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Climate Readiness Framework for Coastal Cities

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Cover photo: Hunter’s Point South Park in New York City is a stormwater park containing a living shoreline that blends gray and green infrastructure. Design by SWA/Balsley, Weiss/Manfredi, and ARUP. Photo: David Lloyd
© SWA

Photo (following page): the Chicago shoreline is grappling with erosion, ecological disruption, and increased flood risks due to climate change. Photo: Ghait Goli



Introduction:

The urgent need for coastal cities to act on climate

As climate risks increase globally, so do risks to the 65 million people who live in U.S. coastal cities.¹ Hurricanes, sea level rise, and extreme rainfall are already affecting U.S. coasts, with metropolitan areas being at high risk due to their outdated infrastructure, impervious surfaces, and increased development. Our physical, social, and economic well-being depends not only on cutting carbon emissions to prevent the worst climate impacts from occurring, but also on adapting to our changing world.

The U.S. coastal economy supports 58.3 million jobs and contributes \$11 trillion annually in goods and services, or 43% of our total gross domestic product. Rising seas, storms, flooding, and erosion fueled by climate change exact a grim toll,

both in terms of loss of life and damage to the economy. Resilience in coastal cities is also an issue of justice. Nearly 60% of their residents are people of color, 50% are renters, 16% are living in poverty, and 13% are non-citizens—each higher than the corresponding national average—and climate impacts are disproportionately borne by historically disadvantaged communities.

Without adequate adaptation efforts, coastal areas could experience up to \$146 billion in annual property losses by 2090 and commensurate negative impacts to communities' health and safety. While planning has been done (to date 34% of U.S. coastal cities currently have climate action plans²), implementation lags significantly, leaving cities unprepared for worsening coastal



Houston during Hurricane Harvey in 2017. The storm generated 60 inches of rain, produced \$125 billion in damages, and killed 36 people in the Houston metropolitan area. The U.S. experienced 19 billion-dollar disasters that year, and 118 from 2018–2023.

hazards—a concept sometimes referred to as the “coastal adaptation gap.” Additionally, more than half of U.S. coastal communities rely on data that underestimates current and future sea level rise, often using risk assessments that are inconsistent with the latest climate science.

The science is clear: Urgent action is needed in U.S. coastal cities, and policy must swiftly recalibrate to address the rapidly intensifying impacts of climate change. Federal action is underway, including the Inflation Reduction Act and the Infrastructure Investment and Jobs Act, from which UOL identified \$21.7 billion in funding available to coastal cities—an unprecedented level of federal investment to advance the resilience of our coasts. Now is the time for the implementation of effective solutions at the local level.

Due to their large and dense population, their accompanying economies and infrastructure, and their physical proximity to multiple climate threats on and offshore, coastal cities are uniquely positioned to advance climate and ocean policy solutions, and the breadth of the work needed is vast—from transitioning to renewable energy to building more climate-resilient infrastructure. Through Urban Ocean Lab (UOL)’s coastal lens, we have identified five key policy themes—each with recommended actions—to help coastal cities meet this crucial moment:

- Coastal ecosystems
- Offshore renewable energy
- Infrastructure
- Community resilience
- Climate-driven relocation

Urban Ocean Lab has identified five key policy themes to help coastal cities meet this crucial moment, each with recommended actions:



Coastal Ecosystems



Offshore Renewable Energy



Infrastructure



Community Resilience



Climate-Driven Relocation

1 According to Urban Ocean Lab, a coastal city is a U.S. Census-designated place within a coastal shoreline county (as defined by the National Oceanic and Atmospheric Administration) with a population of 50,000 or more. Further information is available in By the Numbers: Definition, Demographics, and Climate Risks of U.S. Coastal Cities.

2 Data from a joint analysis (publication forthcoming) completed by Urban Ocean Lab and Columbia University in August 2023. The researchers defined a climate action plan as “a published strategy document that is developed by a city agency or reflective of a citywide planning effort; assesses impacts, vulnerability, risks, and resilience regarding the city and its climate; and contains evidence of cross-sectoral planning.”

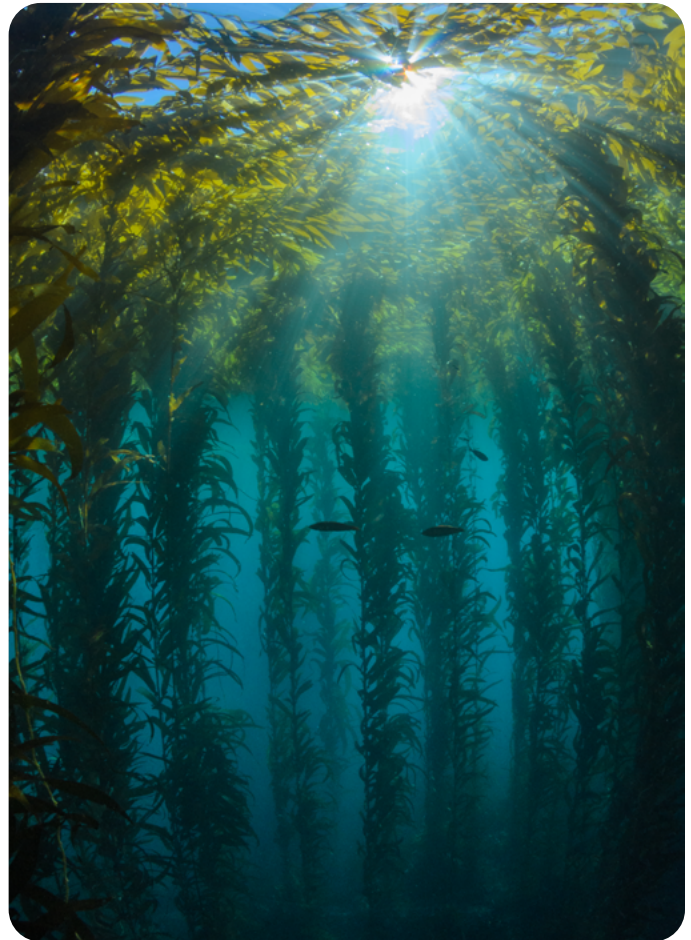


Coastal Ecosystems

Coastal ecosystems exist where oceans or Great Lakes meet the land, and include salt marshes, mangroves, seagrass meadows, kelp forests, oyster reefs, and coral reefs. They offer benefits such as shoreline protection, food security, improved water quality, carbon sequestration, economic prosperity, and cultural services. However, human activities such as coastal development and pollution increasingly threaten coastal ecosystems. For example, wetlands cover over 75.5 million acres (around 15%) of the coastal continental U.S., but from 2006 to 2016, 640,000 acres (1,000 square miles) of that extent were lost, largely to development.

