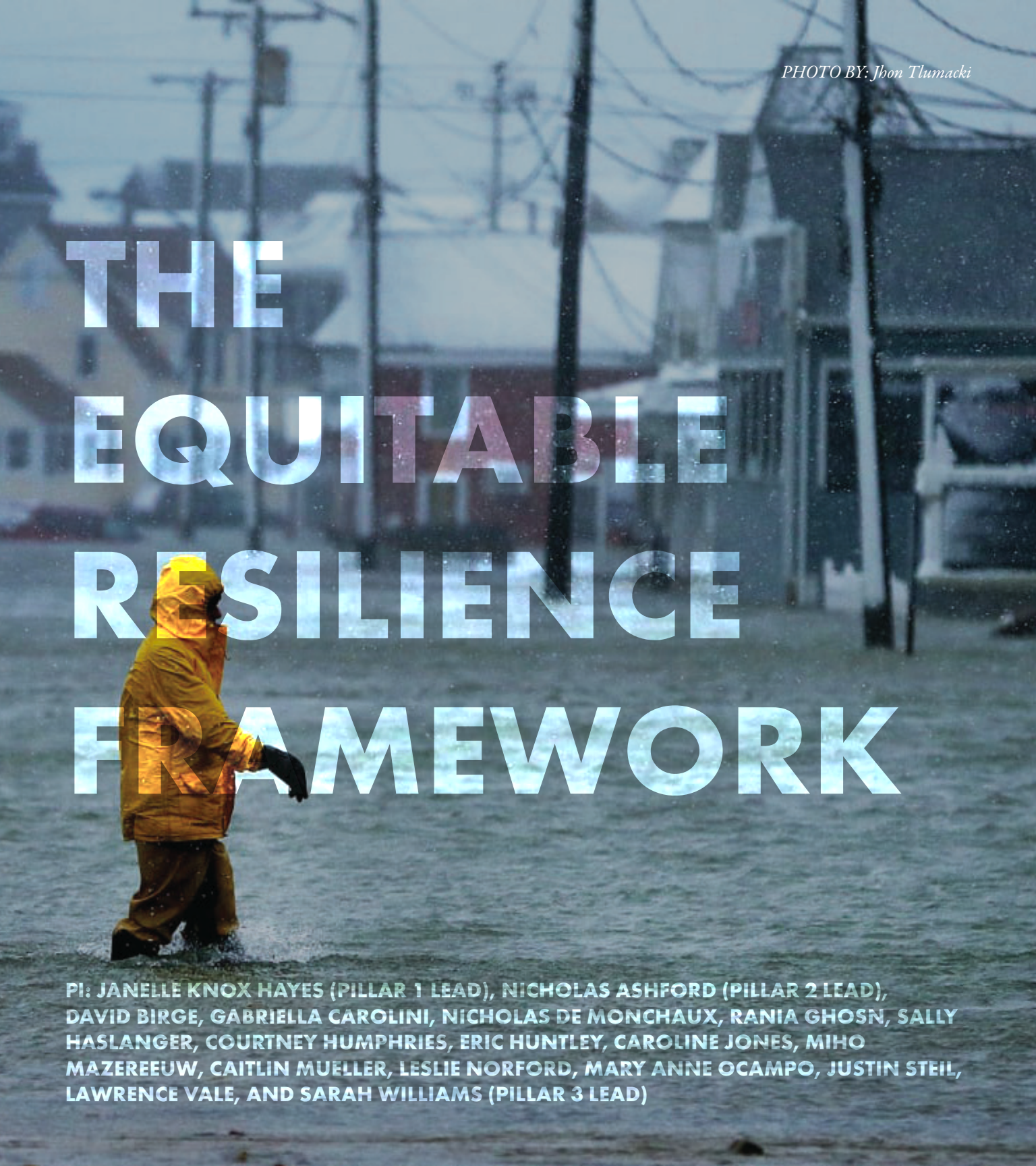


PHOTO BY: Jhon Tlumacki

THE EQUITABLE RESILIENCE FRAMEWORK

A person wearing a bright yellow rain suit and hood is wading through deep floodwaters in a residential area. The water is murky and reflects the overcast sky. In the background, there are utility poles with power lines and the outlines of houses, suggesting a neighborhood affected by flooding. The overall atmosphere is somber and highlights the impact of climate change on vulnerable communities.

PI: JANELLE KNOX HAYES (PILLAR 1 LEAD), NICHOLAS ASHFORD (PILLAR 2 LEAD), DAVID BIRGE, GABRIELLA CAROLINI, NICHOLAS DE MONCHAUX, RANIA GHOSN, SALLY HASLANGER, COURTNEY HUMPHRIES, ERIC HUNTLEY, CAROLINE JONES, MIHO MAZEREEUW, CAITLIN MUELLER, LESLIE NORFORD, MARY ANNE OCAMPO, JUSTIN STEIL, LAWRENCE VALE, AND SARAH WILLIAMS (PILLAR 3 LEAD)

We acknowledge Indigenous Peoples as the traditional stewards of the land, and the enduring relationship that exists between them and their traditional territories. The lands which MIT occupies are the traditional unceded territories of the Wampanoag Nation, the Massachusett and Nipmuc Peoples. We acknowledge the painful history of genocide and forced occupation of these territories, as well as the ongoing processes of colonialism and dispossession in which we and our institution are implicated. Beyond the stolen territory which we physically occupy, MIT has long profited from the sale of federal lands granted by the Morrill Act, territories stolen from 82 Tribes including the Greater and Little Osage, Chippewa, and Omaha Peoples. As we honor and respect the many diverse Indigenous people connected to this land from time immemorial, we commit our work to restoration and seek to leave Indigenous peoples in more empowered positions.

