly facilities and small businesses (California State Treasurer's Office, 2024). CPCFA works with other bond programs to support businesses to finance infrastructure while small businesses can apply for private loans incentivized by government programs (California State Treasurer's Office, 2024). The California Infrastructure and Economic Development Bank (IBank) uses their affordable borrowing capacity to assist smaller government agencies in accessing capital they might not otherwise be able to access. Support from state or philanthropic grants will help a project or business demonstrate their proposals, paving the way for access to capital markets. (***See Case Study 10: Debt-based investment and Case Study 11: Blended finance for commercial real estate***).

Public funds can help reduce perceived project risks whereas philanthropic funds can help bridge funding gaps. These catalytic finance approaches can help support new technology or projects that are perceived as "risky" by providing the data needed for private finance to step in confidently later, thus helping to "bridge the bankability". In this sense, catalytic capital is key to furthering private sector investment, which can help deliver project funding, scalability, and efficiencies alongside an expectation of market-level returns. However, blended finance does not create a repayment source on its own.

One common feature of blended finance commonly utilized is the Public Private Partnerships (PPPs) where public sector responsibilities are provided by the private sector under an agreed funding model (e.g., roads, utilities). These partnerships help de-risk projects by strategically allocating risks and including government

participation, making private investors more attracted to investing. The question that still remains for public-good adaptation is who pays, from what budget or revenue stream does the funding come from, and over what time horizon (Conway, 2026b).

(10) Debt-based investment (IBank)

Location: California, State-wide

Financial structure and collaborators: The California Infrastructure and Economic Development Bank (IBank) is a state-owned and operated financing authority that aids development and financing of infrastructure projects in California. IBank finances public infrastructure and private development through bond issuance, loan provision, and guarantees. IBank launched the Climate Catalyst Revolving Loan Fund to accelerate deployment of climate solutions through flexible, low-cost credit and credit enhancements to public and private applicants. In September 2024, IBank made its first Climate Catalyst Fund investment through $25 million committed to the California Wildfire Innovation Fund, managed by Blue Forest, a non-profit conservation finance organization, in partnership with CSAA Insurance Group.

Mechanism for resilience: Debt-based investment, from public and private banks, can enable finance of large-scale resilient infrastructure and systems, generally at a lower cost of capital than equity. This model is especially useful in instances where there are long-term predictable potential cashflows from the investment. This specific investment in the California Wildfire Innovation Fund aims to support forest restoration, wildfire risk reduction, and utilization of forest biomass.

Implementation/project status: The Climate Catalyst Revolving Loan Fund adopted sector-specific financing plans in three sectors central to California's mitigation and resilience goals: forest biomass management and utilization, clean energy transmission, and climate-smart agriculture. Intake for the fund is active in forest biomass.

Challenges and opportunities for California: IBank is well situated in the California capital market structure to provide catalytic investment that can draw in other sources of capital to resilience investments. A challenge of a project debt-based model for climate resilient infrastructure investment is that much of this pipeline does not generate direct revenue, making the debt repayment model more challenging.

More information: IBank

(11) Blended finance for commercial real estate efficiency retrofits

Location: Canada

Financial structure and collaborators: In 2023, Bank of Montreal (BMO) partnered with Canada Infrastructure Bank (CIB) to launch an innovative blended finance program to deploy financing for energy efficiency retrofits of commercial buildings. This program allows building owners to access concessionary government capital alongside long-term refinancing options that reflect the improved value of the building. CIB set aside CAD 100 million for this program.

Mechanism for resilience: This program supports access to concessionary capital for energy efficiency retrofits. These projects enhance resilience through a reduction of commercial buildings grid reliance which mitigates the impacts of power outages and extreme weather events. This will increase operational resilience and create stronger community energy systems.

Implementation/project status: The retrofit program has begun to finance projects.

Challenges and opportunities for California: California entities, for example California Infrastructure and Economic Development Bank, offer catalytic capital that may be leveraged for blended finance purposes.

More information: BMO to offer first-of-its-kind financing opportunity with building retrofits

Challenges of blended finance

Blended finance is not without its challenges. One primary challenge is being able to successfully identify and bring different parties with diverse incentives and risk appetite to the table and assure that they accept the requirements of the other funding entities. Large-scale adaptation projects require partnerships and strategies to balance the limited amount of public finance with incentives that sufficiently attract private finance. Another challenge may include funders with different regulatory and administrative requirements, thus complicating partnership development, ongoing participation, implementation, and reporting needs. This is especially important for projects that include multiple government stakeholders with restrictions and regulations that must be met before projects can be financed and implemented (e.g., federal agencies are mandated to apply a price preference for domestic end products through the Buy American Act). There may also be complexities that exist for borrowers and other stakeholders dealing with both private sectors and government. Additionally, there may also be political uncertainty and risks when existing or new administrations change policies and priorities, which can harm the trust built among

partners, reduce project capabilities and capacity, and reduce the overall impact the project managers sought to achieve with greater funding value. The opening of the Gordie Howe International Bridge between Michigan, USA and Ontario, Canada, a public private partnership developed over many years, is currently being halted due to shifting political stances from the United States (Clark, 2026). Successfully using blended finance requires knowledge of available funding sources, capacity to utilize those sources, ability to efficiently use funds that might have differing requirements for access, and ability to navigate partner priorities and policies.

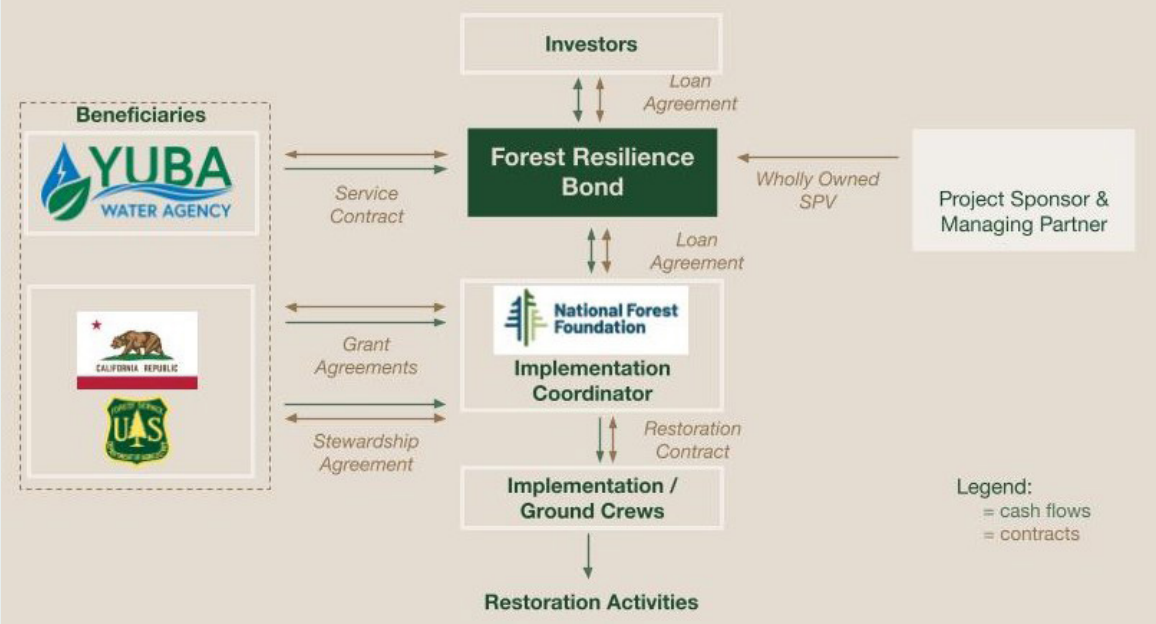
Government agencies continue to play a critical role in blended finance by reducing perceived and real risks and barriers. Risk reduction may occur through first loss protection mechanisms, guarantee structures for projects, and insurance. First-loss protection mechanisms attract private investment by reducing or eliminating possible initial investment losses to support project viability. This helps shift the investment risk-return profiles to make investing more attractive. Different types of guarantees can offer specialized protection against potential losses or defaults to balance different types of risks and benefits. Insurance can help transfer and manage risks for different stakeholders through mechanisms such as parametric insurance to support communities impacted by climate risks. Reforming policies and regulations can help align incentives with capital provider tolerance for new lending. Sharing knowledge and experience of the local market can support investors' familiarity with new markets or sectors which could help create a pipeline of potential investment opportunities. (***See Case Study 12: The forest resilience bond***).

(12) The Forest Resilience Bond –Yuba I

Location: North Yuba River watershed (Sierra mountains)

Financial structure and collaborators: The Forest Resilience Bond (FRB) is a public-private partnership model that channels new funding into high priority forest restoration and distributes costs across multiple stakeholders who benefit from reduced risk. The FRB accelerates restoration work that directly reduces the severity and frequency of catastrophic wildfire events by deploying private capital upfront. Private investors supply upfront capital and are repaid over time with predictable revenue streams by beneficiaries (e.g., utilities, local governments, and private companies). Additionally, the FRB represents a mechanism for pre-disaster investment that lowers expected losses, stabilizes risk portfolios, and supports community resilience. For the Yuba I FRB, Blue Forest oversees the blended finance mechanism with funding commitments from Yuba Water Agency, USDA Forest Service, and CAL FIRE as seen in their funding commitment and flow diagram.

Mechanism for resilience: The Yuba I FRB shows how blended capital can move mitigation work upstream, shifting investment from post-disaster claims to pre-disaster risk reduction. By aligning beneficiary payments with private investments, the model stabilizes funding for large scale fuel reduction and watershed resilience projects, which translates to lower expected insured losses.



Implementation/project status: The Yuba I FRB launched in 2018, with restoration work completed in 2023, years ahead of schedule with additional funding and finance made available.

Challenges and opportunities for California: The FRB is a replicable financial tool that insurers can participate in to reduce portfolio risk, support community resilience, and expand access to long-term insurance solutions in fire-prone regions.

More information: Yuba I FRB

Utility of Blended Finance

While private investors have substantial capital, they are obligated to put those funds towards investments and loans with sufficiently attractive risk and return profiles. In contrast, the public sector has relatively constrained fiscal capacity to fund certain projects. By using their limited funds to catalyze private investments, the public sector can ensure cost-effectiveness of projects through blended finance. Thus, private investment provides valuable finance to scale adaptation projects and improve outcomes, which cannot be done by any single sector alone.

For investors motivated to support entities to finance sustainable development goals while obtaining market-rate returns, investments in adaptation and resilience projects can help meet their goals. Institutions in Public-Private Partnerships can work together to ensure that risks, returns, and target impacts are aligned and delivered to the highest degree. Projects funded through blended finance reduce risks and help create new knowledge on risks and returns, thus opening the opportunity for future deals that may not necessarily require government finance to gain private sector leverage. This can mean forging new blended finance paths with innovative shared risks, costs, and rewards (***See Case Study 13: Debt-for-nature swap and Case Study 14: French Meadows project***).

Depending on the structure of a government's contribution to a blended finance capital stack (Figure 7), government financing can in theory both anchor catalytic funds to attract investors and deliver financial returns for the government entity. This revenue generating option could allow the government to further invest in similar projects. For example, the Clean Water State Revolving Fund provides low-cost financing for a range of water quality projects with the principal and interest payments returned into drinking water infrastructure projects including treatment and distribution systems (California Water Boards, n.d.-b).

(13) Debt-for-nature swap for marine conservation, a blue bond with catastrophe wrapper

Location: Belize

Financial structure and collaborators: In 2021, the Government of Belize repurchased USD 553 million of its public debt at a 45 percent discount in a deal arranged by The Nature Conservancy (TNC). The purchase was made possible through a new "USD 364 million Blue Loan" (also known as a Blue Bond), which was backed by a political risk insurance policy from the US International Development Finance Corporation (DFC) and collaborating financial partners, including Credit Suisse as the sole structurer and arranger. The arrangement involved a parametric insurance "catastrophe wrapper" designed by WTW and underwritten by Munich Re, which will cover loan payments in the event of climate-related disasters (e.g., a severe hurricane). The Blue Bonds increased Belize's credit rating. A portion of Belize's savings from the refinancing was channeled into a USD 180 million marine conservation endowment.

Mechanism for resilience: The deal improves both financial and environmental resilience. By reducing its national debt by approximately USD 190 million, the government of Belize saves money on debt payments. The parametric insurance solution adds a new layer of resilience by waiving a semi-annual debt payment if a

a severe hurricane meets pre-defined trigger criteria. This allows the government to reallocate funds to disaster response and economic recovery. The deal improves natural resilience via the long-term marine conservation fund and by other commitments Belize made as part of the deal (i.e., committing to legally protecting 30 percent of its ocean territory by 2026).

Implementation/project status: Since the original debt-for-nature swap in 2021, the catastrophe wrapper has not been triggered for payout. The Government of Belize pays the cost of the insurance wrapper as part of its debt payment.

Challenges and opportunities for California: Debt-for-nature swaps generally are conducted between sovereign nations – the lending nation and the country with national debt. Consequently, this approach does not directly pertain to California. However, there may be lessons learned from the concept of apportioning savings from refinancing into conservation efforts that might be applicable to the State.