Climate change is only worsening this ecological degradation, and millions of tons of methane are released as these ecosystems are destroyed. Warmer ocean temperatures are threatening seagrass meadows and kelp forests, increasing the frequency of coral bleaching events, and accelerating sea level rise, flooding, and coastline erosion. Additionally, the ocean has absorbed around 30% of the carbon dioxide released by burning fossil fuels, increasing ocean acidity by 30% and making it harder for shellfish and corals to grow their shells and skeletons. By 2100, without dramatic emissions reductions, 97% of coastal wetlands and \$732 billion in ecosystem services could be lost to sea level rise and development.

Urban coastlines have been hardened with infrastructure and buildings at an alarming rate—more than half of the natural shoreline ecosystems in major coastal cities around the world have been replaced. Historically, intact coastal ecosystems provided natural shoreline protection, buffering the impact of storms—often more effectively than expensive seawalls. Without healthy coastal ecosystems, urban populations are more vulnerable to sea level rise, storm surge, regional and local economic downturn, and severed cultural and social relations with coastlines. To prevent further harm to ecosystems and communities, and prepare for climate change, local governments should work to protect, restore, and equitably manage coastal ecosystems.



Giant kelp grows in coastal waters off of California, providing habitat for animals and protecting coastal cities.

Protection

Given the relatively small remaining extent of coastal ecosystems in urban settings, and the many benefits they offer, protecting these ecosystems from the impacts of climate change, pollution, development, and extraction is essential. Experts are urging policymakers to protect at least 30% of U.S. lands and waters by 2030. Coastal cities must safeguard the biodiversity and resilience of the remaining coastal ecosystems.

30%

The minimum share of U.S. lands and waters that experts have urged policymakers to protect by 2030.

RECOMMENDED ACTIONS

- ❑ Identify and expand the suite of legislative and regulatory options for ecosystem protection, by working with state and federal authorities.
- ❑ Ensure coastal development does not adversely impact coastal ecosystems, by establishing and improving local protection policies, such as no net loss, green permits, and green taxes and fees.
- ❑ Address nutrient pollution, stormwater runoff, and sewer overflows by implementing green infrastructure and water treatment approaches that prevent toxins and contaminants from entering the ocean and Great Lakes.
- ❑ Partner with local conservation organizations.
- ❑ Integrate education, research, and workforce development opportunities into protection initiatives.



Jamaica Bay is New York City's largest wetland. Before its designation as a wildlife refuge, it was acutely threatened by human activity for decades. Its location (and sea level rise) necessitates continued and rigorous protection efforts.

Restoration

Coastal and marine ecosystems are deteriorating globally, and toxic runoff into estuaries has increased since the 1960s, causing larger hypoxic areas. In the U.S., significantly cutting greenhouse gas emissions and preserving land for restoration could expand coastal wetlands by 25% by 2100. Coastal cities must prioritize coastal restoration efforts that maintain ecosystem health and community well-being by improving adaptation to climate change, increasing carbon sequestration, and enhancing biodiversity.



Get Climate Ready

Go to [Page 28](#) for a checklist of every recommended action in our Climate Readiness Framework.



RECOMMENDED ACTIONS

- ❑ Develop appropriate urban coastal ecosystem restoration plans, focused on identifying suitable project locations and partners, via input from coastal communities.
- ❑ Collaborate with state and federal agencies on restoration projects, and encourage the inclusion of coastal restoration in regional management plans.
- ❑ Prioritize coastal resilience projects that use natural infrastructure and incorporate ecosystem-based adaptation approaches, like living shorelines, floodplain restoration, greenways, stormwater parks, and bioswales.
- ❑ Shorten permitting timelines, lower permitting costs for restoration projects, and improve publicly available information on restoration permits.
- ❑ Partner with private developers and landowners to catalyze restoration projects that maintain ecosystem health and community well-being.



Artificial tide pools provide habitat for marine life in New York Harbor as part of the Living Breakwaters project. Photo: SCAPE. Project designer: SCAPE. Project sponsor: NYS Office of Resilient Homes and Communities

Equitable management and access

Equitable management seeks to ensure that the protection and restoration of coastal ecosystems delivers sustainable and just outcomes for both the environment and the people who rely on it. For instance, partnerships and land co-management with Indigenous communities can better support ecosystem biodiversity. Conversely, discriminatory housing and land use policies (like redlining and restrictive zoning) have disproportionately exposed historically disadvantaged communities to toxic waterways and increased flood risk. Additionally, communities of color are three times more likely than white communities to live in nature-deprived places—nationwide, 70% of low-income communities live in nature-deprived areas, and only 10% of the U.S. coast and Great Lakes is covered by strong legal protections for public coastal access. Cities must ameliorate these inequalities when developing coastal management plans.

RECOMMENDED ACTIONS

- ❑ Direct funding and resources towards local coastal ecosystem restoration and protection projects, with a focus on neighborhoods facing higher exposure to flooding, the urban heat island effect, pollution, and other climate impacts.
- ❑ Enhance equitable access to shorelines and coastal and ocean ecosystems, including for provisional, recreational, and cultural activities.
- ❑ Improve equitable management by increasing staff diversity in city conservation and environmental agencies, including in leadership positions.
- ❑ Develop meaningful partnerships with Tribal nations, co-creating (co-)management plans, where applicable.



Charleston Waterfront Park project created new access points to the Cooper River in Charleston, South Carolina, restored salt marshes, and provided recreational opportunities for residents. Photo: Landslides, Courtesy of Sasaki



Offshore Renewable Energy

Cities generate over 80% of global gross domestic product, and consume 75% of global primary energy, while emitting up to 70% of the world's greenhouse gas emissions. In the U.S., about half of the country's emissions come from our 10 largest cities and top 5% of the most affluent non-urban areas. Globally, eight of the ten largest cities in the world are coastal. Coastal cities

are well-positioned to help the U.S. achieve emissions reductions targets by transitioning to justly sourced, renewable, carbon-free energy sources, and ensure effective transmission and storage for grid reliability. This can and should include offshore energy—primarily offshore wind at present, and possibly wave, tidal, and thermal energy in the future.