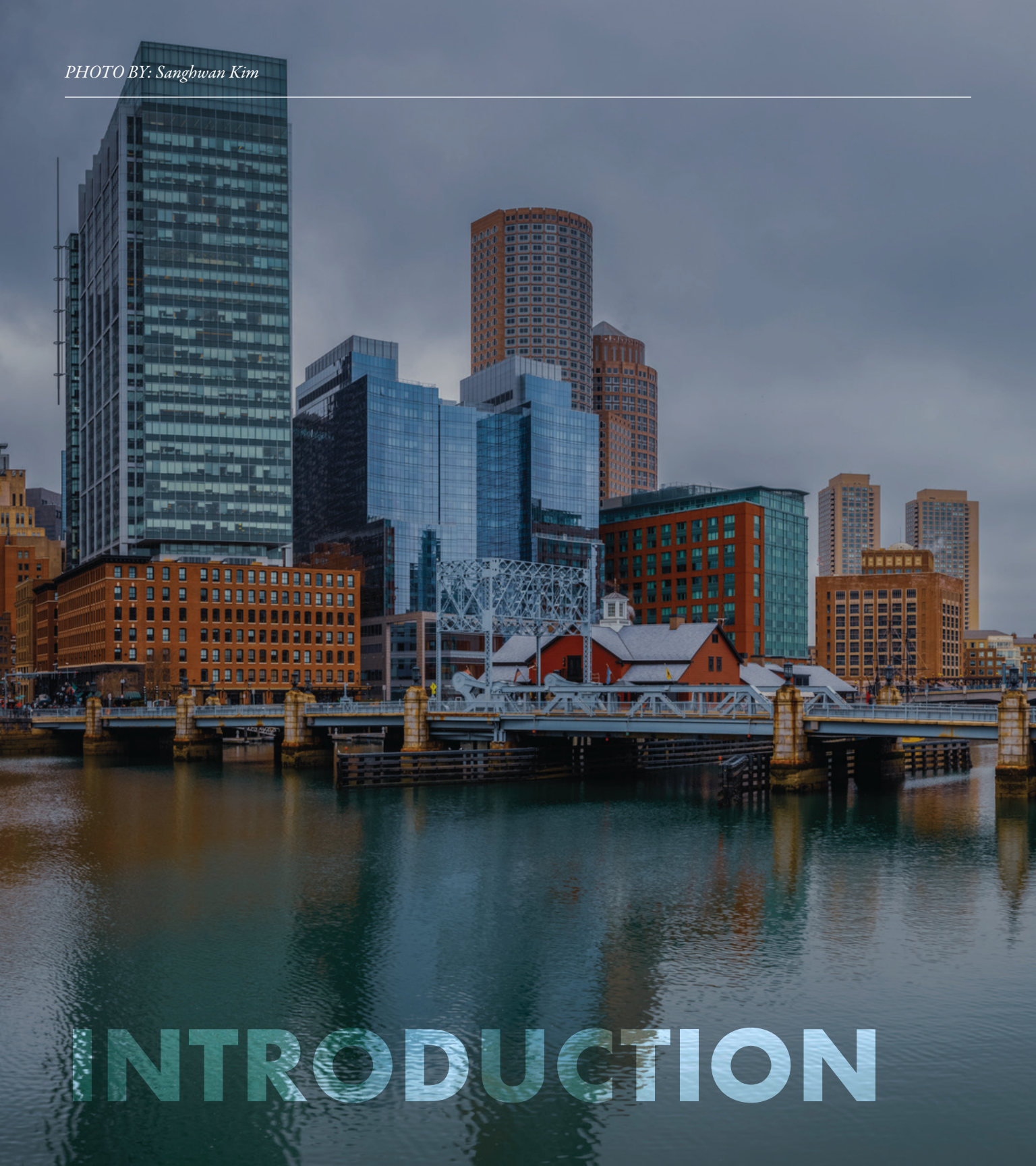
The Morrill Act: <https://www.bcn.org/issues/52.4/indigenous-affairs-education-land-grab-universities>



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INTRODUCTION

Climate change is disrupting the fundamental conditions of human life. Its impacts are also profoundly unequal (King and Harrington, 2018). Climate change exacerbates existing inequities by placing further burdens on communities that are already vulnerable (Islam and Winkel, 2017). While some individuals and communities will have the resources to adapt to or avoid the worst impacts of climate change, others will find their homes becoming uninhabitable, their livelihoods vanishing, and their health and security threatened (Oppenheimer et al. 2019). It is estimated sea level rise alone will create up to 1 billion climate refugees by 2100 (Hauer et al. 2020).

While such inequities are routinely noted, scholars and policymakers have largely failed to grasp the magnitude of their impact or to craft commensurate responses. Solutions that aim to increase resilience often focus on technological fixes and economic metrics rather than on the social complexities of communities -- yet the engagement of community stakeholders is the surest way to achieve efficacy and durability in any projected solution.

This is why a framework for equitable resilience is crucial. Considerations such as equity, justice, and community input are sometimes acknowledged, but they are rarely a fundamental part of the design and implementation of solutions. This needs to change. Current practices in producing knowledge, framing problems, formulating policies, and implementing climate solutions do not take adequate measures to understand or protect vulnerable communities (Adger et al., 2006). Additionally, the solutions themselves can exacerbate vulnerabilities and inequities, whether it is a renewable energy transition policy that burdens low-income utility users, or a resettlement plan that fails to consider the will of the most disadvantaged residents (Anguelovski et al., 2016; Barnett and O'Neill, 2010). Continuing on this path is a recipe for failure. It's clear that mitigating and adapting to climate change require profound societal transformations.

The framework we design is anti-hierarchical -- a transformation in how expertise itself meets community needs for equity in resilient adaptation. The long history of failed social engineering projects demonstrates how top-down climate solutions can worsen existing inequities if they are not embedded in social practices and values (Arnstein, 1969; Davoudi et al., 2012; Meerow et al., 2019). Put simply, solutions built *with* communities have better outcomes (Grabowski et al. 2019; Mackinnon and Derickson 2013; Norris et al., 2007; Wilson 2018). It is not enough to voice concerns about justice or to hold a community meeting. To succeed, climate change solutions must embed social considerations into every step of their design and implementation. They must strive to be inclusive and fair, to promote communication and knowledge-sharing, and to give power to those who historically lack it. And they must do so in a way that is structured and robust, not based merely on good intentions.

The goal of this project is to create an equitable and inclusive design and planning process that will purposefully enhance community capabilities and sovereignty over decision-making, while also helping projects achieve more successful long-term outcomes. An equitable approach to climate resilience strives for fairness in multiple facets and stages. It ensures that people are treated according to their needs and with consideration of both current and historical contexts and of relative advantages or disadvantages.

The framework and protocols we are developing for climate mitigation and adaptation are novel, intended to situate local social practices, knowledge, and values at the heart of the policymaking process. This approach will balance community values and needs with other decision-making parameters. It will enhance and enrich communication between scientists, civil society, and policymakers working on resilience and adaptation strategies. It will help integrate regional and national climate strategies with community-led planning, design, and policymaking to improve resilience and adaptation on a local level. And it will assist groups, particularly underrepresented frontline and Black Indigenous and other People of Color (BIPOC) communities, in shaping their own equitable strategies for building resilience.

To develop a values-integrative design process, this project draws upon a set of normative theories and decision-making frameworks selected to ensure that adaptation planning enhances the resilience of communities most in need. At its core, this is an approach based on **human capabilities** as the measure of well-being for each community (Sen, 1985). A capabilities approach focuses on what individuals can do and what kinds of lives they can live. It is more meaningful than traditional approaches that focus on such single dimensions as income, consumption, expenditure, or self-reported happiness. The capabilities approach we outline is particularly suited to improving resilience because it anchors planning efforts in the direct socio-cultural, economic, technical, and environmental needs and values of communities while situating processes of implementation within community-calibrated spatial and temporal frames.

We intend to put these overarching theories and principles into practice by developing a flexible and expansive approach that can help advance individual projects and also serve as a platform for further research and learning. **Ultimately, we envision this approach as setting the foundation for a new MIT Climate Center for Adaptation and Resilience Equity (MIT Climate CARE) that will bring academic, policy, and civil society networks together to work on integrated climate mitigation and adaptation research, education, and policy practices.** This innovative center will not be rooted in discipline-specific or technology-driven solutions but will rather respond directly to the needs of communities affected by climate change. It will be structured around the question: “*How* should cities respond to climate change to create more just and resilient communities?” The framework will be piloted and refined through a partnership with self-selected communities across greater Metropolitan Boston.