More information: Belize blue bonds for ocean conservation



(14) French Meadows Project for healthier forests

Location: Placer County, California

Financial structure and collaborators: The French Meadows Project, located in the Sierra Nevada, is a restoration and fuel reduction project encompassing 28,000 acres of forestland. It aims to improve the health and resilience of important municipal watersheds in the area and to address barriers to increasing the pace and scale of forest restoration work in the Sierra Nevada following substantial damage from the 2014 King Fire. The project uses an innovative partnership framework for planning, management, and implementation, spanning state, federal, and private land managers, and The Nature Conservancy. The "all lands" approach supports restoration work at the landscape scale and provides a unique opportunity to leverage public and private funds, at an estimated $192.1 million. Funding for the French Meadows Project included federal, local, state and private sources, including significant investment from the Greenhouse Gas Reduction Fund and downstream water beneficiaries. Partial funding includes revenues from the sale of wood products and biomass collected from the area.

Mechanism for resilience: The French Meadows Project leverages risk reduction strategies to promote healthier forests at landscape scales. This leads to reduced wildfire severity in addition to enhanced habitat and refugia connections.

Implementation/project status: Ecological restoration work began in 2019 for mechanical and hand-thinning to reduce fuels. The project will continue fuel reductions followed by prescribed burns.

Challenges and opportunities for California: The Sierra Nevada and Southern Cascades of California have a patchwork of public and private land ownership and would benefit from a private-partnership model to expand and accelerate forest restoration to reduce wildfire risk.

More information: The Nature Conservancy. Nature-based climate solutions: A roadmap to accelerate action in California, French Meadows Ecological Forest Restoration Project

IV. Connecting Social and Economic Priorities Through Adaptation Finance

Key Messages

- Climate change affects all sectors of the economy, yet adaptation investments are often siloed, leading to missed opportunities for synergistic beneficial outcomes
- Indigenous Economies of Care offer a framework and ethic that centers nature, reciprocity, responsibility, and care—not just financial measures—in how to understand economic decisions from a different lens
- Cross-sectoral finance can improve project effectiveness, enhance fiscal efficiency, and scale solutions that deliver health, housing, workforce, and socioeconomic co-benefits

Climate change impacts cut across all sectors and affect social systems, economic activity, and environmental and health in interconnected ways. Because these impacts are cross-cutting, adaptation finance that supports projects addressing these overlapping needs would provide the most synergistic outcomes. Integrating these social and economic priorities into adaptation finance can ensure that investments can deliver adaptation projects and strengthen multiple sectors simultaneously. This section highlights four areas—Indigenous Economies of Care, Health, Housing and Real Estate, and Workforce and Labor—to examine how shared and coordinated adaptation investments can deliver co-benefits that support a more resilient and equitable California.

Indigenous Economies of Care

Traditional Indigenous economic frameworks diverge significantly from the dominant economic construct framing of Western financial markets. In contrast to an extractive relationship with what markets and the state generally term "natural resources," Indigenous societies refer to plants, animals, fish, and other species as relatives or nations, requiring respect and deserving equal treatment (R. Miller et al., 2021). At the core of many Indigenous Knowledges is "the understanding that the world is an interconnected web of relationships, in which the health of the lands and peoples are mutually dependent and sustained through relationships of reciprocity, responsibility, and care underpinned by the principle that each generation should leave the world in as good or better condition than their generation inherited." (Hankins 2024; See the Fifth Assessment's "Tribal and Indigenous Communities Statewide Topical Report" for more insights on Indigenous economies of care). Indigenous ethics tend to recognize that the earth is not a property to be owned, but rather a relative to be cared for. In contrast, Western economics is founded on the notion of individual profit-

maximization and the ownership of commodities through the extraction of resources: "It is not from the benevolence of the butcher, the brewer, or the baker that we expect our dinner, but from their regard to their own self-interest. We address ourselves not to their humanity, but to their self-love" (Smith, 1776).

Moreover, Indigenous economic systems commonly promote community interests rather than individual accumulation and wealth (R. Miller et al., 2021). From an Indigenous perspective, "Living well consists of pursuing actions that strengthen humanity's relational goods created by relationships with nature and with one another...The aim of good living is to increase the value of all relationships without harming them" (Trosper, 2022). Indigenous economic approaches are typically broader than purely monetary. Many Indigenous cultures define wealth and well-being by accounting for social, cultural, and environmental capital in addition to economic capital (Sustainability Directory, 2025). Taken together, these Indigenous 'economies of care' provide an alternative vision and approach for a more balanced relationship with the world around us, one that is less rooted in extractive activities and more towards long-term resilience and stewardship. They provide a vision for integrating non-monetary values into our existing financing structures and a reimagination of an economic system that incorporates valuing nature as a core asset class and an emphasis on long-term investments rather than short-term benefits.

These principles are occurring in several current Indigenous efforts to align finance with cultural values. For instance, the Rincon Band of Luiseño Indians created a First Nations Economic Development Corporation that invests in ways that reflect their values as Native people—"rooted in stewardship of the land, respect for community, and responsibility to future generations,"—with a focus on making long-term investments that balance financial strength with cultural integrity and sovereignty (Rincon Band of Luiseno Indians, n.d.). Likewise, First Sovereign Capital is a strategic investment firm that seeks to redesign venture capital to work for Native entrepreneurs. They invest in sectors positioned for long-term economic shifts and critical to building resilient Indigenous economies, and support investment models that link financial returns to community prosperity (1SVC, n.d.). These examples offer insights to how Indigenous economies of care can be incorporated into innovative adaptation funding and finance to strengthen community resilience.

> *While Indigenous Nations are geographically, culturally, and ecologically diverse, "they are often governed by a strikingly similar value system rooted in relationality, reciprocity, respect, reverence, regenerative practice, responsibility to homeland, kinship with life, service to life, and a notion that all life is equal."*
>
> *– Johnson, 2022*

This Indigenous perspective on the diverse benefits of healthy, resilient ecosystems is also evident in the practice of cultural burning. Indigenous use of beneficial fires prehistorically supported far more acres to burn than during the post-colonization

era, with fires being suppressed and wildfires predominating (Stephens et al., 2007). Both intentional burning by Indigenous communities and lightning helped maintain a biodiverse, sustainable, and resilient forest (Knight et al., 2022). Building on these long-standing practices, several Tribal Nations in California are restoring cultural burn practices as both a climate adaptation strategy and integration of Indigenous economies of care, including Hoopa Valley (***See Case Study 15: Hoopa Valley***), Colfax-Todds Valley Consolidated Tribe (Oxendine, 2025), and Karuk Tribe (Karuk Tribe, 2025). Similarly, the Good Fire Alliance, informed by Indigenous knowledge and/or through partnerships with Indigenous groups, is advancing low intensity prescribed burns to improve biodiversity and reduce wildfire risks through economies of care principles.

Despite the ecological and cultural benefits of cultural burning, Tribes face significant financing challenges such as upfront costs of burning and delayed reimbursements from CAL FIRE grants to conduct burns (Oxendine, 2025). To address this barrier, the Colfax-Todds Valley Consolidated Tribe launched the first tribally led Forest Resilience Bond, securing $5 million in finance for forest restoration in Placer County, California through foliage thinning and prescribed burns. In partnership with Blue Forest, the Tribe developed an innovative blended finance mechanism where private investor capital pays upfront costs and CAL FIRE grants reimburse longer-term costs (Oxendine, 2025). This example illustrates how Indigenous economies of care can leverage finance mechanisms to support adaptation and restoration work by reducing financial burdens and stretching public dollars to enable additional projects.

(15) Hoopa Valley east viewshed cultural treatment and prescribed burn project

Location: The eastern side of the Hoopa Valley, on the current Hoopa Valley Reservation, in what is known today as Humboldt County.

Financial structure and collaborators: In 2021, the Hoopa Valley Tribe was awarded over $1.3 million in CAL FIRE Forest Health Grant funding to help bring fire back to the landscape. The Forest Health Program provides grants to regionally-based partners and collaboratives to significantly increase fuels management, fire reintroduction, post-fire reforestation, and biomass utilization. The Forest Health Program is supported by California Climate Investments, the portfolio of programs funded by the state's Cap-and-Invest revenues.

Mechanisms for resilience: Using the grant funds, the Tribe performed cultural burning on 187 acres, reducing the number of Douglasfir seedlings and competing vegetation, and removing larger trees where needed. This process increases the landscape's resilience to wildfire by improving conditions for mature

oaks and species that depend on the oak woodland habitat. It also promotes the growth of important medicinal and basketry plants and wood for hunting and fishing equipment. Grant funds also supported the construction of three fuel breaks to reduce wildfire threats to the community.

Implementation/project status: The project was completed in March of 2025.

Key challenges and opportunities for California: State climate programs can support Tribal stewardship, while simultaneously supporting adaptation and resilience. Certain program requirements can discourage tribes from applying for funding, like Limited Waivers of Sovereign Immunity, and public agencies need to be mindful of these barriers during program development. Other challenges hindering the use of cultural fire include access to liability insurance, workforce shortages, permitting, upfront costs to initiate cultural burns and forest restorations, and burning restrictions due to weather and other factors. State laws such as SB 926 (2022) established a pilot Prescribed Fire Liability Claims Fund, and SB 310 which allows the California Natural Resources Agency and local air districts to enter into cultural burn agreements in lieu of certain permits, can help reduce these barriers. Additionally, a first tribally led Forest Resilient Bond was launched by the Colfax-Todds Valley Consolidated Tribe in partnership with the nonprofit Blue Forest as a blended finance model that provides private capital to cover upfront costs alongside reimbursement from CAL FIRE grant funds.

More information: Program: Forest Health Program—California Climate Investments, Project Video: Hoopa Valley Tribe Brings Fire Back to the Land, Hoopa Tribal Forestry: http://www.hoopaforestry.com/

Human Health

Climate change can affect human health through direct pathways (e.g., extreme heat leading to heat strokes) and indirect pathways (e.g., drought conditions that affect water quality and food production; wildfires that produce smoke and reduce air quality), leading to substantial impacts on people and the economy (CDI, 2024; Connolly et al., 2024). Investing in adaptation to reduce climate-related health risks benefits the environment, the health of individuals, and saves lives. This is especially true for historically underserved and marginalized communities where health costs such as insurance, doctors' visits, and medicines already place significant financial strains on households.

Despite the interconnectedness of climate change and public health, funding and financing efforts rarely consider these challenges together, missing opportunities for synergies and fiscal efficiencies. While California provides funding for projects that deliver on climate and environmental resilience with public health co-benefits (e.g.

Prop 4 and California Climate Investments), funding and financing programs that specifically focus on the nexus of human health and climate adaptation in the state are still lacking. International plans and actions previously adopted to address this nexus, such as the Belém Health Action Plan (WHO, 2025), Declaration on Climate and Health (WHO, 2023), and Guiding Principles for Financing Climate and Health Solutions (COP28, n.d.), can be useful guides for California to utilize to enable financing that delivers health and climate co-benefits. The adoption of the Guiding Principles led to international philanthropies, governments, and multilateral banks who pledged a total of USD 1 billion to address joint climate and health crises. Previously, only 0.5 percent of multilateral adaptation finance, or 0.2 percent of total adaptation finance (USD 45.9 million), focused on health adaptation projects between 2009-2019 (Alcayna et al., 2023).

Leveraging health finance to support adaptation finance, and vice versa, can lead to more effective projects and greater fiscal efficiency, enabling solutions to scale and provide broader benefits for people, economies, and the environment (Borghi et al., 2024). More insights into the connection between climate change and human health can be found in the Fifth Assessment's "Public Health" report prepared by the California Department of Public Health.

Housing and Real Estate

Climate adaptation can strengthen California's housing and real estate sectors through a range of mechanisms. This includes widespread home hardening, risk reduction through landscape-scale ecosystem management, smarter zoning policies, residual risk transfers with more affordable insurance, and meeting present and future climate needs through improved building codes (Kreider et al., 2024).

California has developed several programs and regulatory approaches that affect housing resilience, including support for home hardening and defensible space, incentives tied to risk reduction, and insurance-related reforms intended to improve recovery and access. The Transformative Climate Communities program, administered by the California Strategic Growth Council, provides funding and support for mitigation and adaptation actions by communities. The Housing and Community Development agency has a similar program to support adaptation. Grant programs in the state provide financial assistance for wildfire home hardening and defensible space such as through the California Wildfire Mitigation Program (CWMP). The CWMP provides financial assistance on defensible space, vegetation management, home hardening, and retrofitting fire-resistant homes to vulnerable populations in six high wildfire prone areas since 2019 (CalOES, n.d.). Using federal Community Development Block Grant Disaster Recovery (CDBG-DR) funding, California is integrating hazard resilience standards into housing recovery programs to ensure that recovery investments reduce future hazard risks for low- and moderate-income disaster-impacted households. This includes rebuilding homes destroyed

by wildfires and hardening at-risk homes to Wildfire Prepared Home standards; rehabilitating and elevating manufactured homes and parks; and building and strengthening infrastructure that reduces hazard risks for vulnerable communities. (***See Case Study 16: Catastrophe bond with integrated disaster-resilience benefits for North Carolina***).