As a result of extractive and discriminatory economic policies, fossil fuel infrastructure has often been sited in or adjacent to low-income communities and communities of color. To redress past and ongoing harms, coastal cities must support a just transition to offshore renewable energy that benefits local communities. By developing workforce training programs, investing in research, and providing onshore infrastructure, coastal cities can actively contribute to a cleaner, more equitable energy future.



Offshore wind farms near coastal cities can help the U.S. transition from fossil fuels to renewable energy sources.

Offshore wind energy

Through 2022, more than two million acres of ocean bottom in U.S. waters have been leased for wind energy, with more leases anticipated by 2025. With over 50 gigawatts (GW) of planned energy generation capacity,³ offshore wind is the largest source of renewable energy in the U.S. Modeling suggests that the U.S. has enough offshore wind resources to deliver more than 4,200 GW of energy across the country—over three times the current demand of the entire U.S. electric grid. While that magnitude of development is unlikely, it puts the U.S.'s current plans for development in perspective. However, planned offshore wind farms face economic challenges, environmental concerns, technical limitations, siting and permitting complications, and interest group opposition that contribute to the delayed expansion of the industry—especially in comparison to onshore wind and solar energy in the U.S., and to international progress. Accelerating offshore wind development requires improved engagement and collaboration between city governments, local communities, offshore wind developers, and other interested parties for an equitable and inclusive clean energy transition.

RECOMMENDED ACTIONS

- ❑ Facilitate community-based planning for offshore wind projects to be responsibly developed and serve local interests.
- ❑ Host and support workforce development programs to promote community participation and ensure local residents will be eligible for jobs in the sector, including roles in port operations, vessel construction, and related fields.
- ❑ Facilitate multi-stakeholder interactions to identify port-specific needs and other shore-based coordination steps to ensure responsible electrical grid interconnection, operations, and management of wind farm support.
- ❑ Buy energy from private farms through power purchase agreements, and support the development of public power utilities and consider expanding the mandate of existing public utilities to build offshore wind farms when feasible.
- ❑ Ensure community revitalization funds from offshore wind developers are established and properly used to support local residents.

+4,200 GW

The amount of energy that could delivered by the U.S.'s offshore wind resources—over 3x the current demand of the entire electric grid.

³ As of May 31, 2023.

Other offshore renewables

Wave, tidal, thermal, and floating solar are promising options for future offshore energy generation. Together, they could theoretically meet 57% of the country's annual electricity demand; however, considering regulatory constraints, social acceptance, competing uses, and other factors, that percentage would realistically be considerably smaller. Coastal cities should consider advocating for and supporting associated research, development, and community education efforts to support improved technologies and their responsible deployment. If a variety of renewable energy options are available, developers, cities, and coastal communities can collaborate to tailor energy systems to the unique conditions and needs of each area.

Transmission and storage

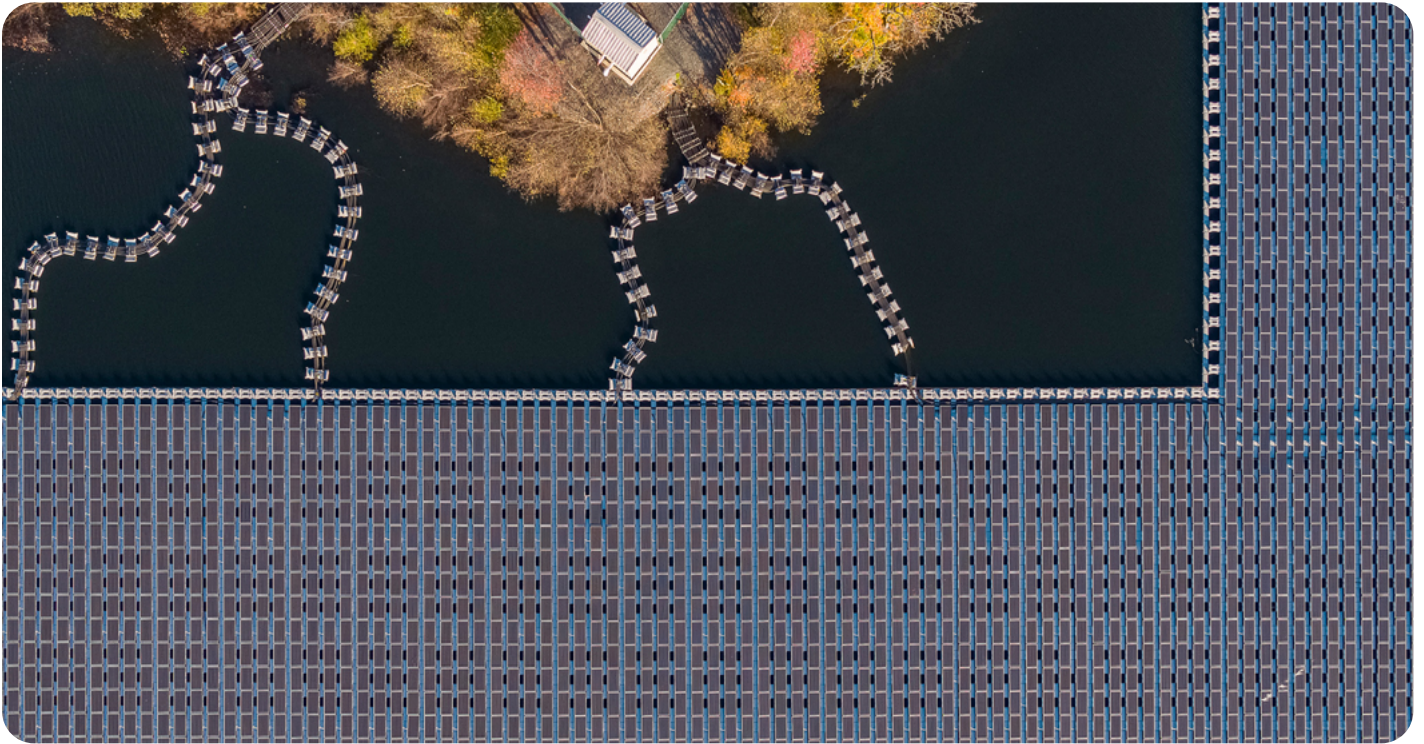
New offshore power sources will need to connect to the grid to ensure that energy can reach consumers. However, transmission points for offshore systems are currently limited, and more than 70% of onshore transmission and distribution lines are over 25 years old, nearing the end of their expected 50-year lifespan. It is critical for the U.S. to build updated transmission systems to support existing and planned offshore energy. The U.S. Department of Energy has released a transmission action plan for offshore wind in the Atlantic, which describes opportunities for coastal cities to improve collaboration, siting, standardization, and other support initiatives for offshore renewable energy transmission. Because offshore renewable energy relies on natural processes to generate power, production cannot easily ramp up during peak hours, and it will be key to, in tandem, develop energy storage opportunities.