Image 1. Boston firefighters worked at the scene of flooding from Boston Harbor on Long Wharf in Boston. Photo by: Michael Dwyer/Associated Press

PHOTO BY: Sanghwan Kim

THE EQUITABLE RESILIENCE FRAMEWORK: Principles and Strategies



Our project adapts the conceptual framework suggested by the MIT Climate Grand Challenge organizing committee by addressing the problem of **climate change adaptation and resilience** with a narrow-scoped proposal operating across three pillars: 1) **Human, community, and social impacts of climate change** (2.2), 2) **Implementation and policy** (2.3), and 3) **Climate observation, forecasting, and risk** (2.4).

We align each pillar with a **primary strategy** that helps it accomplish its goal, and which corresponds to a critical process within a project. Pillar 1 takes a **capabilities approach** to accomplish equitable transformations by placing human capabilities at the center of project planning and design. Pillar 2 employs an **enhanced trade-off analysis** to achieve greater efficacy by integrating human capabilities into project implementation and assessment. Finally, Pillar 3 reinterprets the domain of climate observation, forecasting, and risk posed by the MIT Climate Grand Challenge as a critical disconnect in climate communication, and uses a **civic communication strategy** to achieve greater equity in climate knowledge generation and sharing by enhancing the role of vulnerable, frontline communities in discussions and knowledge-forming with policy makers, industry leaders, and scientists.

We see each of these pillars as interdependent components of an approach to achieving equity in climate resilience and adaptation. Together, they help to recenter climate resilience work on justice goals rather than only on asset protection, disaster avoidance, and economic stabilization. They provide tools for making resilience projects sensitive to community values and accountable for enhancing equity. This framework is designed to be theoretically grounded but practical and deployable in a wide variety of contexts.

2.1 GUIDING CONCEPTS

We begin developing our framework by defining key principles that guide our work but are often misunderstood or misused in planning discussions. **Equity** refers to the fair, yet different treatment of individuals and groups based on need—as opposed to equality, which treats all individuals as the same (Aday and Anderson, 1984; Eckhoff, 1974) For example, requiring all subway riders to access the platform by using stairs treats everyone “the same” but does not meet the needs of someone in a wheelchair; “sameness” is unfair to those with different needs. Equity modifies the rigid application of laws, policies, and practices to secure justice in the light of context and circumstances. Determining what is equitable is often subjective, highly contested, and personal (Bronfenbrenner, 1973; Deutsch, 1975). **Justice** broadly refers to fairness in the ways in which people are treated and the opportunities that they have to determine their future. Realizing or advancing justice at a large scale requires creating laws, norms, and practices that can be applied across a population, while also recognizing the need to assure just outcomes across differently-situated individuals and groups (Arnaud, 2001).

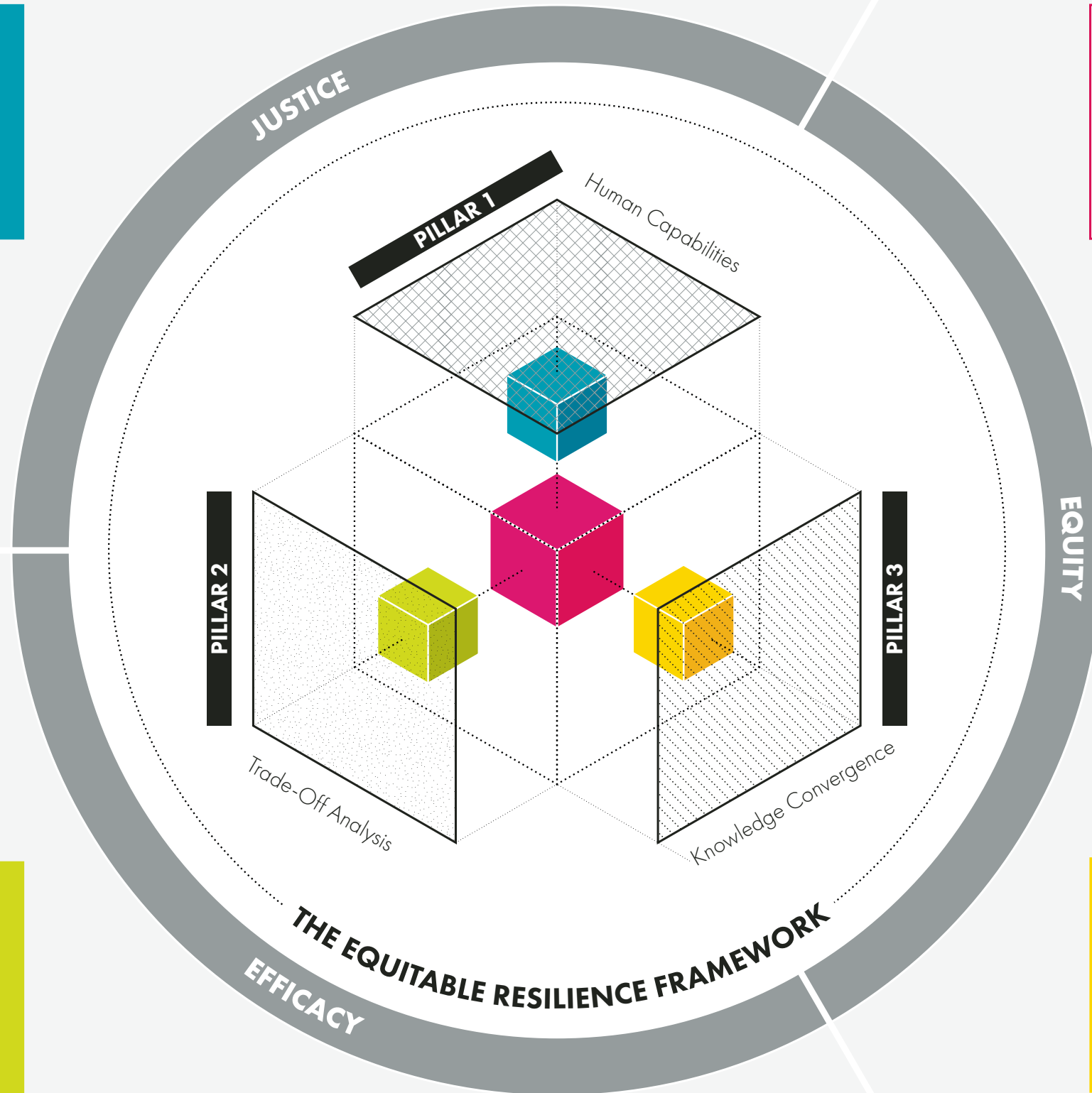


CAPABILITIES APPROACH
TO WELL-BEING
Procedural justice
Epistemic justice
Community justice
Distributive justice