At larger scales, pragmatic residential local government zoning can play a role in reducing risk by minimizing development in high-risk or multi-risk (e.g., flood and wildfire) areas or reducing rebuilds in high-risk areas through buy-out plans (Philson et al., 2021). Investment into nature-based solutions through insurance underwriting and pricing models could also reduce risks by improving the habitats that can buffer against climate perils (Kousky & Burley, 2025). For example, restoring wetlands can help buffer the impacts of strong storm surges, protecting houses and communities along the shore. Together, these strategies can help minimize the harm, damage, and costs from future climate-related catastrophes. (***See Case Study 17: Cost-benefit analysis of resilience in real estate***).

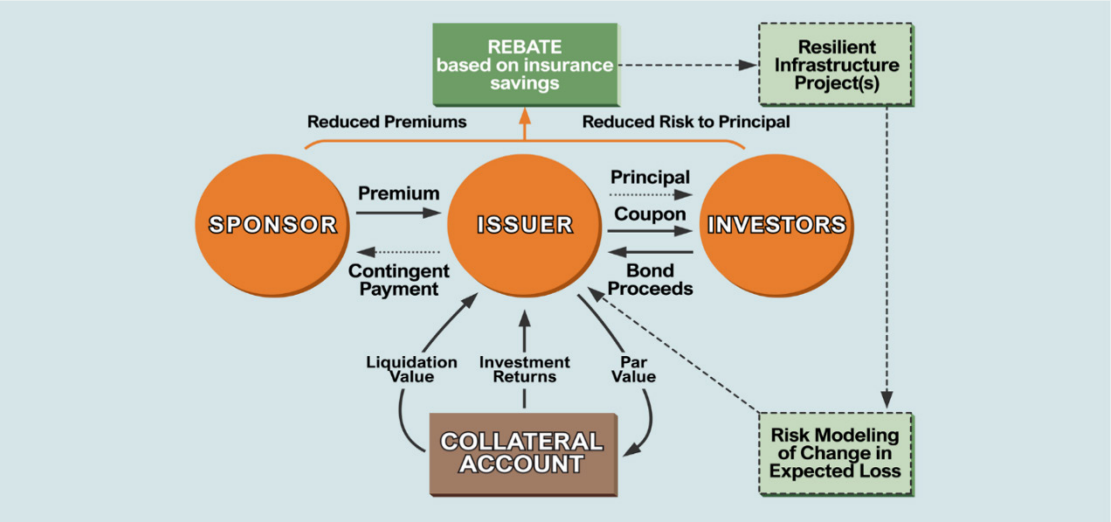
(16) Catastrophe bond with integrated disaster-resilience benefits

Location: North Carolina

Financial structure and collaborators: In March 2025, the North Carolina Insurance Underwriting Association (NCIUA), the State's $1 billion nonprofit "insurer-of-last-resort," worked with Hannover Re and Guy Carpenter to issue a $600 million innovative catastrophe (cat) bond with an integrated disaster resilience feature (see resilience bond structure and financial flows figure). NCIUA purchases both reinsurance and cat bonds each year in preparation for worst-case coastal weather outcomes. Over the past decade, it invested over $130 million in grants to over 20,000 policyholders for home hardening measures and installation of IBHS Fortified RoofsTM. This cat bond is NCIUA's seventh issuance in the Cape Lookout Series and the first to contain a "resilience trigger" that rewards both NCIUA and investors for its risk reduction efforts.

Mechanisms for resilience: A traditional indemnity trigger cat bond results in a payout to a bond issuer (policyholder) if actual losses exceed a predetermined amount (attachment point). The NCIUA's newest Cat Bond includes an additional resilience interest payment of 0.35 percent, that NCIUA will pay annually into a separate account. In each year of the bond term, if aggregate losses remain below 60 percent of the bond attachment point, then NCIUA will receive the total and any interest on it to support additional home hardening grants. If aggregate losses remain below 60 percent of the bond attachment point, then NCIUA will receive the total and any interest on it to support additional home hardening grants.

If aggregate losses exceed the 60 percent threshold at the end of an annual risk period, the accumulated resilience spread and any interest will be paid back to investors in the bond. This resilience feature builds on the Resilience Bond concept developed through the Rockefeller Foundation funded RE.bound Program and is a win-win for both NCIUA and investors, with NCIUA to potentially benefit from additional funds for its grant programs and investors to gain from a payout if they are nearing facing losses on the bond itself.



Implementation/project status: This bond was issued in March 2025 and in March 2026, NCIUA received a received a $2.07 million payout from the 0.35 percent resilience rebate which provided additional funding to install more fortified roofs.

Challenges and opportunities for California: This structure has the potential to work well in California insurance and reinsurance markets where specific place-based risk reduction grant programs can be aligned with state and local reinsurance cycles. However, there are likely to be challenges in quantifying the benefits associated with classes of resilience measures using insurance industry catastrophe bond models for the major perils in California (e.g., wildfire) compared to the perils and risk reduction measures covered in North Carolina (e.g., severe storms and wind). Severe storm and wind damage models benefit from relatively clear building failure patterns linked to specific IBHS-linked features; in contrast, wildfire losses are harder to model due to a complex mix of local conditions like vegetation, topography, and how fire spreads through a community.

More information: Artemis: NCIUA secures its largest cat bond at $600m, as Cape Lookout Re 2025-1 priced; Artemis: NCIUA's recent catastrophe bond included integrated disaster-resilience feature; Artemis: The catastrophe bond, insurance linked securities & investment, reinsurance capital, alternative risk transfer and weather risk management site; RE:bound Program report; NCIUA receives $2 million rebate from resilience feature in GC-structured cat bond | Sustainable

(17) Cost-benefit analysis of resilience of real estate

Location: US

Financial structure and collaborators: This research paper is a collaboration between ClimateFirst, BMO, and Investment Management Corporation of Ontario (IMCO) to analyze a sample portfolio of commercial real estate (CRE) assets across nine US locations. The study examines the cost and benefit implications of integrating resilience enhancements, and the resulting avoided losses over the lifecycle of these assets.

Mechanism for resilience: This innovative study found that while climate risks cannot be eliminated, their financial impacts can be materially reduced. Converting risk and adaptation date into monetary terms enables informed investment decisions, quantifies avoided losses, and makes resilience a more investible strategy.

Implementation/project status: This study is complete and provides a foundation for follow-on research and quantification of the financial impact of resilience for CRE owners and investors.

Challenges and opportunities for California: Two of the nine assets analyzed by this study are in California (San Francisco and Los Angeles). Resilience of commercial real estate is an area of increasing importance for CRE owners and investors, but the benefits of these measures must be clearly articulated to justify the associated cost. There is still much work to be done to quantify possible insurance benefits associated with resilience enhancements, as well as possible operational advantages.

More information: Investing in Resilience: Making Physical Climate Risk a Financial Priority for Real Estate • ClimateFirst Building Solutions Inc.

Workforce & Labor

Effective adaptation finance requires understanding how climate change affects workers across all industries, including the growing risks of climate perils (e.g., through increased heat exposure in the workplace) and evolving job markets. Coordinated funding and financing for adaptation and workforce development can prepare California to respond effectively to these risks while creating skilled jobs. A strong and specialized adaptation workforce can ensure effective implementation of adaptation projects at lower costs due to increased capacity and greater business competition. Investing in a labor movement that values climate adaptation can sustain these sectors when funding fluctuates, as established market structures and employer demand can maintain this workforce. Sectors that are particularly ripe for joint benefits in adaptation and workforce development include firefighting, conservation and land management, resilient energy technologies, resilient building materials and construction practices, land use planning, and climate-smart fisheries and agriculture. (***See Case Study 18: Sierra Institute high road to tribal forest restoration***).

Wild-capture fisheries demonstrate the multifaceted interconnections between adaptation and workforce development in California. Changing ocean temperatures are impacting industrial fishing, with fishers experiencing worsening storms, increased heat exposure, and longer workdays due to shifting fish abundance and distribution associated with warming waters (Tigchelaar et al., 2025).

Supporting adaptive capacity to climate impacts will require changes in the way fishers do their work including changes in the seasonality and location of fishing; the species sought; and adaptive management strategies that incorporate new policies and technologies (Reimer et al., 2025). The fisher workforce will require additional safety training, research investments to guide adaptation efforts, and collaboration between fishers and policymakers to ensure regulations support decent work conditions under a changing climate (Tigchelaar et al., 2025). Furthermore, improving the resilience of the fishery itself and fishing communities through strategies such as nature-based solutions, more responsive management, and enhanced data streams can help fishers adapt to the changing work and environmental conditions. Innovative insurance products can transfer financial risks to protect fishers and their businesses from work interruptions caused by a changing climate (Waite & Linsmayer, 2025).

In the resilient building and construction industry, there is growing demand for advanced materials to make homes more sustainable and protected in a changing climate (Bal & Rani, 2025; R. K. Miller et al., 2022). Meeting the residential adaptation and decarbonization goals for retrofits or new builds will require an expansion of a skilled workforce (Srivastava et al., 2025). However, there are key challenges faced by the industry to meet the workforce and labor demand (R. K. Miller et al., 2022; Srivastava et al., 2025). These include low awareness of resilient building/retrofitting and energy efficiency careers, deficiency in training availability to meet market

needs, limited professional development support in these careers or to transition into these new careers, and inconsistent requirements for contractor licensing. To elevate this skilled workforce, a multi-pronged strategy that encompasses education and training, outreach on career opportunities, support for career progression, and standardizations of regulations and certifications will be needed (R. K. Miller et al., 2022; Srivastava et al., 2025). Growing the home hardening sector could spur $116 billion in economic activity, support around 500,000 jobs, and generate $2.7 billion in tax revenue for the state (Risner & Delaney, 2025).

Similarly, a climate-ready skilled workforce is needed to ensure resilience at the community level to contribute to nature-based solutions construction and green infrastructure (NOAA Sea Grant, n.d.). The National Oceanic Atmospheric Administration's (NOAA) Sea Grant is building a nature-based solutions workforce to support a climate-ready nation as climate risks evolve over time.

The need to consider climate adaptation finance on workforce cuts across all sectors. Supporting climate adaptation and workforce development requires a broad set of tools including, workforce training, seed funding to spur the development of resilient technologies, incentive programs to accelerate the uptake of resilient technologies, and more (Zabin, 2020). Public financing could help identify actions that best deliver evidence of growing adaptive and climate resilient workforce. Additionally, risk reduction through insurance policies to protect workers and businesses from the financial impacts of climate-related business interruption may also spur growth in the climate adaptation workforce. What gets financed will directly impact the critical workforce issues of tomorrow.

(See the Fifth Assessment's "Climate Impacts to the Economy Statewide Topical Report" for more insights on the intersection of workforce and labor with climate change.)

(18) Sierra Institute high road to tribal forest restoration and stewardship

Location: California, State-wide

Financial structure and collaborators: In 2021, Sierra Institute was awarded a $1 million grant through the California Workforce Development Board's High Road Training Partnerships (HRTP) program to establish a partnership between tribes, nonprofits, and regional employers to increase employment opportunities and build capacity for Tribal forest restoration crews. Sierra Institute received an additional $7.5 million in 2024 to expand the partnership. The HRTP program is a uniquely structured grant program that focuses on building sustainable partnerships and acts as a model on how public funding can enhance existing

workforce development to support communities most impacted by climate change. The program is supported by various state funding sources, including the Greenhouse Gas Reduction Fund and the General Fund.

Mechanisms for resilience: This project builds tribal capacity to develop and run forest restoration crews and provides necessary training for diversified job types in the industry. These include forest fuels reduction, nursery work to provide seedlings for restoration projects, advanced firefighting, cultural burn training and more.

Implementation/project status: Since 2021, this project has trained over 700 individuals from more than 25 tribes across California and treated over 800 acres with Tribal restoration crews. The project focuses on developing a pipeline into meaningful, long-term career opportunities in restoration and stewardship for under and unemployed individuals. The project also focuses on leadership development to create sustainability. In March 2025, over 100 Tribal leaders participated in the project's annual leadership gathering and discussed issues like developing a stewardship crew, returning good fire to the landscape, nation-to-nation relations, and more.

Key challenges and opportunities for California: For Tribal communities in rural forested portions of the state, historic injustices and lack of investment in economic and workforce development have created gaps in economic vitality and community well-being. At the same time, the impact of catastrophic wildfire is acute in these rural communities. Building capacity to prevent, respond, and recover from wildfire is a high priority. By providing a tailored workforce training program, brought directly to communities, this project builds economic, environmental, and community resilience. This project is investing in individuals, Tribal businesses and organizations, and in restoring the forests and watersheds critical to the state's water future and wildfire resilience. This kind of investment requires a shift in perspective in terms of economic output. Stewarding forests and watersheds are critically needed but returns on ecosystem investments are hard to measure and require long-term thinking. Building tribal and rural capacity to manage businesses and train crews takes time and decades-long commitments to healthier forests, watersheds, and communities. The High Road to Tribal Forest Restoration and Stewardship model continues to adapt with interest from rural and tribal communities. Sierra Institute is committed to continuing this valuable project and sharing best practices.