RECOMMENDED ACTIONS

- ❑ Support and host research programs on offshore renewable energy technologies through partnership programs such as the Offshore Wind Innovation Hub and participation in federal funding programs, like Advanced Research Projects Agency-Energy, and other collaborative opportunities.
- ❑ Designate specific shoreside areas within their jurisdiction to support offshore renewable energy testing and research.
- ❑ Identify economic development opportunities for offshore renewable energy systems within their jurisdiction.

RECOMMENDED ACTIONS

- ❑ Engage and facilitate community involvement in the public process to identify optimal transmission opportunities.
- ❑ Coordinate with energy utilities and other cities to site transmission connections to the onshore grid in appropriate places.
- ❑ Increase the capacity of battery systems to store energy to help maintain a reliable and functional energy grid.
- ❑ Advocate for research and development to improve battery safety—including fire safety—and performance, and reduce the environmental impacts of producing and decommissioning battery systems.
- ❑ Support and advocate for port development needed for adequate transmission deployment.



A floating solar panel farm on a retention pond near Sayreville, New Jersey.



Offshore substations are critical connection points between the grid and offshore renewables.



Infrastructure

After years of disinvestment, U.S. infrastructure has fallen into disrepair, becoming increasingly vulnerable to breakdowns—a situation exacerbated by the escalating severity, frequency, and duration of climate events. The rigidity of infrastructure and the agencies that govern it can perpetuate environmental degradation and social injustice, failing to address the needs of

coastal city communities and ecosystems. Globally, 75% of the infrastructure that cities will need by 2050 (to accommodate population growth and structural wear and tear) has yet to be built. This is a huge opportunity to properly site, design, and build more climate-resilient infrastructure to withstand extreme weather, sea level rise, and other threats. In tandem, a historic influx of federal funding from the Inflation Reduction Act and Infrastructure Investment and Jobs Act is now flowing to coastal cities. To prevent maladaptation and ensure new investments do not replicate past harms, coastal cities must commit to a just and sustainable approach to creating and locating climate resilient infrastructure projects, while investing in retrofitting and adapting existing infrastructure.

Seaports and airports

Most coastal cities owe their existence to their natural harbors. In their formative years, labor and investment crowded around these landforms where seaports were developed, facilitating maritime trade and stimulating industries like fishing, shipbuilding, and manufacturing, and thus catalyzing urban development. In recent decades, commercial airports have played a similar role, acting as conduits for global connectivity and further propelling local and regional growth. However, many seaports and airports are susceptible to climate impacts such as rising sea levels and extreme weather events. Port adaptation demands a mix of approaches, depending on the context. As cities consider how their ports can be altered to continue serving their purpose, they must also plan to eliminate the burden that seaports and airports place on environmental justice communities.

RECOMMENDED ACTIONS

- ❑ Adopt and enforce planning, zoning codes, and construction standards that account for climate shocks (e.g. cloudbursts and storm surge) and stressors (e.g. increasing heat and sea level rise).
- ❑ Increase funding for port resilience planning.
- ❑ Support decision-making for more climate-ready ports with infrastructure and land use planning tools for city staff and port planners.
- ❑ Invest in protective infrastructure by incorporating natural barriers, like mangroves and wetlands, and engineered defenses, if and when appropriate. Consider elevation of critical infrastructure and relocation of some port facilities to less vulnerable areas.

Working waterfronts

Comprising small harbors, marinas, docks, cranes, refrigeration, transportation, and other waterfront infrastructure, working waterfronts support a diverse array of marine industries and are central to the cultural and economic well-being of coastal cities.⁴ Unfortunately, they are being lost to increased development, competing uses such as real estate and tourism, and worsening climate impacts. These challenges limit businesses' access to the water and create logistical and operational challenges that can stymie economic growth. The loss of working waterfronts can also have substantial impacts on surrounding communities: As water-dependent businesses are displaced, local residents face job loss, economic decline, and a loss of cultural and community identity. To bolster economic activity and support livelihoods, cities need to invest in protecting and rebuilding their working waterfronts.

RECOMMENDED ACTIONS

- ❑ Use public grants, loans, or tax policies to subsidize industrial waterfronts and related infrastructure.
- ❑ Purchase and acquire coastal property for public use or public-private partnerships.
- ❑ Conduct land use planning and zoning to help secure industry access to the waterfront and necessary infrastructure.
- ❑ Collaborate with state agencies to develop working waterfront plans and programs.

Find federal funding opportunities for infrastructure in our guidebook.



⁴ Working waterfronts refer to the collective shoreside lands, infrastructure, and waterways utilized for water-dependent activities, including commercial and recreational fishing, aquaculture, boat building, shipping, marine research, tourism, and other related commercial, industrial, and recreational ventures.