ENHANCED TRADE-OFF ANALYSIS
1. Problem framing
2. Stakeholder + power analysis
3. Report the problem
4. Build consents
5. Multi-criteria
6. Civic communication

Figure 1. The Equitable Resilience Framework



EVALUATION INDICATORS
Communications
Built/Economic
Social/Cultural
Environmental



KNOWLEDGE CONVERGENCE
Civic communications
Science impact
Source and nature of data
Consultation



Our project therefore conceptualizes justice as comprising three separate and equally important goals: **distributive justice**, **procedural justice**, and **epistemic justice**. **Distributive justice** is concerned with how the benefits and burdens of a society—such as income, jobs, housing, property, taxation, and legal benefits—are distributed among people, and how these allocations affect their lives. **Procedural justice** is concerned with the procedures and mechanisms [used] to make policy decisions, and whether they are fair, democratic, and inclusive. **Epistemic justice** relates to the recognition of a community’s expertise about their own culture, circumstances, capacities, and vulnerabilities, and their ability to be included in the production of knowledge, science, and social meanings. These three justices continue to elude communities that have faced historical injustice. We consider all forms of justice holistically within the framework of a capabilities approach.

Efficacy refers to the effectiveness of policies and interventions in achieving climate outcomes. Achieving the goals of our framework requires first rethinking what is meant by both “community” and “resilience.” Different understandings and interpretations of these concepts can lead to unjust solutions. **Resilience** refers to the capacity of a socio-physical system, operating across temporal and spatial scales, to maintain or quickly return to *desired functions* in the face of a disturbance, to adapt to changes, and to *transform systems* that limit adaptive capacity (Adger, 2011; Meerow et al. 2016). Resilience has been critiqued for its ambiguity and tendency to be used to protect systems of entrenched power when applied to human communities (Adger, 2011; Brand and Jax 2007; Folke 2006). An *equitable* approach to resilience must consider existing vulnerabilities and power relations and strive for holistic change that addresses not just physical but also social, cultural, and environmental transformation.

Community, broadly, is a set of interrelationships among social institutions of people in a locality (Bell and Newby, 1974). It can also be defined along a gradient of concepts beginning with geographic proximity and extending to cultural heritage and socio-natural interdependence (Smucker, 1960). The way a community and its values are defined in a planning process impacts how resilience is conceptualized, as well as the potential outcomes of resilience efforts.

The concepts of community and resilience can also be differentiated by their impact and emphasis across time. Drawing from a number of studies of conceptions of time and its impact on planning and organizations (Orlikowski and Yates, 2002; Slawinski and Bansal, 2012; Stephenson, 2010), the Equitable Resilience Framework considers the comparative temporal depth of different community characteristics and resilience strategies and impacts (Figure 2).

For example, regulatory agencies tend to define communities relative to their geographic placement and constitution of individual rights. The timescales of engagement (pink bars) are often short-term and focused on direct physical and infrastructural changes. In contrast, communities—particularly Indigenous

communities—often consider resilience from the standpoint of embedded or even civilizational time (blue and green bars), and are concerned with the social, cultural, and even ecological scale of resilience impacts. For the sake of equity, it is essential to deepen the definitions of community beyond physical proximity to include social and cultural interconnections, and to deepen resilience strategies to address the socio-economic and cultural interdependencies of human and natural systems.

The Equitable Resilience Framework will strive to make resilience efforts more equitable, just, and effective, and to generate long-term economic, social, cultural, and environmental transformations. Developed in collaboration with specific communities in the greater Boston region, the framework will address the technocratic and engineering-focused shortcomings that have historically guided resilience projects (Davoudi et al., 2012; Cretney 2014). It reconceptualizes the linkages between resilience and equity in communities and aims to give researchers and practitioners better theoretical and practical tools for applying the resilience concept to social systems and for helping communities themselves engage in resilience-building.

2.2 VALUES AND PRINCIPLES OF THE EQUITABLE RESILIENCE FRAMEWORK

Rationale: Climate resilience projects and policies are often launched with the intention to find and implement solutions that benefit communities while helping them manage risks. But if projects lack goals, frameworks, and assessment methods oriented towards equity, they may promote injustices in the systems within which they work and actually seed resistance to these “solutions” within the community in which they are deployed (Goh, 2021). Without equity and justice in mind, solutions may wind up serving those who already hold power and leave the marginalized portions of the population worse off than before.

Strategy: Our approach is to integrate the concept of **human capabilities** into work on climate resilience and to develop a strategy to put this concept into practice. Amartya Sen’s “capabilities approach” is designed to critique existing ways of evaluating justice, such as utilitarianism (choosing what makes the most people happy) or resourcism (maximizing people’s access to money, goods, and other external resources) (Sen, 1985). These approaches lack a measure of whether people have, and can meaningfully deploy, the necessary resources to achieve their goals (Berges, 2007). Capabilities are the substantive freedom to achieve well-being, the opportunity to act without obstacles. A capabilities approach does not simply consider mental states like happiness or an accounting of income or goods people have acquired. Instead, it considers whether individuals have real opportunities to lead such a life as they have reason to value (Robeyns, 2006).