More information: High Road Training Partnership | Sierra Institute

V. The Future of California Adaptation Finance

This section emphasizes a more holistic, integrated approach to finance that moves beyond current financial silos to a more holistic and sustainable system grounded in reciprocal, respectful relationships with one another and with nature. This systems-approach recognizes that economic prosperity and ecological resilience are not in opposition but rather reinforce one another. The long-term resilience of financial institutions depends on the health and vitality of natural ecosystems and communities.

A. Adaptation Finance in California Must Transform to Address Systemic Risks and Support Long-term Climate Resilience

Key Messages

- Adaptation financing is not keeping pace with needs, particularly as climate risks become increasingly frequent and severe
- While adaptation finance may appear risky to investors and project funders, supporting adaptation is essential, particularly for vulnerable individuals and communities
- Diversified sources of adaptation finance are critical as federal funding becomes more uncertain
- Effectively tackling the challenges of adaptation finance in California requires innovative approaches that drive resilient, equitable outcomes

Adaptation financing in California is insufficient today, and the gap between financial needs and availability will continue to expand as climate risks accelerate (Moser et al., 2018). Household expenses, wage and productivity, businesses, and the public sector will be impacted by higher costs, lower productivity, and infrastructure damage (CLEE & Next 10, 2025). Traditionally, investment in climate action focused primarily on mitigation—limiting the amount of carbon dioxide released into the atmosphere. There is now increasing recognition that current funding for adaptation and risk reduction is insufficient and may be inequitably distributed. . Adaptation finance must be funded at scale, with emphasis on supporting individuals and communities most vulnerable to climate impacts.

Adaptation finance may appear risky to investors and project funders in part due to the length of time it takes for benefits to accrue, and the diffuse beneficiaries. For example, nature-based solutions are critical adaptation approaches that protect, restore, and sustainably use ecosystems to strengthen the resilience of communities and ecosystems to climate impacts such as flooding, drought, heatwaves, and sea-level rise (Climate Adaptation and Protected Areas Initiative, 2024). Yet, the benefits of nature-based solutions can take a long time to mature, misaligning with short-term investment horizons (Ding & McLaren, 2025). They also provide a broad social good, which can be hard to monetize. Adaptation finance can also be challenging because companies and industries may consider certain costs and impacts to the public as externalities for which they do not bear responsibility. Additionally, risk signals from climate change are not harmonized across financial providers. Land use decisions by local governments permit, or even encourage, development in risky areas, and banks back mortgages for these properties despite their exposure to climate risk, resulting in increased risks and exposures. The higher risk and steep financial losses experienced by the insurance sector challenges its ability to send effective risk signals and be accessible and affordable. Strengthening the messaging on long-term realized benefits, improving risk signals, and advancing proposals that elevate social benefits along capital needs can help create stronger investment opportunities in the long run.

The current shift in federal priorities away from pre-disaster planning and post-disaster response and recovery funds will likely have a dramatic impact on California. The 2025 Los Angeles fires exemplify this situation. Of the $33.9 billion in FEMA funds requested by Governor Newsom, only $3.1 billion has been appropriated, which includes $2.9 billion in loans and some direct assistance (FEMA Gov, 2025; Fields, 2025). Traditionally, states and local governments have relied heavily on FEMA to fund disaster recovery and response. However, these funds have become increasingly unreliable due to cancellation of programs or delays in payments (see section on the Public sector above). Additionally, the loss of other federal funding, such as funds associated with the Inflation Reduction Act and the Infrastructure Investment and Jobs Act reduces financial support to advance overall climate and adaptation goals. With limited federal funds, state and local governments, individuals and corporations will need to seek other funding sources for existing and future climate adaptation projects now rather than later. As states across the country continue to grapple with major disasters and seek federal financial support to support increasing adaptation costs, obtaining federal finance support will become more competitive.

B. Advancing More Resilient, Equitable Outcomes Through Innovative Adaptation Finance

Key Messages

- California can reimagine innovative financial tools to help communities and businesses respond to intensifying climate impacts and advance a sustainable, equitable, and thriving future
- Strengthening the financial systems to minimize frontline impacts on vulnerable communities can speed recovery while reducing long-term economic burdens on the state
- Incorporating climate risks into investment decisions and understanding the investable cashflow increases the capacity to mobilize public and private capital towards adaptation projects in California

The intensification and acceleration of devastating climate impacts require new and innovative responses across society, including within the financial markets. Transformation to a more sustainable world requires the re-invention of business models (Onyia & Tuyon, 2023; Sachs & Sachs, 2021; van Zanten & van Tulder, 2020) that integrate sustainability into the policies, strategies, products, and services of the global financial industry (Méndez-Suárez et al., 2020; Onyia & Tuyon, 2023; Yip & Bocken, 2018). Financial markets and institutions play a central role in achieving global goals of environmental, social, and economic balance and stability (Sachs & Sachs, 2021). As society adapts to more frequent and intense climate impacts, California can reimagine financial tools that generate lasting economic and social value and advance a more sustainable, equitable, and thriving future.

> *"[I]t is too easy to see adaptation as a narrowly defensive task – protecting core assets or functions from the risk of climate change;" rather, it can be viewed as "an opportunity for social reform, for the questioning of values that drive inequalities in development and our unsustainable relationship with the environment."*
>
> *– Mark Pelling 2010*

Climate-related events such as wildfire, flood, and extreme heat are expensive for individuals, businesses, and governments. Surviving and recovering from climate-related events requires financial resources. Yet, communities and individuals that tend to have fewer resources—seniors, immigrants, communities of color, people with disabilities, LGBTQ+, and others—are at the frontline of climate impacts and recover more slowly (CBO, 2024a). The continual downward spiral for impacted individuals will have long-term economic consequences for state and local governments, such as health, housing, and livelihood costs. Shifting our financial systems' approach to minimize frontline impacts can enable these vulnerable communities to recover more quickly and reduce financial burdens. (***See Case Study 19: Parametric micro insurance for workers in heatwaves***).

Investment decisions that incorporate and price climate risk can drive capital toward proactive adaptation instead of reactive recovery. By valuing the financial impacts of climate change on asset costs, revenues, and long-term financial viability, investors strengthen the case for adaptation investments as powerful tools to preserve economic stability and avoid escalating costs. However, translating priced climate risk and avoided costs into reliable cash flows can be challenging. Complex repayment structures tied to unrealized benefits often deter investors seeking simpler, more predictable returns. Nonetheless, aligning private capital with long-term resilience outcomes can enable risk-informed decisions that help close the adaptation finance gap. Conway (2026b) notes that adaptation and nature-based resilience benefits are more likely to become financeable when four conditions are present: a defined payer, a contractual payment mechanism, a durable source of payment, and a clearly measured resilience or ecosystem service being paid for. This framing helps distinguish broad economic value from investable cash flows and clarifies why avoided losses often require institutional payment architecture before they can attract private capital.

In California, policymakers can set clear standards for resilience indicators, while public funding and credit enhancements can de-risk private adaptation investments and simplify cash flow structures for private investors. Partnerships with local governments, community-based organizations, utilities, and insurers can help translate avoided costs into more credible and measurable value streams. Engaging the community will be paramount to understanding how climate change affects them and in developing locally relevant and appropriate adaptation solutions. Building trust, engaging with all stakeholders, and co-designing adaptation projects will lead to improved outcomes overall.

(19) Parametric micro insurance for workers in heatwaves: rapid payout and financial empowerment via business interruption insurance

Location: India (Gujarat, Rajasthan, Maharashtra), and Los Angeles, California (proposed pilot)

Financial structure and collaborators: : A collaborative effort between the Self-Employed Women's Association (SEWA), a leading trade union for informal women workers, and several partners, including Arsht-Rock and Climate Resilience for All, developed a parametric micro-insurance product designed to protect women in India's informal work sector, such as farmers or waste recyclers. Women workers pay a small annual premium ($3), and a fixed payout ($4.80) is automatically triggered directly to them when a pre-defined heat index is

exceeded for two consecutive days. The program reaches approximately 50,000 women, with support from other organizations like Swiss Re, ICICI Lombard, and Blue Marble.

Mechanisms for resilience: This strategy leverages risk transfer to benefit women workers who rely on daily income and are highly vulnerable to the health and financial impacts of extreme heat. The parametric trigger ensures rapid payouts to provide immediate cash assistance to cover lost income and prevent women from taking on debt. The initiative also promotes a co-benefit of financial inclusion that ensures payouts are deposited directly into bank accounts, giving women greater autonomy and decision-making power to cope with future climate shocks.

Implementation/project status: The policy was piloted in 2023 and expanded in 2024, with multiple payouts triggered. Women workers pay the premium and are the policy beneficiaries, with philanthropy also supporting this project.

Challenges and opportunities for California: Building on the knowledge and experience gained through the program in India, California established a partnership among the public sector, industry, and NGOs. The partners include the California Department of Insurance, Inclusive Action for the City (a BIDsCommunity Development Financial Institution), Climate Resilience for All, SwissRe, and the Robert Wood Johnson Foundation. This new, groundbreaking "south-north" pilot initiative proposes to bring heat insurance, direct cash support, and resilience to heat-exposed sidewalk vendors in Los Angeles through a parametric insurance product to protect outdoor worker health and income in the face of rising heat conditions.

More information: When women are climate resilient; Insurance to impact: a guide to building resilience in a hotter world

C. The Long-term Resilience of Financial Institutions Depends on the Health and Vitality of Natural Ecosystems and Communities

Key Messages

- Healthy, thriving ecosystems underpin our economy and provide vital risk reduction services
- Nature is under threat, and the impacts to nature and people are exacerbated by climate change

- Losing nature results in material financial risks across all sectors of the economy
- There are opportunities to assess, evaluate, manage, and reduce nature-related risks, as well as to protect and restore nature

Healthy ecosystems can make communities safer and reduce disaster loss following catastrophic events. Yet, nature is being lost at alarming rates, driven by land and water degradation, habitat destruction, overexploitation, disease spread, and invasive species. In addition, climate change is exacerbating extreme natural conditions that are devastating not only to humans, but to the wildlife and plants ill adapted to excess heat, drought, precipitation, and wildfires. Loss of biodiversity risks food insecurity; disease; degradation of air, water, and soil; economic security; and social instability. Biodiversity loss ranks as one of the top five risks facing humanity over the next ten years (UNEP, 2022).

The World Economic Forum concluded that $44 trillion of economic value generation, over half the world's total GDP, is moderately or highly dependent on nature and its services (World Economic Forum, 2020). Businesses and suppliers directly rely on healthy abundant oceans, lands, and forests for their supply chains and raw materials, and so do the banks that finance, invest, and lend to those businesses (UNEP, 2021). Nature loss results in material financial risks across all sectors of the economy, affecting the performance, asset values, and long-term financial stability of financial institutions' clients. Managing nature-related risks is essential to ensure the long-term resilience of financial institutions (UNEP, 2026b).

Ecosystem degradation can translate into significant financial risks through several transmission channels. With ecosystem decline, businesses dependent on natural resources may face higher input costs, lower revenues, or reduced production due to diseases and pests which increase their credit risk and weaken the collateral value of the land. More frequent and severe natural disasters can lead to insurance companies facing higher claims and consumers facing higher premiums while local governments becoming financially strained due to increased expenditure on disaster recovery. Key infrastructure located in high-risk areas may face physical damage without the buffer of natural systems, disrupting business operations and supply chain, thus materially affecting financial stability.

Existing financial structures and markets prioritize uninhibited financial growth and financial returns which create perverse incentives that contribute to nature loss. The costs of harmful impacts are often externalized and borne by the public. Current incentive structures, including harmful subsidies and short-term profit maximization, accelerate nature's decline and push ecosystems toward tipping points that could irreversibly undermine future economic stability and profitability (IPBES, 2026). The disconnect between nature and finance is accelerating biodiversity loss while increasing operational and financial risks for businesses.

An urgent shift toward a new relationship with nature underpinned by financial models that measure, manage, and mitigate impacts on ecosystems is needed. Understanding and practicing Indigenous economies of care may be one avenue to move towards this relationship. This change is possible but requires better measurement, data, trusted relationships, new models, and incentives. Currently, less than one percent of publicly reporting companies disclose biodiversity impacts, and lack of reliable data, models and scenarios are cited by financial institutions as key barriers to action (IPBES, 2026).

The prominence of nature considerations within the corporate and financial sectors has grown rapidly, driven in part by the 2022 Kunming–Montreal Global Biodiversity Framework (Convention on Biological Diversity, 2022) and reinforced recognition of interconnections between climate change and biodiversity loss. New frameworks such as the Taskforce on Nature-related Financial Disclosures (TNFD) (TNFD, n.d.) and Science Based Targets Network (SBTN, n.d.) catalyzed a proliferation of guidance, tools, and methodologies (UNEP, 2026b), including a set of disclosure recommendations and guidance that encourage and enable businesses and the financial sector to assess, report, and act on their nature-related dependencies, impacts, risk and opportunities (TNFD, 2023). In addition, nature-based risk assessments enable financial institutions to evaluate the potential negative impacts and dependencies of their activities on nature at the corporate level. These assessments support more effective management of nature-related risks and can reveal strategic opportunities to reduce exposure and strengthen resilience (UNEP, 2026b).