Workers unload mussels for processing in coastal Maine. Less than 20 miles of the state's 5,000 miles of coastline remain as working waterfronts, having rapidly disappeared. Photo: Gulf of Maine Research Institute



Top: A portion of Buffalo Bayou Park in Houston after Hurricane Harvey. Bottom: The same park, one year later. The 160-acre public space designed by SWA was designed to flood, helping the city prepare for extreme weather events. Harvey produced more rain (+60" in parts of Texas) than any other tropical cyclone in U.S. history. Photo: © SWA

Water management

Infrastructure that transports drinking water, wastewater, and stormwater, and provides protection against coastal flooding and erosion, is increasingly at risk of disruption, damage, and permanent inundation from climate change. The Environmental Protection Agency estimates that U.S. drinking water and wastewater systems will require an investment exceeding \$744 billion over the next 20 years. Additionally, coastal climate impacts and urbanization are threatening the availability and quality of our water resources, exposing communities and ecosystems to pathogens and harmful chemicals. Combined Sewer Overflows (CSOs) also present a problem in this regard: Because combined sewer systems collect stormwater and wastewater in a single pipe, they can be overwhelmed during rainfall and discharge untreated sewage into water bodies. Coastal flooding and saltwater intrusion from rising seas heightens the risk of wastewater infrastructure failure—at six feet of sea level rise, an estimated 31 million people in the U.S. could lose access to wastewater services. Meanwhile, excessive groundwater extraction is not just depleting drinkable water, but also causing land to sink beneath coastal cities, risking faster exposure to sea level rise that can threaten other sources of potable water. Engineered defenses to curb flooding from sea level rise and storm surge can be expensive, susceptible to failure, harmful to ecosystems, and unevenly distributed, potentially worsening risks for neighboring communities. In light of these concerns, coastal cities must thoughtfully construct and upgrade water management infrastructure to better withstand climate impacts while simultaneously implementing strategies for the safe and efficient management of limited water supplies.

RECOMMENDED ACTIONS

- ❑ Retrofit, elevate, or relocate water facilities at risk from climate impacts.
- ❑ Ensure comprehensive management of the full water cycle through sustainable water use and coordinated management across sectors.
- ❑ Mandate and incentivize the construction and maintenance of green infrastructure—such as rain gardens, permeable pavers, and green roofs—on both public and private land to absorb rain and reduce runoff.
- ❑ Require the development and implementation of plans to mitigate CSOs, focusing on infrastructure separation, increased water storage capacity, and enhanced monitoring systems to manage and prevent overflows.
- ❑ Diversify water sources and adopt water efficiency measures, such as water metering and wastewater reclamation, to reduce stress on groundwater aquifers and mitigate saltwater intrusion.
- ❑ Incorporate green-gray strategies into protective shoreline infrastructure.

+\$744 billion

The investment needed in drinking water and wastewater systems over the next 20 years in the U.S.



Community Resilience

Climate change poses significant risks to community wellbeing and social cohesion. Although there is no common definition of community resilience, UOL conceives of it as the ability of a group to harness and cultivate local knowledge, resources, and networks to effectively prepare for, withstand, and respond to climate shocks and stressors.

When coastal cities support community resilience, they can improve disaster preparedness and response, social equity, economic stability, and environmental sustainability, and ensure frontline communities do not continue to be disproportionately impacted by climate change. New York City was unprepared for Superstorm Sandy, and social cohesion and capital were critical to the city's recovery: In the wake of the storm, community organizations and local non-profits led emergency response efforts, providing essential services to residents who were left without power, heat, or running water for days on end. Effectively fostering community resilience hinges on community involvement, power sharing, and collaboration; workforce development and related community programming; and improving livelihoods and health.



In Boston, community members provide input on Coastal Resilience Solutions for Dorchester, a plan to prepare the neighborhood for coastal flooding and sea level rise. The plan is part of the Climate Ready Boston initiative. Photo: SCAPE

Community involvement, power sharing, and collaboration

Historically, government-led community engagement with underserved groups has often been superficial, opaque, or disingenuous, leading to distrust. By recognizing, honoring, and leveraging local expertise through participatory governance,⁵ cities can foster inclusivity and equity, amplify the effectiveness of disaster response strategies, and encourage greater social cohesion and collaboration.

Community-based organizations (CBOs)—local entities often trusted and adept at catalyzing engagement and action in neighborhoods—are at the heart of this work. CBOs frequently run dedicated, physical hubs that serve multiple purposes, including spaces for gathering people during and after disasters and for exchanging goods, services, and information. By working with these organizations, city governments can create a strong and responsive network of nodes to foster community resilience.



RECOMMENDED ACTIONS

- ❑ Build and deepen relationships with community members, key community-based organizations (CBOs), and broader networks or alliances.
- ❑ Collaborate with community members and CBOs on implementing or strengthening disaster preparedness plans via emergency management staff.
- ❑ Provide local funding (or facilitate the use of federal funds) to support leadership and advisory positions for CBO members to participate in neighborhood and citywide climate planning.
- ❑ Improve access to funding by providing CBOs with technical grant writing assistance, simplifying grant applications, and permanently increasing municipal budgets for community programs.

Left: WE ACT for Environmental Justice attends the 2023 March to End Fossil Fuels in New York City. WE ACT was founded as a community-based organization in West Harlem in 1988 to enact grassroots political change to combat environmental racism. The organization recently ran a \$1 million capacity-building grant program with New York State to help fund other environmental justice organizations, and helped develop a community-driven emergency preparedness plan for Northern Manhattan. Photo: Alex Miller

⁵ Participatory governance refers to the active involvement of community members in a city's decision-making process.

Workforce development and related community programs

Robust workforce development and community programs can foster economic stability and act as a bulwark against the long-term economic ramifications of climate change, helping residents navigate the challenges and opportunities inherent in a transforming world. For example, the new American Climate Corps program will, in its first year, equip 20,000 young people with the skills they need to pursue climate-related careers. Similar workforce development programs could be launched at the state and city level to meet local needs. By cultivating careers in blue-green industries (such as clean energy, coastal restoration, and water management), coastal cities can build a skilled workforce for emerging roles, offer sustainable alternatives for workers transitioning from fossil fuel jobs, support existing occupations that foster climate readiness, and contribute to overall economic development.

20,000 people will be employed by the American Climate Corps in the program's first year.

RECOMMENDED ACTIONS

- ❑ Provide comprehensive support, such as upskilling and reskilling programs, career counseling, and financial assistance for local community members interested in low-carbon careers and workers displaced by a transition to a low-carbon economy.
- ❑ Foster partnerships with private sector companies, trade unions, and educational institutions to align workforce training with the current and future needs of a green economy.
- ❑ Develop a job creation and placement program for climate roles in the public and private sectors.
- ❑ Ensure a diverse and inclusive climate workforce by prioritizing unemployed, underemployed, and other underserved groups in the accessibility and design of programs.
- ❑ Offer tax incentives and grants to businesses that create jobs in the green economy, particularly in areas most affected by the decline of fossil fuel industries.
- ❑ Create economic programs that center the priorities of disaster-affected communities (as opposed to status quo disaster capitalism).