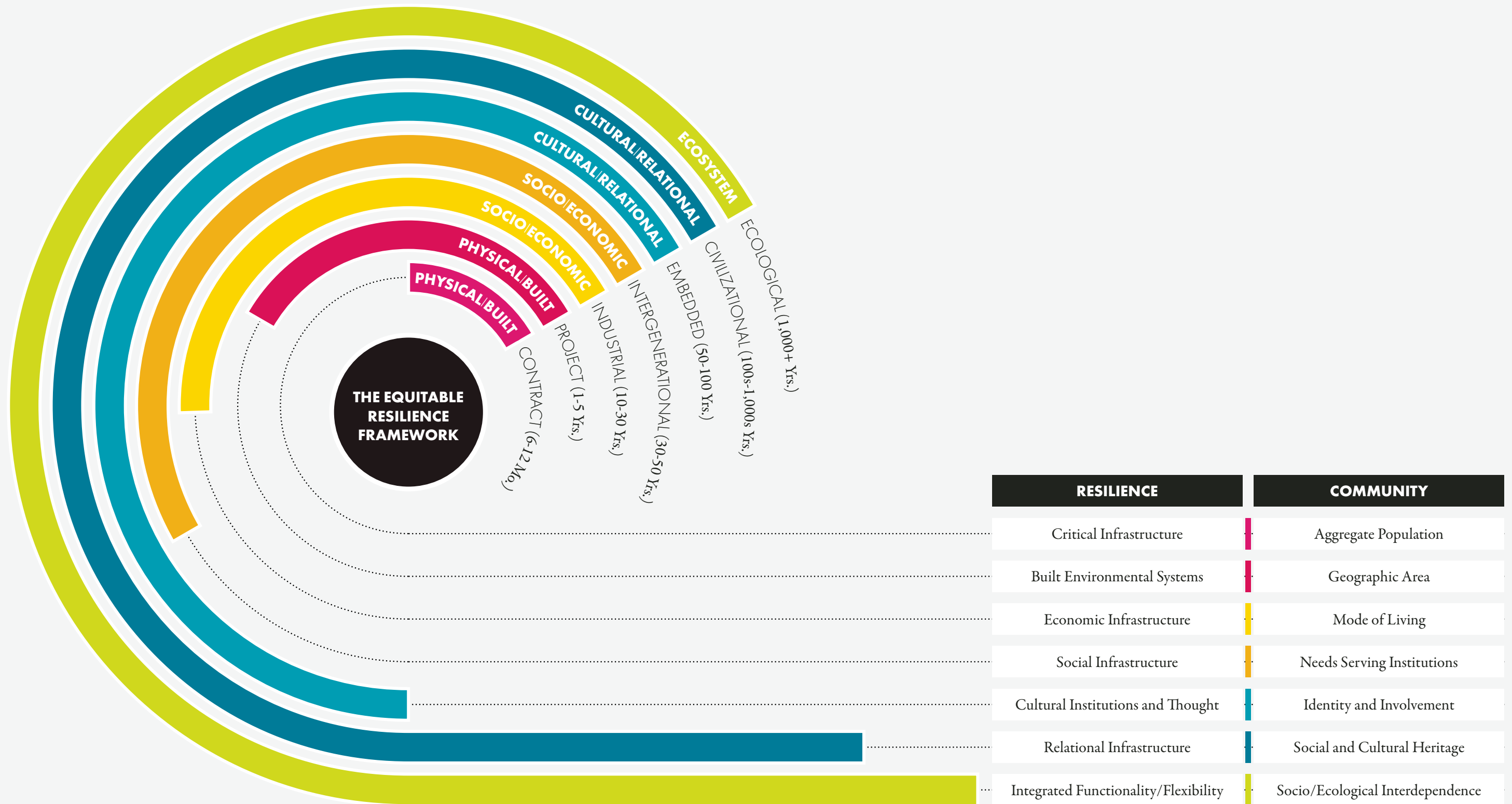


Figure 2. Temporal Depth of Resilience Adaptations Across Domains

The capabilities approach has been used fruitfully in a global development context. The United Nations Development Program helps countries build their citizens' capabilities, for instance, in order to achieve goals that are not captured by traditional measures like GDP, such as alleviating poverty and hunger, providing universal elementary education, empowering women, and combating diseases like HIV/AIDS and malaria. At MIT, the approach has also been successfully deployed by the D-Lab to develop design and engineering solutions to problems faced by communities around the world. The Equitable Resilience Framework is the first application of the capabilities approach to address climate justice and resilience in a domestic urban planning context. Building capabilities in this way promotes long-term structural changes that are robust and enduring, because they engage directly with the values in communities where they are deployed.

Putting the capabilities approach into practice in a resilience context raises methodological and practical questions, such as how different capabilities should be identified, aggregated, or prioritized for an overall assessment. Deploying this strategy effectively will require **developing indicators** that can be used to guide the formation of policy goals and to evaluate outcomes. Metrics are needed that describe the implications of enhancing capabilities for achieving justice while also helping to mitigate and adapt to climate change (Cutter, 2019; Reckien et al. 2018; Robeyns, 2005; Ziervogel et al. 2017).

We propose to build and test a capabilities index that can measure and track the function and goals of a community over time, such as self-determination, environmental sustainability, economic fulfillment, cultural preservation, and other values. We draw particularly upon the work of Ingrid Robyens (2003), who argues that **procedures** are critical for developing a capabilities index, including 1) explicitly creating integrated capability sets that allow for community input and debate, 2) providing methodological justification so that the techniques used to generate the set can be scrutinized, 3) considering the particular legal, political, and social context, 4) generalizing items at different levels, and 5) taking steps to include all important elements while reducing overlap.

Innovation: Implementing a capabilities approach as outlined here provides a robust framework for bringing equity to the heart of urban climate adaptation. It offers an actionable strategy for communities most in need of immediate climate adaptation to have their knowledge, concerns, and self-defined values and desired capabilities form the center of their climate resilience.

2.3 FRAMEWORK IMPLEMENTATION AND ASSESSMENT: AN ENHANCED TRADE-OFF ANALYSIS

Rationale: Resilience theory regards people as part of complex and interdependent social and ecological systems. This system-level perspective has been important for creating approaches to climate change adaptation that integrate the built environment, ecosystems, and social systems to advance both social and environmental benefits. But its goals are challenging to reach with common methods used to assess and implement policies and projects, particularly cost-benefit analysis, a tool that is widely deployed by state and federal agencies to make climate resilience and adaptation program funding decisions.

Cost-benefit analysis aggregates the effects on different actors and reduces them to simple monetary terms: net benefit values or a benefit-to-cost ratio. The result is attractive to policymakers because it provides a simple number to indicate a program's value. However, this metric misrepresents the complexity of comparing environmental, human, and financial gains or losses (Choy, 2018). First, by aggregating many factors into one, it effectively erases important differences among impacts. And second, by reducing the analysis to economic terms, it fails to fully capture factors like community well-being or enhanced biodiversity that are subjective and intangible. Both can contribute to unjust outcomes and undermine the efficacy of projects.

Strategy: Policies that aim to enhance resilience should address not just the causes and impacts of climate change but also current and potential social inequities. While sometimes described as "win-win" solutions, in reality these policies have trade-offs for different stakeholder groups. Not all implications of policies can be expressed in simple economic terms. We instead propose to use an enhanced **trade-off analysis** as the primary tool to make policy decisions. Trade-off analysis is a decision support tool that is helpful when there are multiple objectives and some uncertainty about the impacts of different interventions. It allows for a multi-dimensional analysis of the impacts of key decisions on different individuals and groups in a community. Rather than aggregating the potential impacts of a policy decision into one metric, it disaggregates them into distinct units and creates a trade-off matrix to identify trade-offs, outcomes, and potential alternatives, and arrives at a negotiated decision guided by values (Hall et al., 2008). The tool can therefore be used to build agreement between stakeholders and to manage potential conflicts and competing interests, while revealing imbalances of power among various stakeholders, especially marginalized stakeholders.

Trade-off analysis is a multi-step process that first involves **describing a problem** to be addressed and using **stakeholder and power analysis** to understand how the problem is perceived by various stakeholders and through different lenses of social, political, and economic power. This information is then represented in a **trade-off matrix**. Next, alternative solutions to the problem are formulated, and **con-**

sensus building is used to consider how trade-offs impact different stakeholder groups across different time periods and locations. Finally, **multi-criteria analysis** is used to assess (quantitatively and qualitatively) potential outcomes from each alternative. In making this assessment, it's important to consider several factors: stakeholder buy-in for each alternative, distributional inequalities and how they will be addressed, system-wide impacts, and how well each alternative will solve the problem.