D. Systems Capital Provides an Alternative Way of Envisioning Our Economic Systems to Moderate the Impacts of Climate Change on People, Ecosystems, and the Economy

Key Messages

- Systems capital provides an innovative structure for aligning the interconnected nature of the world around us with financial capital
- Systems capital takes a more holistic view of the relationships among people, ecosystems, and the economy

Financial capital can be "a fundamental enabler of innovation and action, and a core societal infrastructure" (Hannant et al., 2022). Yet, it is becoming increasingly clear that our existing economic systems, including conventional investments that focus on direct financial returns, must be reimagined to temper and moderate the impacts of climate change on people, ecosystems, and the economy. "Systems capital" offers

one way of envisioning how capital can be better aligned with the interconnected nature of the world around us and the systems that shape our quality of life and sustain all living things (Hannant et al., 2022). A systems capital approach looks beyond investment approaches that target individual activities and instead focuses on transformational potential. Where conventional investment tends to allocate capital to specific activities based on their potential to create direct returns, a systems capital approach takes a more holistic view influenced by Indigenous approaches to economies. This includes the "Seventh Generation Principle" and a mindset of a world built around reciprocal, connected relationships, where humans, other living beings, and ecosystems rely on one another (Hannant et al., 2022). These perspectives can be integrated into how adaptation is approached more broadly, rather than being siloed.

> *'How can we better attune to the interconnected nature of the world around us, and the systems which determine our quality of life and sustain all living things?'*
> *– adapted from Hannant et al. 2022*

Policies and market conditions can halt and reverse biodiversity loss by incentivizing conservation and the sustainable use of biodiversity (IPBES, 2026). A 'bioeconomy' may offer another approach to valuing nature and social justice in our economy. A bioeconomy is described as "a model of productive and economic development that uses natural resources in a sustainable, regenerative and conservationist manner, and which is based on justice, ethics and inclusion, where humankind follows rules to allow people to live and produce the things that society needs in ways that take nature into consideration, that work with and respect traditional communities, that are less resource-intensive and that are, as much as possible, circular" (Lambertini, 2025). By adopting nature-positive practices and delivering nature-positive outcomes, the bioeconomy aims to halt and reverse the destruction of nature, contributing substantially to stabilizing the climate (Lambertini, 2025).

These alternative economic strategies are already being implemented at scale. For example, Hawai'i Investment Ready (HIR), a non-profit impact investing intermediary, has implemented a systems capital approach for investing in Hawai'i's economic transformation (Hawaii Investment Ready, n.d.). HIR has found that enterprises engaged in adaptation and resilience solutions frequently become de facto "risk warehouses," absorbing volatility created by climate change, fragile infrastructure, and thin local markets. (***See Case Study 20: Hawai'i Investment Ready***).

Adaptation finance must therefore address not only how much capital flows, but how systemic risks are allocated and coordinated across actors. By building trusted networks among enterprises, funders, and public partners, HIR concluded that collaboration becomes a form of infrastructure—enabling more effective deployment of grants, debt, and partnership capital toward shared resilience goals. This concept

of partnerships as infrastructure is becoming more popular, in recognition of the ability of partnerships to provide stability, strength, and trustworthiness in times of uncertainty (Urban Ocean Lab, 2026).

The move from a conceptual systems capital framework to an operational one requires concrete institutional changes. Public budgeting processes, procurement, insurance pricing, benefit-cost analysis, credit assessment, infrastructure planning, and long-term maintenance funding all need to be restructured to treat nature and finance as interdependent, rather than separate, with nature a fundamental consideration rather than a mere externality.

(20) Hawai'i Investment Ready impact investing for climate adaptation through food system resilience and biocultural restoration

Location: Hawaii

Financial structure and collaborators: Hawai'i Investment Ready (HIR) is an Indigenous-led nonprofit impact investing intermediary advancing climate adaptation through food system resilience and biocultural restoration. In Hawai'i, food production, land stewardship, and cultural practice are deeply interconnected. Strengthening local food systems supports ecological regeneration, reduces import dependency, and reinforces Indigenous stewardship of 'āina, which is a layered, complex and foundational Hawaiian concept that includes the practice of caring for the land, honoring the spiritual life force of the land and waters, and embracing the kinship relationship and interconnected responsibilities and relationships of all life forms. (Urban 'Āina: An Indigenous, Biocultural Pathway to Transforming Urban Spaces; Episode 5: The meaning of aloha '?ina with Professor Davianna P?maika'i McGregor | Hawai'i Public Radio)

Through its 'Āina Aloha Economy Fund and related initiatives, HIR deploys patient, flexible debt alongside coordinated grant capital and technical assistance to enterprises building local production, processing, and distribution infrastructure. HIR also convenes and coordinates a cohort of aligned philanthropic, public sector, and private impact investors, recognizing that adaptation outcomes require trust-based relationships and capital alignment, not isolated transactions.

Mechanism for Resilience: In practice, HIR found that climate adaptation is both a capital deployment challenge and capitalization structure challenge. Enterprises restoring land and rebuilding local supply chains often absorb system-level risks, including thin markets, demand volatility, infrastructure gaps, and climate exposure, that they cannot price or manage alone. Intentionally structuring

blended capital stacks by integrating catalytic grants, patient debt, and coordinated partnership capital, HIR works to distribute systemic risks more appropriately across actors to enable long-term ecological, economic, and cultural resilience.

Implementation/project status: The HIR Accelerator program supports numerous social enterprises in improving their business models to scale their impact and assists them in accessing resources to implement their next level of growth. The program utilizes its unique regional training and coaching toolkit to provide a fully integrative capacity building experience.

Within HIR, the Leveraging Hawai'i Capital program hosts quarterly impact investing oriented workshops to uplift expert knowledge and best practices for investing in and capitalizing the solutions needed to address the social and environmental challenges faced in Hawai'i. In addition, HIR's Hawai'i Capital Scan (HCS) provides a map of government, private sector and philanthropic capital in Hawai'i to better align capital to food system growth.

HIR is currently pursuing a new and innovative systems-based, multi-stakeholder approach for its food systems accelerator program to activate meaningful momentum towards a viable and equitable post-plantation agriculture and food system for Hawai'i.

Challenges and Opportunities for California: Unknown at this time

More Information: Home - Hawaii Investment Ready

VI. Conclusion

Climate change is a systemic risk that affects every sector of the economy with far-reaching consequences for all Californians. The financing challenges associated with adaptation are similarly interconnected and require thinking expansively about the tools available for funding and financing projects to enable large-scale adaptation. California's adaptation finance landscape is therefore best understood as a mosaic of public funding, private capital, insurance, household investments, philanthropy, and blended approaches, each with different strengths, limitations, and implications for equity, scale, and long-term resilience. While financing adaptation is costly, financing recovery is even costlier, and both can easily become inequitably distributed or result in maladaptation. Finance and funding mechanisms can be designed carefully to reduce accessibility barriers for underserved communities and prevent shifting risks and costs to those most vulnerable in this interconnected system. As climate risks intensify, the ability to better align these mechanisms with California's social, ecological, and economic priorities will become increasingly consequential.
This report provided an overview of the landscape of adaptation funding and finance in California with concrete examples to learn from. This overview consisted of:

- The challenges of tracking and accounting for adaptation financial flows at the state level. Overcoming these challenges can lead to improved financial and outcome-based monitoring that enables right-sizing California's investment in adaptation.
- An overview of the mechanisms available for funding and financing adaptation and examples of strategies for addressing barriers for disadvantaged communities. While many of these mechanisms are not exclusively used for adaptation, they can be leveraged and tailored to meet the specific needs and challenges of adaptation projects, including through blended finance that combines multiple sources of capital.
- A synopsis of actors involved in raising and dispersing financial flows. This provides decision makers with knowledge on the potential partnerships that can support adaptation projects.
- The intersection of economic and social factors with respect to adaptation funding and financing, including Indigenous economies of care, housing & real estate, workforce & labor, and human health.
- Reimagining of California's future adaptation funding and finance landscape to benefit people, economies, and infrastructure, and nature.
- Twenty case studies showcasing concrete examples of funding and/or financing mechanisms for adaptation projects that California decision makers and practitioners can learn from to inform their own approaches. These case studies provide a powerful understanding of how efforts can scale through cross-sector collaboration.

Adaptation finance provides an avenue to deliver transformations in our systems to strengthen ecosystems, improve lives and livelihoods, and reduce climate risks. Blending diverse finance mechanisms can support large scale adaptation with synergistic and complementary benefits. Because finance actors vary in their capital, priorities, risk tolerance, and restrictions, developing layered finance strategies can close the funding and project gaps to deliver benefits. Positive and long-term outcomes are more likely when adaptation is collective, prioritized, and sustained, especially for those most vulnerable to impacts from climate change.

Adaptation is essential in reducing the human, environmental, social, and economic toll of more frequent and severe natural disasters. California has the tools and knowledge to innovate to strengthen the economy and protect humanity and nature through adaptation. Thinking beyond the current systems and embracing systems-level capital can be a great start for reimagining an adaptation finance future that provides far reaching financial and non-financial benefits. Collective actions can prioritize, shape, and ultimately finance adaptation that benefits all and strengthens California.

Appendix A. Adaptation Needs by Peril

Extreme Wildfire

California is already experiencing the impacts of more frequent major wildfires, caused by climate driven heat and drought and exacerbated by historic forest fire suppression and development in higher-risk areas (Kumar et al., 2025). The devastating wildfires in Los Angeles in January 2025 destroyed over 16,200 structures, cost between $76–$131 billion in damages, and compounded housing affordability and availability problems (Li & Yu, 2025). In addition, the wildfires are expected to cause a 0.48 percent decline in county-level GDP for 2025, amounting to approximately $4.6 billion and a total wage loss of $297 million for local businesses and employees in the affected areas (Li & Yu, 2025). The economic forecast report by LAECD's (2026) estimated the steepest job losses occurred in the fire areas of Eaton (19 percent) and Palisades (26 percent) year on year in quarter two of 2024 to 2025, compared to flat employment countywide. They also estimate that economic impacts of the combined fires could total $4.6–$8.9 billion and that 25,000–49,000 job-years of employment would be lost across 2025 to 2029 (LAECD, 2026).

The increasing frequency and intensity of California wildfires worsen existing air quality issues and cause higher incidence of air pollution-related hospitalizations and deaths (Thilakaratne et al., 2023). Spending on wildfire resilience has steadily grown since 2016–17 (LAO, 2025a), but greater growth in sustained funding and financing for resilience and risk reduction work is needed to offset the rise in wildfire-related harm, displacement, and economic losses (Wear et al., 2025).

Financing and funding can incentivize and directly support actions such as fire-resistant building and retrofitting practices, parcel and landscape-level fuels reduction projects, tribal practices for wildfire management, and insurance coverage to close the protection gap. Wildfire home hardening and community-level mitigation are critical to reducing wildfire risk in high risk areas (Zamanialaei et al., 2025) and to the insurability of California's housing and other building stock. Reduced risk is essential to housing affordability, a healthy California real estate sector, and the downstream financing of local schools, infrastructure, insurance costs, and other programs. Landscape level fuel reductions near wildland urban interface (WUI) and post-fire landscape restoration are needed to reduce wildfire risks; promote healthy forests; and improve water quality, habitat connectivity, and biodiversity. (***See Case Study 14: French Meadows Project***).

Flood and Drought

California has the highest year-to-year variability in rain and snowfall among the US states. Additionally, climate change intensifies a 'weather whiplash' effect in California, resulting in swings between floods and drought (DWR and CNRA, 2023). Flood impacts cost the US an average of $46 billion per year in 2014–2024 and are expected to rise by a quarter to a third by 2050 (CBO, 2024b). California is no exception to rising flood impacts. For example, in December 2022, extratropical cyclones and atmospheric rivers caused record-breaking flooding and landslides in California, causing $5–7 billion in economic losses (Moody's, 2023). Droughts can degrade drinking water quality, increase human exposures to fungal spores and toxins from harmful algal blooms, lead to higher tree deaths, increase fire activity and severity, and threaten aquatic habitats. In California, low-income families and particular demographic groups are especially impacted during droughts due to rising household and business water service costs, debt, and reliance on small water systems/wells (OEHHA, 2022).

Co-managing flood and drought risks in California will require investments in a variety of adaptation projects, such as floodplain restoration, improved water and drought management strategies (e.g., Forecast-Informed Reservoir Operations), and flash flood infrastructure in cities, to name a few. Both green (i.e., nature-based) and gray (engineered hard structure) projects can help mitigate against hazards and reduce the risk to people and property. Innovations to increase insurance coverage can also help Californian communities and businesses build resilience to floods and drought. A key challenge in financing flood and drought projects is that these projects are commonly long-lived, cross jurisdictional, and financed through fragmented institutions (federal agencies, state agencies, local water districts) which can cause complications in financing implementation or maintenance. This is particularly true for multi-benefit systems such as reservoirs that provide flood protection and municipal water supply. In coastal areas, these risks also interact with sea level rise, storm surge, and erosion, increasing both the frequency and consequences of flooding.