Disaster preparedness and recovery

A well-informed public, coupled with adequate city resources and thorough risk assessment, is the foundation for effective disaster preparedness. In the 1980s, the U.S. experienced one billion-dollar disaster every 4 months on average,⁶ but now, one occurs every three weeks—and they are concentrated in coastal states. Today, more than half of U.S. residents are not ready for a disaster and preparations by local governments face many common obstacles, such as inadequate funding, capacity constraints, and ineffective coordination across agencies. Preparedness encompasses planning and education strategies to enable both agencies and residents to effectively anticipate, address, and recover from relevant extreme weather events, such as hurricanes. This can take many forms, including contingency plans to activate in case of an emergency (e.g., city workers rerouting public transit routes to maintain service).

RECOMMENDED ACTIONS

- ❑ Hire a full-time emergency manager and chief resilience officer, and increase dedicated and trained emergency management staff.
- ❑ Follow (and iterate on) FEMA's Comprehensive Guides to develop and maintain emergency operations and communications plans.
- ❑ Develop and regularly update hazard mitigation plans and comprehensive emergency response plans with climate-specific scenarios, such as high tide flooding and compound events.
- ❑ Enhance social safety nets, such as emergency relief funds, to expedite financial assistance to affected individuals and communities immediately after disasters.
- ❑ Develop outreach and education programs to boost local awareness of and enrollment in flood and disaster insurance.
- ❑ Leverage federal, state, and local funding to adequately support emergency management.



Read our report on community-led response, recovery, and resilience in NYC after Superstorm Sandy.



A Community Emergency Response Training course in Fairfax County, VA. Photo: Joe Loong CC BY-SA 2.0

⁶ All values have been adjusted for inflation in 2022 dollars.



Climate-Driven Relocation

Climate-driven relocation is an adaptation strategy involving the intentional movement of people, homes, and infrastructure away from climate-vulnerable locations and into places (often called “welcoming communities”) that are further inland or at higher elevations.⁷ In 2022, extreme weather events displaced 3.4 million people living in the U.S., and up to 13.1 million people may be displaced by 6 feet of sea level rise by 2100.

In some areas, proactive and strategic relocation will be necessary to protect the lives, livelihoods,

and cultures of coastal communities. However, federal relocation programs have largely been both reactive and inaccessible to the populations most impacted by climate change. Moreover, such programs often overlook broader community and ecological needs, such as the provision of just relocation pathways for residents, safe and affordable housing, and the restoration (and repurposing) of vacated land. Challenges like high population density, racialized housing patterns, and rapid development make equitable relocation in coastal cities complex.

Alongside federal and state efforts, local government action will be critical to meet the growing urgency and demand for relocation assistance in the U.S. Through innovative policies for housing, land use, and financing, coastal cities can not only reduce risk, but also enhance residents’ quality of life and foster multigenerational resilience. Additionally, ongoing collaboration between cities and across sectors will be necessary to accelerate the adoption of effective and equitable relocation policy at scale.



A lot in Oakwood Beach, New York City, before and after relocation. In 2012, Superstorm Sandy severely damaged the neighborhood. Homeowners responded by forming a committee to petition New York State to facilitate a neighborhood-scale voluntary buyout. 180 homeowners chose to participate. Photos: Nathan Kensinger

⁷ Climate-driven relocation is sometimes referred to as “managed retreat,” however, that latter term can imply top-down approaches that could undermine the agency and self-determination of coastal communities.

Housing security and mobility

The U.S. faces a critical shortage of affordable housing, and the affordable housing that does exist in coastal cities is disproportionately located in low-lying, flood-prone areas. Moreover, competitive real estate markets and high cost of living can further exacerbate housing insecurity for low-income communities and communities of color. As coastal residents seek safer ground, those with limited resources can experience difficulty finding comparable housing in areas outside of flood zones and may end up relocating to equally or even more hazardous neighborhoods. Meanwhile, wealthier populations relocating to safer locales can drive up housing costs and heighten displacement risks for low-income residents—a phenomenon known as climate gentrification.

13.1 million

The number of people who may be displaced by six feet of sea level rise by 2100.

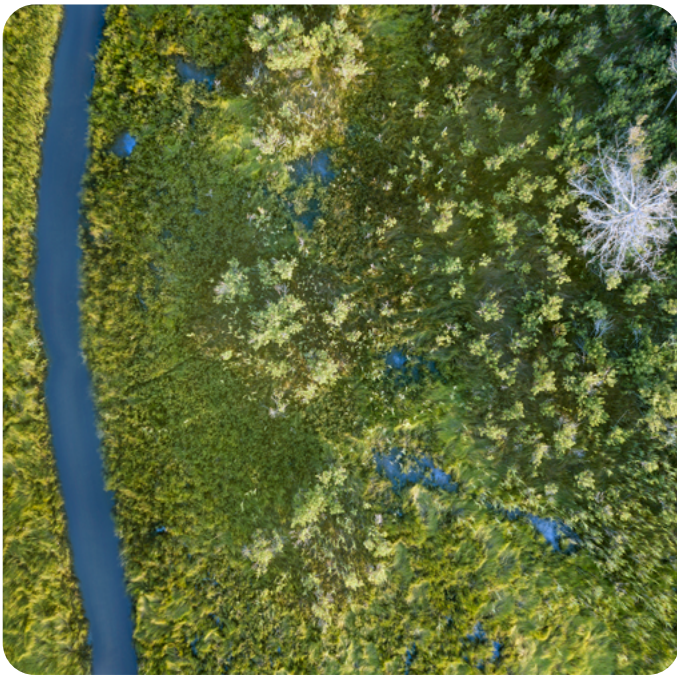
RECOMMENDED ACTIONS

- ❑ Prioritize the development of affordable, climate-resilient housing in upland areas in municipal master plans, zoning plans, hazard mitigation plans, and climate action plans.
- ❑ Foster regional partnerships and collaboration among state, county, and local governments to broaden housing choices and resources for relocating residents.
- ❑ Develop inclusive relocation programs that expand socioeconomic opportunities for low-income communities and communities of color who have been historically excluded from homeownership.
- ❑ Provide accessible information, financial assistance, technical guidance, and other social services to residents considering or currently undergoing relocation.
- ❑ Pair relocation efforts with fair housing policies, anti-displacement laws, tenant protections, and shared equity housing models.⁸
- ❑ Increase infrastructure investments (such as transportation, waste and stormwater services, and healthcare) in welcoming communities.