In addition to this basic framework, we add a novel emphasis on the capabilities approach developed in Pillar 1 as a way of framing community benefits and harms that result from adaptation and resilience policies. The trade-off analysis is informed by a set of other tools—summarized in Appendix B, Table 1—that aid in identifying problems and evaluating solutions from a justice perspective. These tools, which will be deployed based on the needs and context of a specific project, will address justice goals by, for instance, evaluating historical and systemic inequalities, distinguishing between differences in understanding and valuing time, and using geospatial analysis and data science to understand different impacts across space. They include evidence-based techniques for assessing the economic, social, and environmental effects of public policy, as well as several tools that emphasize community participation in research, budgeting, planning, ground-truthing, fact-finding, decision-making, and advising.

Our next steps in continuing this research will be to work towards integrating capabilities-based indicators of community wellbeing with traditional socio-economic and environmental measures. Testing and implementing this strategy will help us understand any barriers to adoption by policymakers and refine our approach. The public participation inherent in our approach will provide an opportunity to advance research on how public discussions of community resilience shape the formation of community values (Sen, 2017).

Innovation: The enhanced trade-off analysis we propose uses methods that are more procedurally and epistemically just. It increases transparency in decision-making by elucidating who reaps the benefits and who is burdened with the costs of policies. Most of all, it prioritizes human capabilities above profits and asset protection.

2.4 KNOWLEDGE CONVERGENCE: CIVIC COMMUNICATION AND STAKEHOLDER ENGAGEMENT

Rationale: Despite tremendous scientific and technical progress that has made it possible to measure and predict changes in global climate systems and to assess risks to local ecosystems and human societies, this knowledge alone will not ensure just outcomes for communities. Scientific and technical knowledge generated by unjust social systems can perpetuate injustices. In particular, failure to facilitate communication to and from communities who are disproportionately burdened by climate risks, or to incorporate other knowledge forms such as traditional ecological knowledge, can lead to solutions that actually perpetuate ineffective and unjust outcomes (Goh, 2021).

Climate adaptation strategies often suffer from communication problems such as emphasizing top-down and expert-led communication and failing to fully include community input into planning, design, implementation, and data production. Communication may not be sustained over time because of the limited time scale of interventions. Lack of community involvement can lead to a misrepresentation of community needs, assets, and values. The result is communication that is uneven, inequitable, unsustainable and, hence, unimpactful.

Strategy: Just methods of communication are a core part of building equitable resilience strategies. The traditional role of individuals has been primarily as recipients of information, acting in various contexts to make choices. Better forms of civic engagement and communication can help individuals take on an expanded role in shaping knowledge and responses to climate change (O'Neil, 2013). Literature suggests a need to develop climate communication tools that address the impacts of climate change at varying temporal and spatial scales, and that enable dialogue between community, scientists, industry and policymakers. We aim to enhance three domains of climate communication:

Domain 1. Communicating climate science and impacts: Integrate art, science, and civic engagement to bring new awareness to climate change and to the needs and opportunities for capabilities-based adaptation. This domain finds value in diverse methods, disciplines, media, and perspectives. It shifts the focus of climate science communication from a technocratic perspective to a civically-minded one, which will enhance care, boost representation, and develop more grounded and relatable strategies.

Domain 2. Incorporating community-based data into climate science and policy: Expert knowledge captured in science and policy can promote epistemic injustice if it fails to include community-based data. More effective communication requires shifting the focus of data production and collection to enhance epistemic justice by giving voice to vulnerable communities. Creating maps that show social vulnerabilities, for instance, can help prioritize equitable climate adaptation interventions (Bethel et

al. 2014). Data generated by vulnerable communities—such as how they use and value the places they live—can offer new perspectives for creating equitable solutions. Incorporating community-based data improves the efficacy and equity of resilience planning by letting communities assess and direct solutions towards solving the most critical challenges, which are often unknown or unmapped by current practices.

Domain 3. Enhancing consultation in the planning, design, and policy process through community recognition: Project consultation processes are often driven by data, technology, and professional expertise, and may fail to advance socially inclusive and equitable outcomes. Our approach enhances communication that is community-centered, participatory, and self-governed. It identifies opportunities for storytelling, identity-building, data-collecting, and solution design that are civic, inclusionary, locally grounded, and actionable. It also develops techniques to create shared understanding among all parties founded on mutual trust and recognition.

We adopt a **civic communication strategy** that draws upon a set of tools that enhance community engagement with and power over climate communication and decision-making for resilience. These tools are concerned with knowledge access, dissemination, and convergence. **Transmedia communication** draws upon multiple communication modes to communicate climate science in a way that enhances the salience of key issues. **Data visualizations** create interactive maps, infographics, and statistical information, and can be combined with participatory research tools to integrate local and traditional ecological knowledge. **Artistic interventions** creatively communicate the urgency of interventions to the public and invite dialogue. **Community data integration and co-creation** collects data with the participation of the broader community to learn about goals, engage stakeholders, and build cooperation.

Innovation: We believe that improving climate science communication (Domain 1) will increase understanding amongst vulnerable communities of the risks they face. Engagement will spur resilience planning efforts outlined by Domains 2 and 3, triggering long-term and cross-scalar involvement in resilience-building. Incorporating community-based data (Domain 2) will provide more robust and evidence-based outcomes for prioritizing equitable climate adaptation interventions and improve decision-making and policy interventions in highly vulnerable areas where resources are particularly scarce. Enhancing consultation through community recognition (Domain 3) will help advance understanding of the role of digital communication in reinforcing entrenched inequities and biases, and provide opportunities for reducing injustices in digital processes of knowledge production and distribution. Collectively, these efforts will create a transmedia framework to guide data creation and assessment.

2.5 FRAMEWORK INTEGRATION

The Equitable Resilience Framework centers justice in **human capabilities**, considers and selects policies based on their impacts on community vulnerability and capabilities using **enhanced tradeoff-analysis**, and brings together the various stakeholders and knowledge types needed to advance society-wide resilience through **knowledge convergence**. The novel framework and protocols we are developing serve as a pathway to policy and practices that generate more equitable, impactful, and long-term solutions capable of delivering not just resilience of physical form, but also the true socio-economic and cultural transformation of societies, such that they can operate in balance with their natural environments. As the case study below demonstrates, the framework is flexible and can be adapted to a range of different mitigation and adaptation situations.

PHOTO BY: Sergey Galyonkin

APPLYING THE FRAMEWORK:

The Case of Boston's
Seaport District



The Boston Seaport District is a 1000-acre, low-lying, post-industrial area just east of downtown Boston. Revisioning of the site started in the late 1990s, capitalizing on billions of dollars of public funding that created new highway and transit connections and cleaned Boston Harbor. Early plans for the Seaport foresaw a vibrant mixed-use neighborhood for families with ample green space (Boston Globe, 2017). However, in 2010, then Mayor Thomas Menino rechristened the area the Boston “Innovation District” and the neighborhood rapidly evolved into an elite tech and life sciences hub with luxury offices, apartments, restaurants, and cultural attractions. It now has the highest median household income in all of Boston and a population that is only 3 percent Black and 89 percent white, exacerbating longstanding issues of segregation within the city (Elton, 2020). For decades, Boston law has required at least 25 percent of construction hours on major developments to go to people of color, but the city has not levied a fine since 2011 (Boston Globe, 2017). Additionally, the Seaport industries—finance, consulting, and high tech—do not adequately recruit for diversity. As a consequence, the considerable wealth generated by the Seaport Development has not been inclusive.