Sea Level Rise

Along the coast, sea level rise compounds existing flood risks from storms, atmospheric rivers, wave action, and tidal flooding, creating distinct financing needs for both protection and long-term adaptation. California's coastal communities face increasing pressure to adapt to changing extremes from atmospheric rivers and storm surge, rising groundwater levels, and to rising sea levels, which are projected to rise 0.8 ft by 2050 and 1.6–3.1 ft by 2100 across the state (California Sea Level Rise Guidance, 2024). In this century, approximately 600,000 residents and $150 billion (2010 dollars) in property across California could be exposed to storms and sea-level rise-driven flooding (Barnard et al., 2019). Public spaces will also be impacted: in some parts of California, over two-thirds of beaches may be lost by 2100 without preventative or management action (California Sea Level Rise Guidance, 2024). Sea level rise accentuates coastal storm impacts, including erosion, and communities must be prepared for a rapid increase in the frequency of coastal flooding (California Sea Level Rise Guidance, 2024).

According to research done for California's 5th Climate Assessment, while average wave conditions are projected to remain relatively steady under future conditions, extreme waves exhibit notable increases of up to 50 percent in parts of Central and Southern California. Projections of storm-driven extreme sea levels show increases of about 0.3 meters by mid-century. Together, these impacts significantly amplify coastal hazards along California. Annual coastal climate risks could rise 1.6-fold ($166.9–$269.4 million) in Santa Cruz, 3.7-fold ($17.6–$65.6 million) in Ventura, and over 80-fold (<0.2 to over $15.8 million) in Half Moon Bay. This means, for example, that the 20-year storm damage in Santa Cruz would be $590 million by 2085, up from $378 million today (Reguero et al., 2026). In addition, research from California's Fifth Climate Change Assessment found that tsunami depths and resulting damage risks escalate with rising sea levels. While the impact is non-linear and dependent site-specific effects, a general increase of vulnerability occurs as sea levels rise highlight the compounding effects of coastal climate risks (Patton et al., 2026).

Sea level rise will increase demand for funding and financing across a range of adaptation needs. In many parts of the state, transportation infrastructure such as roads and railways will need to be repaired, upgraded, or strategically relocated (du Vair et al., 2023). Green and gray coastal infrastructure can be installed to buffer against coastal flooding, using green infrastructure such as wetlands where possible and hard armoring as a last resort. While the scale of benefits from adaptation options can vary significantly between municipalities based on local risk factors, recent advances in modeling capabilities such as CoSMoS-Adapt are poised to help decision-makers consider local factors and estimate tradeoffs between early and delayed investments in adaptation (Reguero et al., 2026). Insurance innovations can also help California communities build resilience to coastal flooding. For example, the City of Imperial Beach is exploring new insurance mechanisms to build resiliency in

their community. (See Case Study 6: Flood protection and insurance solutions). Sea level rise has also prompted highly controversial discussions of managed retreat with limited action within California to date.

Extreme Heat

Extreme heat is a major threat to the health of Californians and to the economy. The California Department of Insurance's (CDI) report on the impacts of extreme heat across seven selected extreme heat events during 2013–2022 found that mortality rates for disadvantaged community tracts were between 14–30 percent higher than non-disadvantaged community tracts for six of the seven extreme heat events examined (CDI, 2024). The report also showed that heat impacts the health and safety of individuals and the economy, with those seven extreme heat events causing a cumulative $7.7 billion in losses due to impacts such as lost manufacturing and agricultural productivity, damage to key infrastructure like roads and rails, decreased electricity stability, and increased demands on governmental services. Total social welfare losses associated with premature deaths was the most significant cost across the studied events, costing between $77 million and $2.2 billion per event. The cost of heat-related damage to road and rail infrastructure and associated transportation delays ranged from $3.8–$35 million per event.

The impacts of extreme heat have only recently begun to be fully acknowledged and therefore the financial flows are not well-established. Nonetheless, the California government recognizes this threat and financial support for building resilience against extreme heat is gaining traction. The Greenhouse Gas Reduction Fund and Proposition 4 are funding the Extreme Heat and Community Resilience Program to support local, regional, and Tribal efforts to reduce the impacts of extreme heat (LAO, 2025c). And, in 2021, CDI's Climate Insurance Working Group's report (Climate Insurance Working Group, 2021) provided recommendations on extreme heat and other perils, including the development of a heat ranking tool to communicate heat threats and potential impacts. CalHeatScore, launched in 2025, is now used as a heat-health ranking system to raise awareness of risks from extreme heat events in the state (OEHHA, n.d.).

While extreme heat periods are becoming more common, the baseline perception of normal heat levels is also shifting (Soga & Gaston, 2024). California's average summer temperature has already risen nearly 3 degrees F (1.8 degrees C) since 1896 (Scripps Institute of Oceanography, n.d.). Shifting baseline syndrome makes climate change more difficult to perceive, diminishing urgent action to ensure communities, ecosystems, and the economy remain resilient under this chronic threat. While heat records continue to break across days (Climate Central, 2026) and years (NOAA, 2025), supporting better decision making to reduce extreme heat risks requires understanding how shifting baseline syndromes affects a diverse group of individuals

including laypeople, policymakers, and practitioners (Soga & Gaston, 2024). Key adaptation actions that could build resilience to extreme heat include planting trees to increase urban canopy, making community cooling centers widespread and accessible, and supporting outdoor workers to stay indoors when it is unsafe to work outside, such as through insurance mechanisms. (See Case Study 19: Parametric micro insurance for workers in heatwaves). Other legislative actions include safe maximum indoor temperatures standards (SB 655 Dwelling Units: Indoor Temperature, n.d.) and proposed tenant cooling device rights (AB2616 Hiring of Real Property: Indoor Temperature, n.d.).

Compounding and Cascading Hazards

Hazards like wildfire, extreme heat, drought, flood, and landslides amplify their individual effects when they occur near to one another in time or space and/or occur simultaneously with non-climate emergencies (e.g., earthquake). Research on the temporal and spatial interactions between heat, drought, and wildfires in summertime California shows that one third of the state experienced compounding hazard events (extreme heat, drought and/or wildfire) in recent decades (Shives et al., 2025). In particular, urbanized areas amplify vulnerabilities such as exposure to more heat, aging infrastructure, social inequities, and reduced adaptive capacity. A recent survey of 595 California post-fire debris flows, a type of landslide that can be triggered when extreme rainfall impacts recent wildfire burned areas, demonstrates that this cascading hazard frequently occurs even under relatively weak atmospheric river storm conditions (Oakley et al., 2025). Compounding hazards can complicate processes involved in adaptation finance, particularly as they relate to post-disaster recovery funds. Losses associated with secondary catastrophic events are sometimes covered by insurance, as in the case of post-fire debris flows, but are often not covered by insurance, which obfuscates coverage for consumers and sometimes leads to litigation or household financial difficulties. Compounding hazards can concentrate losses in a way that is difficult for insurers and reinsurers to manage, increases costs, and delay or prevent recovery for communities. Adaptation can be effective by taking a multi-peril approach that considers the potential interactions between these events.

Appendix B. Key Characteristics of Different Funding and Financing Mechanisms

Mechanism: Bonds

Municipal bonds (general obligation bonds, revenue bonds)

Description:

- Municipal bonds are a debt financing tool used by state and local government agencies to fund capital projects and public services. Bond issuance may be

subject to voter approval requirements depending on the type of bond and form of repayment.

- **General obligation (GO) bonds** are backed either by the full faith and credit of the issuer or by a promise that ad valorem property taxes will be levied to pay off the debt, allowing increases on property taxes beyond the 1 percent rate capped by Proposition 13. To issue new general obligation bonds at the local level, a two-third voter approval is required. State GO bonds must be approved by a majority of voters.
    - **Strength:** Good for financing large public projects that do not generate revenue (e.g., infrastructure). The guarantee lends a high-level of security for investors that allows for a high-credit rating and access to low interest rates for government borrowers. Good for large, long-term capital projects because the cost is distributed and benefits are distributed across multiple generations of taxpayers.
    - **Example:** In 2024, voters passed Proposition 4, called the Climate Bond, authorizing $10 billion in general obligation bonds for water, wildfire prevention, and protection of communities and lands, with a requirement for annual audits. Repaying the money could cost $400 million a year over 40 years, a legislative analysis said, meaning taxpayers could spend $16 billion. California Natural Resources Agency (CNRA) is the coordinating agency.
    - **Challenge:** GO bonds are subject to voting approval and are limited to what they can fund (e.g., they focus on shovel-ready projects).
- **Revenue bonds** are backed by a specific revenue stream such as tolls or lease payments. Many revenue bonds do not require voter approval. Revenue bonds are not guaranteed and thus typically have higher interest rates than general obligation bonds.
    - **Strength:** Many revenue bonds do not require voter approval. They allow costs for large, long-term projects to be spread across multiple generations who are benefiting.
    - **Challenge:** Revenue bonds require the project to have a revenue stream, are not guaranteed and generally have higher interest rates than GO bonds.

Private activity bonds

Description:

- **Private activity bonds (PABs)** are issued by state or local governments on behalf of a project's private developers. Eligible activities include adaptation and resilience-oriented projects such as desalination, combined heat and power, sewage facilities, solid waste disposal facilities, and qualified green building and sustainable design projects.

- **Strength:** Private activity bonds allow private entities to benefit from federal income tax exemptions.
- **Challenge:** Congress limits what private activities can qualify for tax-exempt financing, which can limit the value of qualified PABs used in an annual state volume cap.

Outcome-based financing (social impact bonds, environmental bonds)

Description:

- **Outcome-based financing** is when a government agency partners with a private sector entity that is responsible for initial capital investment and ongoing service provision. Private investors loan money for upfront financing and ongoing operations. If the private entity is successful in its service delivery, the government agency reimburses the upfront capital to the private sector entity, which then repays the private investors. The government agency may also provide payments as the service achieves milestones, or provide variable interest rates or payment schemes depending on the success of the project. Outcome-based financing requires significant public sector capacity to develop contracts with private sector service providers and to manage a monitoring and evaluation program.
  - **Strength:** Incentivizes measurable project success as positive outcomes are expected before private loan investment is reimbursed. Transfers project risk away from tax-payer funded programs.
  - **Challenge:** Often a limited application and value amount. Significant public sector capacity required for monitoring and evaluation. Limited use to date and therefore few demonstrated examples of success.

Green labeled bonds

Description:

- Green bonds and Resilience Bonds are similar to traditional bonds, but they have a specific focus on raising financing for "green projects" as determined by a given taxonomy. While the Green Bond market historically suffered from lack of standardization (prior to 2020), there have been significant moves towards consistency in labeling through the Climate Bonds Initiative, the ICMA Green Bonds Principles, and the European Green Bonds Standard. Green Bond issuances have skyrocketed since 2015, when issuance was under USD 46 billion. In 2024, Climate Bond Initiative-aligned green bond issuances reached an annual volume of USD 670.9 billion.
  - **Strength:** Social impact investor appeal; showcases commitment to spending towards environment purposes. There has been a lot of work in this area (e.g., ICMA Green Bond Principles; Climate Bonds initiative; European Green Bond Standard).

- **Challenge:** Limited use to date (although fast growth); historical lack of standardization of what it means to be "green"; administrative complexity.

Mechanism: Grants

Grants

Description:

- A funding tool used for disbursing money for climate adaptation. Grant funding is typically sourced from federal, state, local funds/taxpayers, but can also be sourced from private or philanthropic funds.
  - **Strength:** Money raised from broader geographies (e.g., federal level) can be invested locally and attract additional funding sources.
  - **Challenge:** High capacity needed to apply, manage, and report on fund use. Not a continuous source of funding.
  - **Example:** The State Coastal Conservancy Grant Program will allocate Proposition 4 "Climate Bond" funding through grants with a focus on Wildfire Resilience Funding and Coastal Flooding and Shoreline Resilience Funding.

Mechanism: Taxes

Parcel tax

Description:

- Parcel taxes are special taxes that are based on a fixed amount of tax per parcel of land, rather than on the value of the land. They may be levied with two-thirds voter approval to fund a variety of local government services. This source of funds is particularly applicable for adaptation and resilience projects for which it may be more difficult to quantify costs and benefits to specific properties, as is needed for assessments and fees.
  - **Strength:** Does not require quantifying costs and benefits to specific properties; continuous source of funding.
  - **Challenge:** Subject to voter approval; restricted to public purpose use voted on; typically regressive mechanism affecting low-income households disproportionately as parcel taxes are fixed amounts per parcel.
  - **Example:** In 2016, the voters in the nine San Francisco Bay Area counties passed Measure AA to authorize a $12/year parcel tax for 20 years which provides $500 million in funding for the authority to use to restore wetlands and mitigate against expected sea level rise.