⁸ Shared equity housing models involve a partnership between homeowners and public or nonprofit entities, where the homeowner gains affordable access to a property while agreeing to share any future equity gains with the organization, ensuring long-term housing affordability for future buyers.

Land use and conservation

For coastal cities to realize the full benefits of relocation, vacated land must be repurposed and maintained in ways that strengthen flood resilience (by adapting land to absorb or buffer floodwaters), benefit coastal communities (by increasing public access to open space or creating economic opportunities), and support the health of ecosystems (by restoring and assisting the upland migration of coastal wetlands). Yet, vacated land often falls into abandonment or mismanagement. Vacated properties often either have no deed restrictions, allowing re-development, or are bound with restrictive permitting and land use regulations, making it challenging to repurpose them for ecological, cultural, or recreational purposes. Without a vision, plan, and resources for future land use, relocation in U.S. coastal cities—which face intense development pressures within limited available space—can lead to blight or risky (re)development.



Cattus Island County Park in Toms River, New Jersey, recently grew through the state’s Blue Acres program, incorporating land impacted by Superstorm Sandy.

RECOMMENDED ACTIONS

- ❑ Utilize climate projections in land use planning to identify both near- and long-term uses for vacated land.
- ❑ Prevent future development and prioritize ecological protection and restoration and migration, through easements, land swaps, and the transfer of development rights, on high-risk parcels.
- ❑ Prioritize a community-centered approach to land use planning to ensure relocating residents can access, benefit from, and steward new uses on the land they’ve left behind.
- ❑ Embed relocation of homes, infrastructure, and other non-residential coastal land use into long-term, regularly updated regional and municipal plans (such as comprehensive plans, hazard mitigation plans, climate action plans, capital improvement plans, and watershed plans).
- ❑ Support collaboration and knowledge-sharing across cities, and between land owners, land managers, local communities, and other environmental stewards to coordinate effective management of restored parcels.

Innovative finance

To support just, comprehensive relocation programs, coastal cities require dedicated, long-term, diverse, and flexible funding sources—including public, private, and philanthropic dollars. Yet, most local governments rely on competitive federal grants, which are limited in terms of their availability, accessibility, equity, and speed. Coastal cities must diversify their funding streams to expand relocation programs, provide quick, proactive, and locally responsive assistance, while also safeguarding local budgets.

RECOMMENDED ACTIONS

- ❑ Increase city government staff capacity to apply for and manage multiple and innovative funding streams.
- ❑ Develop a dedicated revenue stream for relocation.
- ❑ Explore collaborative approaches for relocation financing to distribute the costs and enable resource-sharing across neighboring cities, and between public and private entities.
- ❑ Explore public-private partnerships and philanthropic funding to close gaps in public financing for relocation programs.
- ❑ Leverage economic development and conservation finance tools, such as environmental bonds and community block grants, for the remediation, restoration, and maintenance of vacated properties.



A home on Isle de Jean Charles, Louisiana. Over several decades, the island dwindled from 22,000 to 320 acres due to coastal erosion and sea level rise. The state received \$48.3 million in federal grants to relocate residents. Photo: Karen Apricot, CC BY-SA 2.0 DEED

Conclusion

Even with ambitious mitigation efforts, climate impacts will continue to intensify over the coming decades, underscoring why coastal cities must prioritize and invest deeply in accelerating adaptation and resilience efforts. This climate readiness framework puts forward over 70 recommended actions that coastal cities must take to address the urgency of the climate crisis, and ensure that the social and economic well-being of communities is prioritized in climate plans. Notably, implementing policies for coastal ecosystems, offshore renewable

energy, infrastructure, community resilience, and climate-driven relocation only represents only a portion of the sustained and coordinated investment of time, funding, and effort required to achieve climate-ready coastal cities. UOL's future work will support and expand on these initial recommendations, and through research and collaboration, provide coastal cities with the necessary tools and knowledge to implement effective policy solutions, promote environmental justice for residents, and influence broader changes to state and federal policy.

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Appendix

Checklist for Coastal Cities



Coastal Ecosystems

PROTECTION

- ❑ Identify and expand the suite of legislative and regulatory options for ecosystem protection, by working with state and federal authorities.
- ❑ Ensure coastal development does not adversely impact coastal ecosystems, by establishing and improving local protection policies, such as no net loss, green permits, and green taxes and fees.
- ❑ Address nutrient pollution, stormwater runoff, and sewer overflows by implementing green infrastructure and water treatment approaches that prevent toxins and contaminants from entering the ocean and Great Lakes.
- ❑ Partner with local conservation organizations.
- ❑ Integrate education, research, and workforce development opportunities into protection initiatives.

RESTORATION

- ❑ Develop appropriate urban coastal ecosystem restoration plans, focused on identifying suitable project locations and partners, via input from coastal communities.
- ❑ Collaborate with state and federal agencies on restoration projects, and encourage the inclusion of coastal restoration in regional management plans.
- ❑ Prioritize coastal resilience projects that use natural infrastructure and incorporate ecosystem-based adaptation approaches, like living shorelines, floodplain restoration, greenways, stormwater parks, and bioswales.
- ❑ Shorten permitting timelines, lower permitting costs for restoration projects, and improve publicly available information on restoration permits.
- ❑ Partner with private developers and landowners to catalyze restoration projects that maintain ecosystem health and community well-being.

EQUITABLE MANAGEMENT AND ACCESS

- ❑ Direct funding and resources towards local coastal ecosystem restoration and protection projects, with a focus on neighborhoods facing higher exposure to flooding, the urban heat island effect, pollution, and other climate impacts.
- ❑ Enhance equitable access to shorelines and coastal and ocean ecosystems, including for provisional, recreational, and cultural activities.
- ❑ Improve equitable management by increasing staff diversity in city conservation and environmental agencies, including in leadership positions.
- ❑ Develop meaningful partnerships with Tribal nations, co-creating (co-) management plans, where applicable.



Offshore Renewable Energy

OFFSHORE WIND ENERGY

- ❑ Facilitate community-based planning for offshore wind projects to be responsibly developed and serve local interests.
- ❑ Host and support workforce development programs to promote community participation and ensure local residents will be eligible for jobs in the sector, including roles in port operations, vessel construction, and related fields.
- ❑ Facilitate multi-stakeholder interactions to identify port-specific needs and other shore-based coordination steps to ensure responsible electrical grid interconnection, operations, and management of wind farm support.
- ❑ Buy energy from private farms through power purchase agreements, and support the development of public power utilities and consider expanding the mandate of existing public utilities to build offshore wind farms when feasible.
- ❑ Ensure community revitalization funds from offshore wind developers are established and properly used to support local residents.