The Seaport was also developed without fully considering the impacts of climate change. The Climate Ready Boston report (2016) details how a single nor'easter with 9 inches of sea level rise (expected by the 2030s) could cause \$1.2 billion in damage in the neighborhood (City of Boston, 2016). A subsequent planning process outlined a shoreline protection system for the Seaport up to projected 2070 sea levels at a cost of roughly \$1 billion (City of Boston, 2018a). More extensive projects to protect the entire harbor such as a massive sea-wall system, costing upwards of \$10 billion, have been shown to be unrealistic and infeasible (Kirshen, 2018).

3.1 RECONCEPTUALIZE THE BOSTON SEAPORT DISTRICT

Resilience and equity planning for sea level rise in the Seaport District highlight missed opportunities to address broader systemic problems and find just solutions. The Seaport District needs a more considered plan for protecting the existing built environment and remaining empty and post-industrial land. This plan should address broader systemic inequities and vulnerabilities of citizens both in the district proper, and the city at large. South Boston cannot be understood in isolation of its relationship to other neighborhoods including Roxbury, Dorchester, and Mattapan, which represent two-thirds of the city's Black residents (Elton, 2020), and which support smaller businesses (Boston Redevelopment Authority, 2016). Comprehensive resilience planning could help to remedy existing inequities in the Seaport district by expanding community definitions to emphasize the impacts on lower-income and BIPOC communities throughout Boston. It could ensure that any investments to create resilient infrastructure utilize BIPOC-owned businesses, and that they avoid burdening inland neighborhoods by, for instance, asking developers to pay into a fund for protective infrastructure to offset the need for public funds.

The city's Resilient Boston Harbor Vision includes self-stated goals of drawing on nature to adapt the shoreline, enhancing equity through connectivity, and providing effective long-term flood protection (City of Boston, 2018b). Nevertheless, the Climate Ready Boston planning process has emphasized a narrow definition of waterfront resilience, focusing on shoring up critical infrastructure, elevating streets and walkways where possible, and building shorefront parks (City of Boston, 2016). While the city's plans mention ideas for addressing racial disparities through climate resilience, they do not provide a clear path for achieving social, racial, or economic equity. Strategic planning has not evaluated solutions from the standpoint of limiting development in high-risk areas, accepting planned sea-level rise rather than creating physical barriers, or transitioning infrastructure to shore up social, economic, and ecological resilience with the input of the full range of stakeholders who will be impacted. Planning has also not expanded to include neighboring cities of Winthrop, Chelsea, Milton, and Quincy, and the broader function of the Boston Harbor Ecosystem, which includes eight different watersheds (Massachusetts Department of Environmental Protection, 2003).

3.2 DEPLOYING THE EQUITABLE RESILIENCE FRAMEWORK

Local civic and nonprofit organizations have recently demanded a more inclusive, equitable, and resilient approach to waterfront planning in Boston (Boston Waterfront Coalition, 2021). To respond to this call, we would first seek to bring together stakeholders from the city and across Boston's neighborhoods. We would build on the robust physical vulnerability analysis that has already taken place, but add a new focus on analyzing vulnerabilities and adaptation opportunities through the lens of human capabilities (see 2.2 above). Potential areas of focus include economic productivity, access to housing and professional opportunities, social and cultural care, engagement and recreation, and the function of communities within their natural environments. The process would seek to coordinate analysis and goal-setting across Boston's neighborhoods, and to the extent possible with the neighboring cities around Boston Harbor.

We would apply an enhanced trade-off analysis approach to seek consensus on and make decisions about future planning in the district (see 2.3 above). The trade-off matrix would consider the impact of different types of interventions, such as elevating critical infrastructure, filling in land to generate more green buffer systems like coastal wetlands, building barrier walls, and the potential interactions of different projects geographically and temporally. The analysis will help prioritize projects with a more systematic understanding of impacts over time.

Across these approaches, we would harness knowledge convergence and civic engagement strategies (see 2.4 above) to better assess vulnerabilities and desired capabilities; map and visualize the potential social, economic, cultural, and environmental impacts of different interventions; engage diverse stakeholders; and ultimately to gather their support for implementing the ideas. We would then evaluate the success of interventions using capabilities indicators to continuously refine the approach. Table 1 details how the Equitable Resilience Framework might transform projects and policies.



Image 2. Boston Seaport District development

TABLE 1. EQUITABLE RESILIENCE FRAMEWORK CAPABILITIES AND INTERVENTIONS IN SOUTH BOSTON CASE

	BASELINE STATE	ERF INTERVENTION WITH POTENTIAL TRANSFORMATIONS
ECONOMIC: SHELTER	Economic growth in the Seaport via \$200 million in property tax breaks and other financial incentives has contributed to affordable housing shortages and spiraling rent increases.	Higher prices are offset by increases in affordable housing subsidization and protections result in increased purchasing power of most vulnerable groups to afford more resilient units.
ECONOMIC: DIVERSITY AND PROFESSIONAL OPPORTUNITIES	Limited job growth in specific areas (i.e. finance, consulting and high-tech) without addressing racial disparities.	Resilience planning to generate dignifying jobs with more racially-diverse hiring, result in increased use of union labor, racial equity in unions and their decision-making. City creates subsidies to diversify business opportunities and residential access.
SOCIAL: LONGEVITY	Economic growth that is highly unequal both along community, geographic, and racial dimensions.	More inclusive growth along racial lines, and better distribution of social services, with connections between neighborhoods results in more equitable health outcomes.
SOCIAL: POLITICAL ENGAGEMENT AND SOVEREIGNTY	Seaport district high - level planning and key decisions made by mayor and developers.	Strategies that increase equitable engagement and outcomes such as participatory trade-off analysis, community-led planning, and community land trusts generate greater engagement and sovereignty.
CULTURE: SENSES, IMAGINATION, AND THOUGHT	Cultural institutions are built in Seaport (ICA in 2006), but there's a lack of free civic institutions like libraries and programming for diverse communities.	Collective mapping and storytelling and a free online database for climate action are created. Increased investment in public education, diversity initiatives in art and higher education. Business incentives aim at enhancing human capabilities instead of increasing growth as a whole.
CULTURE: INNOVATION	Innovation is concentrated in a few sites around metro Boston where universities including at Kendall Square, in the South Boston Innovation District and Roxbury Innovation District. Focus is primarily on high-tech and biomedical industries	Innovation holistically approached for collaborative engagement, creating economic opportunities across neighborhoods and industries. The climate challenges offer the testbed for innovation, architecture and design that embraces the challenge of a sea level rise and a dynamic coast. Resilience and adaptation innovation bring socio-ecological interaction and generating new growth industries such as offshore wind and tidal energy, ecosystem tourism, and aquaculture.
ENVIRONMENT: SAFETY FROM ENVIRONMENTAL HAZARDS	Climate change poses serious risks to communities, private property, and public infrastructure. The challenges are addressed independently project by project.	Investments to protect this neighborhood are designed to benefit rather than burden socially vulnerable neighborhoods. Interventions are systematic and coordinated across neighborhoods and cities with public and private investment generating holistic and interconnected living ecosystem defenses.
ENVIRONMENT: SOCIO-ECOLOGICAL INTERDEPENDENCY	Seaport development has created several new parks, but many are privately owned; surveys indicate that BIPOC residents find the waterfront exclusionary. A cleaner Harbor has helped to create better coastal habitat in the area, but there is little coordination for resilience projects across neighborhoods and cities.	Planning focuses on public ownership models for open space, the needs of diverse constituencies, and explores alternative uses of Seaport coastal area — including transformation into recreation spaces or wetlands. Coordination of ecological preservation projects, including protection of endangered species, salt marsh preservation, and water quality assurance result in development of living coastline economies.