Tax-increment financing (TIF)

Description:

- Tax-increment financing can be used to raise funds for climate adaptation and is a value capture tool that collects property tax revenue based on increases in property values that result from a particular enhancement or improvement. Tax-increment financing to date has focused primarily on transit improvements, but there is potential for this tool to be used for adaptation and resilience projects that provide a benefit to property and thus increase its value. For example, green stormwater infrastructure investments can reduce runoff impacts and increase recreational and aesthetic value which leads to property value increases. Tax-increment financing does not affect tax rates (i.e., percentage of value that is taxed) but rather captures the added real estate value that a project induces at the already established tax rate.
  - **Strength:** Does not increase the tax rate directly at the time it is put into place; continuous source of funding; incentivizes project success.
  - **Challenge:** Subject to voter approval; variable funding amount.
  - **Example:** In California, Enhanced Infrastructure Finance Districts (EIFDs) and Community Revitalization and Investment Authorities (CRIAs) are authorized to use tax-increment financing and can issue revenue bonds backed by tax increment financing. Annexation Development Plans can also utilize tax increment financing. Under California Assembly Bill 733 (Berman), enacted in 2017, EIFDs may be used to pay for "projects that enable communities to adapt to the impacts of climate change."

Mello-Roos tax

Description:

- Mello-Roos taxes are special taxes that local agencies can levy to pay for public facilities (including facility acquisition, construction, rehabilitation or expansion), and/or services. This taxation scheme was developed to bypass the property tax limitations established by Proposition 13. To levy a Mello-Roos tax it is necessary to form a Community Facilities District (CFD) that outlines the boundaries of who will pay the tax. Once the boundaries of the CFD are determined, two-thirds of qualified electors in the district must approve of the special tax. Mello-Roos taxes may be particularly applicable to adaptation and resilience projects given that 1) they are often created for new development where new infrastructure can be designed according to resilience-oriented principles or objectives, 2) there is flexibility in the Rate and Method of Apportionment (RMA), which may allow for risk exposure to be accounted for within the tax rate structure, and 3) there is flexibility in determining what properties will be taxed (properties do not need to be contiguous) which can be beneficial for adaptation and resilience projects that have geographically dispersed benefits.

- **Strength:** Taxed population boundaries do not need to conform to city or county boundaries, and the project only needs to demonstrate benefit to the CFD. Revenue generated by the tax can go towards direct payments or to service bond debt for proposed improvements. Rates can be relative to land use type and areas.
- **Challenge:** Significant administrative process to develop and collect funds; quantified tax value considers multiple factors and the formula is not standardized across the CFD.

Other taxes (e.g., sales, gas, hotel, utility users, business license)

Description:

- Other taxes can also be used to raise funds for climate adaptation. Residents, businesses, and visitors pay taxes which can be disbursed by local governments. Typically, these are general taxes, which require only a simple majority for cities and counties to levy (less than two-thirds threshold for special taxes) or two-thirds of legislature for state general taxes. They can be regressive, with a disproportionate burden on low-income communities. Some communities in California use transient occupancy taxes paid by short term renters (e.g., in hotels or AirBNBs) to fund infrastructure projects.
  - **Strength:** Flexible in use; can require a simple majority vote for cities and counties to raise levy.
  - **Challenge:** Subject to voter approval; can be regressive with disproportionate burden on low-income communities; requires two-thirds of legislature for state general taxes.
  - **Example:** In 2024, the city of Santa Cruz voted to pass Measure K, allowing for a 0.5 cent increase in sales tax to fund a variety of resilience initiatives including wildfire prevention programs, flood mitigation efforts, and disaster recovery services. This will result in approximately $10,000,000 annually, until ended by voters.

Mechanism: Investments

Direct Investment through Adaptation-Focused Investment Funds

Description:

- Investment by financial institutions, funds, or corporate companies with technologies, products, and solutions that facilitate positive resilience impact. Often a minority stake where companies have commercial revenue and a growth trajectory.
  - **Strength:** Significant potential source of capital; independent of changing government priorities.

- **Challenge:** Investors expect return on investment. Not suitable for projects that provide public benefits without significant financial return.

Incentives (e.g., exemptions, discounts)

Description:

- Incentives encourage a certain action or investment through some form of reward. Examples include tax credits, regulatory streamlining, rebates, and exemptions from processes or standards. Incentives that encourage adaptation and resilience investment are particularly applicable when a monetizable risk is avoided.
  - **Strength:** Encourages actions or other investments.
  - **Challenge:** Limited support to consumers due to cut-off limits or restrictions.
  - **Example:** FEMA's Community Rating System offers discounts between 5 percent and 45 percent on insurance premiums to reward risk-reducing investments or actions. On the local government scale, Wildfire Adapted Sonoma County has completed Phase 1 of the FEMA funded Wildfire Adapted project, which is focused on risk assessment, and is now awaiting FEMA's approval to move forward to the Phase 2 incentive program, which may provide up to $10,000 in rebates to help property owners to complete defensible space and/or home hardening tasks that were identified as priority actions in Defensible Space or Home Wildfire Assessments.

Voluntary carbon markets

Description:

- An organization (typically a private corporation) can purchase a "carbon credit" from a voluntary carbon market, which can be used to offset their own emissions in order to meet an emission reduction pledge. These credits are certified by third-party civil society organizations and can include projects with adaptation co-benefits such as avoided deforestation or ecosystem restoration.
  - **Strength:** Corporations provide additional funding to adaptation projects without any expected financial return or public capital required.
  - **Challenge:** Without strong oversight, carbon credits sometimes lack the permanence and double counting protections required to ensure that funding is going towards additional emission reductions and adaptation benefits; participation is dependent on corporations' spending willingness to meet emission reduction targets.

Mechanism: Fees and Assessments

Property related fees: water, stormwater, and wastewater fees

Description:

- Property-related fees are fees that local governments impose to provide services that have a direct relationship to property ownership, including water delivery, sewer service, stormwater management, and flood control fees. Property-related fees are subject to Proposition 218, which requires that any increase in fees must first be presented at a public hearing. If there is a majority protest, the fee increase cannot go forward. Water and wastewater fee changes are subject to this majority protest threshold. Wholesale water supply agencies and private utilities are not subject to Proposition 218, although privately owned water utilities' rate setting is regulated by the California Public Utilities Commission (CPUC).
    - **Strength:** Common and well understood way to fund services that directly benefit property owners.
    - **Challenge:** Subject to public hearing and protest threshold for fee increases.

Non-property-related fees: gas, electric

Description:

- Non-property related fees such as gas and electric fees can be used to raise funds for climate adaptation. Non-property-related fees can be imposed to provide services unrelated to property ownership. Non-property-related fees can typically be imposed by local agencies without voter approval as long as the costs of the fees do not exceed the reasonable costs of provision of the services that the fees will be used to pay for and as long as the fees are not considered taxes under Proposition 26. Common non-property-related fees include gas and electric fees, fees for services or products such as transit, and fees for reasonable regulatory costs such as processing of building permits. Funds are sourced from users and become available to spend by public agencies on the local/regional/state level.
    - **Strength:** Can be imposed without voter approval to cover specific services; funded by broader population than property taxes.
    - **Challenge:** Fees cannot exceed the reasonable cost of provision of the services that the fees will be used to pay for.

Other user fees (e.g., transit fares, tolls)

Description:

- Other user fees such as tolls and fares charged to those who use and benefit from the services can be used to raise funds for climate adaptation.

- **Strength:** Flexibility in fund use.
- **Challenge:** Participation of disadvantaged and vulnerable communities may be limited without affordability programs, and this option can be regressive.

Assessments and Special Assessments

Description:

- Assessments and special assessments are related but differ in their purpose and how they are charged.
- **Assessments** are based on the valuation of the property and raise funds to deliver public benefits including safety-related investments, schools and libraries, and roads. They are valued regularly and charged annually. These are generally considered a regressive tax.
- A **special assessment** is a charge imposed on property owners in a specified geographic area or district to fund projects or services that provide direct benefits to properties in that district. The amount of the charge must correlate with the benefit that the property owners are anticipated to receive and the cost of the service provision. Special assessments cannot fund general public benefit services or improvements. This requirement can be particularly challenging for adaptation and resilience projects that provide benefits at broad scales rather than to specific, well-defined properties. A special assessment can only be imposed if approved by a majority of property owners that respond to the mail-in form, weighted proportionally by the assessment each owner would pay.
  - **Strength:** Special assessments can be applied on flexible geographies; not considered a tax under Proposition 26, simple majority support of affected property owners required.
  - **Challenge:** Subject to voter approval requiring majority of affected property owners; extensive documentation of benefits required.

Business Improvement districts

Description:

- Business improvement districts (BIDs) are typically formed to enhance existing public services or to provide additional services. BIDs are particularly applicable for adaptation and resilience projects that improve customer experience (e.g., enhance recreational or aesthetic value) and that benefit from economies of scale, such as district-wide stormwater infrastructure improvements. Fees can be based on property value or imposed as a business license fee.
  - **Strength:** BIDs are programs of the municipality in which they are established thus decreasing administrative complexity.

- **Challenge:** Limited legal authority to raise revenues or charge fees for services.

Cap-and-Invest

Description:

- Government agencies can set declining limits on allowable emissions and issue emissions allowances equal to those limits. Allowances can be directly allocated to firms, made available at auctions, or traded among program participants to incentivize firms to reduce their greenhouse gas emissions. Revenue from Cap-and-Invest Program auctions can be spent on climate projects, using a variety of mechanisms.
  - **Strength:** Greenhouse gas emissions mitigation incentive; flexibility in revenue use from cap-and-invest auctions for climate projects, including adaptation and resilience.
  - **Challenge:** Difficult for government agencies to determine an appropriate cap on emissions, which requires strong baseline greenhouse gas emissions data and a clear emissions reduction target.
  - **Example:** The California Air Resources Board (CARB) holds quarterly Cap-and-Invest Program auctions, in which corporations can bid for greenhouse gas emission allowances. Revenues from these auctions are deposited into the Greenhouse Gas Reduction Fund (GGRF) and are appropriated to climate-related programs. Programs spend the funding through mechanisms including grants, rebates, revolving loans, and incentives.

Mechanism: Loans

Federal loans

Description:

- Federal loan programs, authorized by Congress, are a commonly used approach to disburse financing for climate adaptation and resilience projects. They offer appealing terms such as long repayment periods and fixed low-interest rates that are not tied to project risk, unlike private market loans. Repayments can often start five years after the project has reached "substantial completion." If the project is eligible, the borrower can be public or private.
  - **Strength:** Generally lower interest rates and long-term financing; often includes access to capital for underserved communities and can support projects from small to large scale; federally backed loans may be more stable in risk.
  - **Challenge:** Complex application and approval processes; highly competitive and limited flexibility for use of funds; federal funds are spread across many agencies making it difficult for applicants to find the right loan

to apply for; may encounter benefit-cost analysis barriers in underserved communities, and can include geographic and demographic biases.

- **Example:** Transportation Infrastructure Finance and Innovation Act (TIFIA) Program, administered by the US Department of Transportation; The Water Infrastructure Finance and Innovation Act (WIFIA) Program, administered by the US Environmental Protection Agency.

Revolving loan funds

Description:

- Revolving loan funds are pools of public capital from which loans can be made. The repayments of principal from old loans are used to issue new loans and typically, the collected interest funds the administrative costs of running the revolving loan fund. State revolving loan funds include the Clean Water State Revolving Loan Fund, the Drinking Water State Revolving Loan Fund, and the Infrastructure State Revolving Loan Fund. The California Clean Water State Revolving Fund offers low-interest loans for water supply and water quality projects. The Drinking Water State Revolving Fund (DWSRF) offers low-interest loans for drinking water and other water capacity projects including treatment and distribution systems. California's Infrastructure State Revolving Fund (ISRF) provides financing to non-profits and public agencies for infrastructure and economic development (excluding housing). If the project is eligible, the borrower can be public or private.
  - **Strength:** New loans are more easily created through repayments of old loans, without additional public capital required.
  - **Challenge:** Typically small pools of public capital; can make a limited number of loans and need to wait until old loans are repaid to initiate new loans.
  - **Example:** The Carlsbad Municipal Water District used loan funding to expand its recycled water system to increase capacity by 2 million gallons per day, install new piping, and relocate and construct new recycled wastewater storage. The City of Joaquin used financing for a water meter installation. The Pico Water District received Infrastructure State Revolving Funds to replace a well with a new energy efficient one that will bolster the groundwater production, reduce electricity costs, and improve reliability.

Program related investments (PRIS)

Description:

- Program-related investments (PRIs) are administered by philanthropic foundations and often structured as revolving loan funds. Foundations use PRIs to invest in programs that align with their mission and goals. Foundation PRI programs recognize that they might not receive a full return on their

investment, and PRIs can be structured as convertible loans so that if a recipient cannot repay the full loan, a portion of the funding can convert to a grant.