OTHER OFFSHORE RENEWABLES

- ❑ Support and host research programs on offshore renewable energy technologies through partnership programs such as the Offshore Wind Innovation Hub and participation in federal funding programs, like Advanced Research Projects Agency-Energy, and other collaborative opportunities.
- ❑ Designate specific shoreside areas within their jurisdiction to support offshore renewable energy testing and research.
- ❑ Identify economic development opportunities for offshore renewable energy systems within their jurisdiction.

TRANSMISSION AND STORAGE

- ❑ Engage and facilitate community involvement in the public process to identify optimal transmission opportunities.
- ❑ Coordinate with energy utilities and other cities to site transmission connections to the onshore grid in appropriate places.
- ❑ Increase the capacity of battery systems to store energy to help maintain a reliable and functional energy grid.
- ❑ Advocate for research and development to improve battery safety—including fire safety—and performance, and reduce the environmental impacts of producing and decommissioning battery systems.
- ❑ Support and advocate for port development needed for adequate transmission deployment.



SEAPORTS AND AIRPORTS

- ❑ Adopt and enforce planning, zoning codes, and construction standards that account for climate shocks (e.g. cloudbursts and storm surge) and stressors (e.g. increasing heat and sea level rise).
- ❑ Increase funding for port resilience planning.
- ❑ Support decision-making for more climate-ready ports with infrastructure and land use planning tools for city staff and port planners.
- ❑ Invest in protective infrastructure by incorporating natural barriers, like mangroves and wetlands, and engineered defenses, if and when appropriate. Consider elevation of critical infrastructure and relocation of some port facilities to less vulnerable areas.

WORKING WATERFRONTS

- ❑ Use public grants, loans, or tax policies to subsidize industrial waterfronts and related infrastructure.
- ❑ Purchase and acquire coastal property for public use or public-private partnerships.
- ❑ Conduct land use planning and zoning to help secure industry access to the waterfront and necessary infrastructure.
- ❑ Collaborate with state agencies to develop working waterfront plans and programs.

WATER MANAGEMENT

- ❑ Retrofit, elevate, or relocate water facilities at risk from climate impacts.
- ❑ Ensure comprehensive management of the full water cycle through sustainable water use and coordinated management across sectors.
- ❑ Mandate and incentivize the construction and maintenance of green infrastructure—such as rain gardens, permeable pavers, and green roofs—on both public and private land to absorb rain and reduce runoff.
- ❑ Require the development and implementation of plans to mitigate CSOs, focusing on infrastructure separation, increased water storage capacity, and enhanced monitoring systems to manage and prevent overflows.
- ❑ Diversify water sources and adopt water efficiency measures, such as water metering and wastewater reclamation, to reduce stress on groundwater aquifers and mitigate saltwater intrusion.
- ❑ Incorporate green-gray strategies into protective shoreline infrastructure.



Community Resilience

COMMUNITY INVOLVEMENT, POWER SHARING, AND COLLABORATION

- ❑ Build and deepen relationships with community members, key community-based organizations (CBOs), and broader networks or alliances.
- ❑ Collaborate with community members and CBOs on implementing or strengthening disaster preparedness plans via emergency management staff.
- ❑ Provide local funding (or facilitate the use of federal funds) to support leadership and advisory positions for CBO members to participate in neighborhood and citywide climate planning.
- ❑ Improve access to funding by providing CBOs with technical grant writing assistance, simplifying grant applications, and permanently increasing municipal budgets for community programs.

WORKFORCE DEVELOPMENT AND RELATED COMMUNITY PROGRAMS

- ❑ Provide comprehensive support, such as upskilling and reskilling programs, career counseling, and financial assistance for local community members interested in low-carbon careers and workers displaced by a transition to a low-carbon economy.
- ❑ Foster partnerships with private sector companies, trade unions, and educational institutions to align workforce training with the current and future needs of a green economy.
- ❑ Develop a job creation and placement program for climate roles in the public and private sectors.
- ❑ Ensure a diverse and inclusive climate workforce by prioritizing unemployed, underemployed, and other underserved groups in the accessibility and design of programs.
- ❑ Offer tax incentives and grants to businesses that create jobs in the green economy, particularly in areas most affected by the decline of fossil fuel industries.
- ❑ Create economic programs that center the priorities of disaster-affected communities (as opposed to status quo disaster capitalism).

DISASTER PREPAREDNESS AND RECOVERY

- ❑ Hire a full-time emergency manager and chief resilience officer, and increase dedicated and trained emergency management staff.
- ❑ Follow (and iterate on) FEMA's Comprehensive Guides to develop and maintain emergency operations and communications plans.
- ❑ Develop and regularly update hazard mitigation plans and comprehensive emergency response plans with climate-specific scenarios, such as high tide flooding and compound events.
- ❑ Enhance social safety nets, such as emergency relief funds, to expedite financial assistance to affected individuals and communities immediately after disasters.
- ❑ Develop outreach and education programs to boost local awareness of and enrollment in flood and disaster insurance.
- ❑ Leverage federal, state, and local funding to adequately support emergency management.



Climate-Driven Relocation

HOUSING SECURITY AND MOBILITY

- ❑ Prioritize the development of affordable, climate-resilient housing in upland areas in municipal master plans, zoning plans, hazard mitigation plans, and climate action plans.
- ❑ Foster regional partnerships and collaboration among state, county, and local governments to broaden housing choices and resources for relocating residents.
- ❑ Develop inclusive relocation programs that expand socioeconomic opportunities for low-income communities and communities of color who have been historically excluded from homeownership.
- ❑ Provide accessible information, financial assistance, technical guidance, and other social services to residents considering or currently undergoing relocation.
- ❑ Pair relocation efforts with fair housing policies, anti-displacement laws, tenant protections, and shared equity housing models.
- ❑ Increase infrastructure investments (such as transportation, waste and stormwater services, and healthcare) in welcoming communities.

LAND USE AND CONSERVATION

- ❑ Utilize climate projections in land use planning to identify both near- and long-term uses for vacated land.
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