TOWARDS AN MIT CENTER FOR CLIMATE ADAPTATION AND RESILIENCE EQUITY



Our proposal seeks to develop, refine, and test the Equitable Resilience Framework in collaboration with communities in the Greater Boston Metropolitan area over the next five years. Once the Equitable Resilience Framework has been refined, tested, and evaluated, we propose to establish a research center that will work with other institutions and stakeholders to deploy our approach in other US cities, and eventually cities globally. To achieve this mission, we have developed a 10-year plan of work that includes research, education, and outreach. Our initial efforts in the first three years will focus on further developing key strategies and tools for each of the three project stages described above.

Project Values and Design: While there is a robust literature around the capabilities approach, it has not been fully operationalized in the context of resilience and adaptation with a set of metrics that can track the progress of a community over time. We will partner with local communities in the Boston metro region to develop these metrics for the unique capacities that each community values. We will also investigate how to integrate universal and broadly comparable capabilities with community-defined and context-specific measures and characteristics.

Project Implementation and Assessment: Trade-off analysis is well understood as an alternative to cost-benefit analysis, but we will seek to further enhance considerations of equity and justice by integrating additional techniques that assess the distribution of impacts and resulting changes in vulnerability. Our first three years of funding will develop and test this equity-enhanced trade-off analysis approach for assessing the outcomes of policies and programs.

Knowledge Integration and Dissemination: Further work is needed to systematically assess the large and diverse landscape of knowledge interventions in resilience, including what communications methods have been tried, how each process has unfolded, and who has participated. We will synthesize this information across three dimensions: improving science impact, enhancing consultation, and extending data research. Then we will work with community partners to develop a series of guiding principles and strategies that can serve as a toolkit for their resilience planning efforts.

After this core research and development work, the next phase of the project will focus on deploying these tools with community partners in the Boston area and advancing pilot projects. Finally, we will leverage this demonstrated progress to expand our work geographically and to create a climate center that can bring together academics, communities, policymakers, and industry partners to develop innovative, equitable, and transformative solutions.

4.1 DETAILED TIME FRAME

Years 1-2. Develop the solutions: We develop core tools that enable the center's work, evaluation indicators to track the progress of interventions for boosting community capabilities, protocols for taking an equitable trade-off approach to project assessment, and a toolkit of communication techniques that can enhance community integration, consultation, and contribution to science-based resilience solutions.

Years 2-3. Test the principles: We work with partner communities across the Boston metro area to refine the principles and techniques of the Equitable Resilience Framework through a series of focus groups, interviews, community meetings, and cross-sectoral resilience forums.

Years 3-5. Implement the Equitable Resilience Framework: We begin to fully implement the Equitable Resilience Framework with community partners around Boston. We develop pilot projects and assess the efficacy, equity, and justice outcomes in terms of both process changes and material results.

Year 5. Evaluating and Refining the Equitable Resilience Framework: We use the evaluation metrics developed to assess physical, social, economic, and environmental impacts.

Years 6-10. Build a center for climate justice: We develop a climate center that serves as a model for centering justice in the pursuit of climate resilience. Using a hub-network approach, we continue to expand our work in the greater Boston Metropolitan area while working with other institutions to deploy our approach in other cities around the world.

4.2 IMPACT

Our approach brings together education, research, and practice. It is built on a research model that can be tested, modified, and refined for better generalization and deployment in different contexts around the world. The center's educational and research initiatives will bring Undergraduate, Masters and PhD students, and postdocs together across disciplinary lines to design and develop new strategies and knowledge. The combined academic, participatory research, and planning approach will bring policy and industry practitioners into dialogue with community members, providing a framework for co-designing innovative resilience solutions. The center itself will serve as a platform for disseminating this work more broadly. This work will give vulnerable communities greater voice and agency in adapting to climate change.

4.3 TEAM STRUCTURE

The Equitable Resilience Framework is led by PI Janelle-Knox Hayes, Associate Professor in the Department of Urban Studies and Planning, with support from pillar leads Nicholas Ashford (ENG) and Sarah Williams (DUSP). We are joined by an additional 14 faculty and researchers, and 8 students from across the institute, representing a wide variety of disciplines and interests:



Image 3. Drawing created during the "Equitable Resilience: A Necessary and Underinvestigated Aspect of Sustainable Urban Systems" conference. Photo by MIT, LCAU.



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WITH SUPPORT FROM:

Students participating in the development of the Equitable Resilience Framework including: Surbhi Agrawal, Joban Arango-Quiroga, Shekhar Chandra, Colleen Chiu-Shee, Osamu Moses Kumasaka, Deni López, Antares McCoy-Villaneda, and Haley Schilling.

Our external collaborators including: the Boston Housing Authority, City of Boston, GreenRoots, Native Land Conservancy, North American Indian Center of Boston, and Ethics Institute at Universiteit Utrecht.

The Norman B. Leventhal Center for Advanced Urbanism.

PHOTO BY: Osamu Kumasaka

CONCLUSION

05

Climate change is the greatest challenge of our time. It asks us to fundamentally reconsider our economies and the physical, social, and environmental infrastructures that underpin them. Climate change also presents an opportunity to transform our social and economic systems to benefit all members of society rather than to perpetuate patterns of exploitation and injustice. Resilience strategies must address not just critical physical infrastructure but also the socio-economic and cultural interdependencies of human and natural systems. This is the only way to truly bring human and natural systems into a more sustainable relationship. Capitalizing on MIT's interdisciplinary strength, capacity for innovation, and outstanding record of engaging communities, policy makers and industry, the Equitable Resilience Framework proposes to bring justice and equity into the heart of climate planning while enhancing resilience outcomes for all stakeholders. The novel framework and protocols we are developing situate local social practices, knowledge, and values at the heart of policymaking. They center climate resilience on issues of environmental justice and sustainability that empower impacted communities. The generous funding and support of the Climate Grand Challenges will make this dream a reality.



Image 4. Image created during the Coastal Resilience Workshop: Sharing Indigenous Knowledge and Experience
Photo by Austin Cepeda.

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