- **Strength:** Doesn't expect full return on investment; partial conversion of loan to grant is sometimes possible.
- **Challenge:** Not a continuous source of funding.
- **Example:** The Gates Foundation anticipates 90 cents returned for every $1 invested out of its PRI portfolio.

Sustainability-Linked / Sustainability-Labeled Loans

Description:

- Sustainability-**linked** loan: Debt financing solutions that reward sustainability performance by the borrower
- Sustainability-**labeled** loan: Debt and structured debt financing solutions directly used for sustainable and/or climate transition projects
  - **Strength:** Incentivize sustainability performance.
  - **Challenge:** Limited uptake/limited examples.

Blended Finance Structures (co-lending, guarantee, interest rate buy down, etc.)

Description:

- Blended finance structures are financial vehicles involving co-financing across the private and public sector. Typically, these structures are launched by government entities with the goal to incentivize private sector participation in deals that may be seen as too risky or new to pursue without government incentivization. These structures frequently involve repayment to government entities, meaning funds can be recycled to new projects as they are repaid.
  - **Strength:** Potential to leverage benefits and manage risks of multiple financial mechanisms.
  - **Challenge:** Complex structures to formulate and communicate.
  - **Example:** The GoGreen Financing program works by offering finance companies a credit enhancement in the form of a loss reserve. The loss reserve helps mitigate the risk for finance companies because they can access these funds in the case of a default. This allows the finance companies to offer more attractive terms, like lower rates, larger amounts to borrow, or longer time periods for repayment, than they otherwise could. The credit enhancement also allows finance companies to approve financing for a wider base of borrowers, such as homeowners with lower credit scores or small businesses with only a few years of operating history.

Mechanism: Insurance

Indemnity Insurance

Description:

- Indemnity insurance can finance climate adaptation. With indemnity insurance, damages from a covered event are assessed and then a payout is made once a deductible has been subtracted (i.e., the amount of damages for which the policyholder is responsible before the insurer starts paying) and going up to the coverage limit or total damages, whichever is smaller. The policyholder pays the premium for the policy at regular intervals. When premiums are risk-based and risk-reduction (e.g., home hardening for wildfire) is accounted for in the premium, indemnity insurance can incentivize adaptation.
    - **Strength:** Can incentivize adaptation when premiums are risk-based; familiar and widely used or even required; high likelihood that the payout covers a large portion or the entirety of a loss to help with recovery.
    - **Challenge:** Can disincentivize adaptation if premiums are not risk-based; slow process for policyholder to receive payout which can hinder recovery.

Parametric Insurance

Description:

- Parametric insurance can rapidly finance climate adaptation by funding reparation of damage or covering other costs from a natural disaster. In a parametric insurance policy, a trigger threshold is predetermined for a chosen metric or metrics (e.g., wind speed), and if that threshold is met, the policy pays a predetermined amount to the policyholder. In contrast to indemnity insurance policies, damages do not need to be assessed by a loss adjuster. This difference means that parametric policies pay out faster than indemnity policies, and that there is a greater risk that the payout does not match the actual amount of damage because the trigger is an imperfect proxy ("basis risk").
    - **Strength:** Fast payouts to enable quick recoveries; potential to cover costs that indemnity insurance does not cover including costs that are difficult to quantify (e.g., natural systems) or are small (e.g., medicines lost due to power outages).
    - **Challenge:** May not cover the full cost of recovery or restoration of the damage; potential that damage does not trigger a payout (e.g., loss occurs when metric is just below the trigger threshold); unfamiliar to the average insurance consumer.
    - **Example:** The Mesoamerican Reef and Hawaiian reefs are insured with parametric policies. Habitat restoration and conducting recovery actions quickly following disasters can be critical to the reefs' success. Rapid parametric insurance payouts can help make this happen.

Micro-insurance/ inclusive insurance

Description:

- Inclusive insurance, formerly known as microinsurance, is a type of insurance designed specifically to meet the needs of emerging or underserved communities. It historically focused on low-income individuals and families, particularly those in developing countries or underserved by traditional insurance providers. These policies offer affordable protection against various risks like illness, injury, death, property damage, or natural disasters. These mechanisms usually leverage parametric insurance structures.
  - **Strength:** Affordable protection especially for vulnerable communities and individuals; covers costs that indemnity insurance can not due to the ratio of administrative costs to payout size.
  - **Challenge:** May not cover full costs of recovery or restoration of the damage.

Catastrophe bonds

Description:

- Catastrophe bonds (CAT bonds) are a type of insurance-linked security (ILS) designed to transfer specific insurance risks related to catastrophic events like hurricanes, earthquakes, wildfires, and floods from insurers to investors. These high-yield debt instruments offer insurers an alternative mechanism to manage their exposure to potential large-scale financial losses from such events.
  - **Strength:** Lack of correlation with other markets makes them attractive to investors managing a portfolio.
  - **Challenge:** Require significant investments in insurance industry modeling to quantify, validate, and price the value of physical risk reduction measures. Varying levels of maturity of resilience programs and models for different perils (e.g., wind, flood, and wildfire).
  - **Example:** North Carolina's state insurer (NCIUA) issued the first-ever Cat Bond with integrated resilience features to reward physical risk reduction measures. The term "Resilience Bond" has also been used to describe this type of insurance policy. (***See Case Study 15: NCIUA cat bond***).

Catastrophe Wrappers

Description:

- Catastrophe wrapper insurance policies can insure bonds. Governments may struggle to raise funds for bonds if they face risks from natural disasters that increase their chances of defaulting on payments to investors. A catastrophe wrapper is an insurance payout that can be used to make bond payments in the event of a covered catastrophe. A government with a catastrophe wrapper

can follow through on debt payments and is therefore likely to receive a higher credit rating. This can help it raise more funds with better interest rates for projects.

- **Strength:** Increases credit rating of the government, making better interest rates accessible.
- **Challenge:** Limited use cases.

Appendix C. Glossary

Actors: Financial capital sectors that contribute to adaptation funding and financing. This includes groups such as the public sector, insurance, private capital, households, and philanthropic organizations.

Blended Finance: The use of public or philanthropic funds to leverage or lower the risks associated with commercial financing, or to reduce the cost of capital.

Cap-and-Invest Program: A California program that sets a limit, also called a cap or allowance, on the total amount of greenhouse gas emissions allowed from covered sources. The allowances are auctioned by the state, in which proceeds are reinvested into programs that further reduce emissions, or traded on secondary markets. It is a key element in California's strategy to reduce greenhouse gas emissions while generating revenue for state investment in clean energy and community programs. Formerly known as Cap-and-Trade Program.

Capital Stack: A layered structure of different sources of capital that together funds or finances large scale projects. Sources can be ranked by risk, return, and repayment priority.

Carbon Credits: Tradable financial instruments with each credit unit nominally representing a commitment to remove one ton of carbon dioxide from the atmosphere or avoid emitting one ton of carbon dioxide that would have otherwise entered the atmosphere.

Carbon Market: A market structure where carbon credits can be traded, sold, and bought.

Climate Adaptation Finance or Adaptation Finance: The financial flows that support adaptation and resilience activities, including activities that seek to prevent harm, reduce or transfer risk, recover from impacts, or promote economic, social, and natural systems' co-benefits, across all sectors.

Disinvested Communities: Communities where investment and resources are systemically withdrawn, resulting in a decline economic, social, and environmental wellbeing and opportunities

Financing: process of obtaining money or capital for various purposes to pay for an asset or service and generally requires repayment with interest. Examples include loans or bonds with revenue sources coming from mechanisms such as savings stream, tax base or rate base.

Funding: The financial resources available and provided to pay for or offset the costs of an asset or service, generally for a specific purpose and generally not required to be repaid. Examples include grants, appropriations, taxes, fees, or philanthropic support.

Greenhouse Gas Reduction Fund (California): The central account where California's Cap-and-Invest revenues are deposited to support over 100 climate-focused programs administered by state agencies that focus on climate mitigation, adaptation, and resilience projects.

Indemnity Insurance: An insurance structure in which a consumer pays premiums at regular intervals with the expectation that in the event of a loss, the insurance company will provide a payout for claims based on actual covered loss, up to the policy limit.

Independent Insurance Agent: A third-party that represents multiple insurance companies and assists consumers in purchasing insurance coverage, with the authority from the company the agent represents to underwrite or bind coverage for consumers.

Indigenous Economies of Care: A framework and ethic that centers nature, reciprocity, responsibility, and care, not just financial measures, in how we understand the economy.

Insurance: Risk transfer mechanisms that, upon purchase, provide financial protection for individuals, businesses, and entities following loss, damage, injury, or death.

Investment in risk reduction: Spending on measures that reduce expected losses, such as home hardening, flood protection, ecosystem restoration, heat resilience, or wildfire mitigation.

Insurance Broker: A third-party that assists consumers in shopping for insurance coverage but does not have the authority from any insurance company to underwrite or bind coverage

Household Spend: Financial spending by individuals or households. In the case of household spend on climate adaptation, this is often used to mitigate property like homes to be more resilient to climate impacts, or reduce the risk associated with certain perils including morbidity and mortality.

Maladaptation: Unintended consequences of adaptation that inadvertently increases vulnerability to climatic stimuli, such as increasing vulnerability and inequitable outcomes, increasing greenhouse gas emissions, or inhibiting necessary systemic change, now and into the future.

Managing General Agent: A specialized type of insurance agent vested with underwriting authority by one or more insurance companies who take on the risk when a policy is written.

Mechanism (finance): Ways to raise and disburse capital for climate adaptation.

Parametric Insurance: Insurance that pays a pre-defined amount in the event of loss or damage when a measurable event meets an agreed threshold, such as flood depth, wind speed, or temperature.

Philanthropic Capital: Donations and grants made by organizations (businesses and non-profits) and individuals who have accumulated wealth and are choosing to give away some of their assets for the benefit of society and specific public causes of interest.

Private Capital: Investment strategies that deal with private assets or that private companies make that are outside the public markets.

Private Finance: Management, planning, and use of financial resources by individuals, households, businesses, and other non-government entities.

Public Sector: Part of the economy that is composed of all levels of government.

Public Sector Finance: Management of revenue, expenditures, and debt for government and government-controlled entities.

Public-Private-Partnerships (PPPs): Public sector responsibilities are provided by the private sector under an agreed funding model (e.g., roads, utilities) to help de-risk projects by strategically allocating risks and including government participation, making private investors more attracted to investing.

Resilience: Ability to prepare and plan for, absorb, recover from and more successfully adapt to adverse events.

(climate) Risk Reduction: Process of reducing potential negative impacts from climate change. This can be at the household, community, societal, and environmental levels.

Risk transfer: Tools such as insurance, reinsurance, risk pools, parametric coverage, or catastrophe bonds that move residual financial risk but do not, by themselves, reduce underlying physical risk.

Socioeconomic Equity: A principle that individuals and communities are provided a fair distribution of resources and opportunities depending on different starting points and needs to ensure everyone has a fair chance of success regardless of social or economic background.

Systems-level: Framework to include broader social, ecological, health, and equity considerations into adaptation planning and implementation.

Systems-level Capital: A way of envisioning how capital can be better aligned with the interconnected nature of the world around us and the systems that shape the quality of life and life sustenance.

Transformational adaptation: Refers to the adaptive actions that change the fundamental attributes of socio-ecological systems in response to expected climate change and its impacts, including structural, functional, or locational transformations, to strengthen the resilience of ecosystems and society.

Appendix D. Acronyms

Acronym	Full name
AAE Fund	ʻĀina Aloha Economy Fund
AAL	Average Annual Loss
BMO	Bank of Montreal
CARB	California Air Resources Board
Cat	Catastrophe
CDBG-DR	Community Development Block Grant Disaster Recovery
CDFI	BIDsCommunity Development Financial Institution
CDI	California Department of Insurance
CIB	Canada Infrastructure Bank
CLEE	Center for Law, Energy & the Environment
CNRA	California Natural Resources Agency
CPCFA	California Pollution Control Financing Authority
CRU	Carbon Reporting Unit
DFC	Development Finance Corporation
FAIR Plan	Fair Access to Insurance Requirements
FEMA	Federal Emergency Management Agency
FMA	Flood Mitigation Assistance (grant)
FMAG	Fire Management Assistance Grant
GDP	Gross Domestic Product
GGRF	Greenhouse Gas Reduction Fund
GHADs	Geologic Hazard Abatement Districts
GHG	Greenhouse Gas
GO Bonds	General Obligation Bonds
HIR	Hawai'i Investment Ready
HOAs	Homeowners Associations
HRTP	High Road Training Partnerships
ICLEI	Local Governments for Sustainability
IPCC	Intergovernmental Panel on Climate Change
MGAs	Managing General Agents

NCIUA	North Carolina Insurance Underwriting Association
NFIP	National Flood Insurance Program
OECD	Organisation for Economic Co-operation and Development
RAPTR	Resources Agency Project Tracking and Reporting
TNC	The Nature Conservancy
UIIF	Urban Infrastructure Insurance Facility
UN	United Nations
USACE	US Army Corps of Engineer
WEF	World Economic Forum
WTW	Willis Towers Watson
WHO	World Health Organization



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