

## **Adapting to Climate Change on the Coast: Changing Values, Behavior, and Policies\*\***

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### **Summary**

Coasts are experiencing the effects of climate change at the same time that coastal populations are growing. Even if we reduce carbon emissions, we will have to make some adaptations to the effects of climate change. Climate models, geological studies, and measures of sea levels show that waters are rising faster along coastlines in the northeastern United States than along other coastlines. The northeast can become a global leader in coastal adaptation by reducing harms from storm surge, wind, and flooding, while protecting vulnerable people and affirming local values for coastal living. Industry, government agencies, nongovernmental organizations, and social groups all need to act. Priorities should be to reduce development along hazardous shorelines and to use adaptive building practices throughout coastal watersheds.

### **Current realities**

People are drawn to the water. Although few of us currently fish, sail cargo ships, or unload goods at the docks, 10% of the world's population live in low-lying shore areas. About half of the world's people live within 100 miles of a coastline and depend on its infrastructure and services. Coasts are dynamic by nature, but climate change is forcing unprecedented and dangerous changes, including sea level rise and increased likelihoods for severe storms, at the same time that even more people are moving to the shore.

Many of the human and financial costs of our over-exposure to climate risk are hidden, making it difficult for property owners and officials to appreciate the benefits of reducing hazards. Some costs are hidden because they are borne by people who attract little attention. For example, individuals who are uninsured or underinsured may be financially devastated by storm losses. Other costs are hidden because they are diffused and are borne by ecosystems, insurance and utility ratepayers, and national taxpayers. And most costs are hidden because they will happen in the future and are difficult for most of us to consider when making decisions today.

### **Scientific opportunities and challenges**

Recognizing that intensive settlement along the shore is very recent and is increasing around the world can help us imagine a different future under climate change. This requires us to identify the causes of vulnerability (e.g., poverty, physical disabilities), the costs of inaction, what we love about the coast, and what we are willing to change. For instance, is it essential to have housing right on the sand to enjoy the beach?

The key causes of increased coastal hazards are climate change, skewed incentives for development, and building practices. Reducing carbon emissions (i.e., climate change mitigation) is necessary for reducing the rate of climate change. However, the amount of carbon already in the climate system means that we will have to adapt, no matter how much we reduce emissions. Adaptation should focus on the two other key causes for increased coastal hazards: skewed development incentives and building practices. Adaptation does include a range of other human behaviors (e.g., household disaster preparation, evacuation planning), but nearly all of these changes are needed because of coastal over-development.

The skewed nature of the incentives for developing coastal land can be understood using the demographer's perspective that people migrate in response to conditions that push and pull, such as the availability of housing. The pull of the shore is the problem. If a government is not strict in

regulating coastal settlements or if it actively subsidizes development, it signals that coastal development is safe. Research also finds that disasters can become an opportunity for increased development, especially where property values were already rising. Property rights make it difficult for governments to restrict redevelopment. Yet research finds that municipalities greatly underestimate the costs of servicing sites that are repeatedly damaged.

Building practices make coastal hazards worse. Pavements and compacted grass turn rain and snow into runoff, causing inland flooding. In places where building is poorly regulated, such as poor areas in less-affluent countries, storms may easily damage flimsy buildings. Even in places with strong building codes, standards may not be suited to changing risks (e.g., by requiring houses to be elevated to reduce surge damage). And investment in high-value, nonadapted property continues in places where sea level rise is obvious. This is the case in Miami Beach, where seasonal high tides flood the streets, even in the absence of a storm.

### **Policy issues**

Reducing hazards is not just a task for lawyers and engineers. The following recommendations concern public involvement, institutional arrangements, and social values.

- Understand that the shore is much broader than a narrow strip of sand. Ecological connections from the ocean to bays and estuaries support landscapes that are resilient. Connections can be restored where they have been broken. Removing bulkheads and other barriers allows protective coastal wetlands to migrate inland. A policy in the Netherlands called “room for the river” reduces flooding harms by prohibiting building in floodplains. This watershed-level approach requires action by the U.S. Federal Emergency Management Agency (FEMA), including the National Flood Insurance Program, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, state environmental agencies, municipalities, and landowners.
- Identify what people value about coastal life and how those values will be affected by climate change. This requires considering the most vulnerable people and valued sites, recognizing that climate change is creating new vulnerabilities. Processes for clarifying values have been promoted by several groups (e.g., 100 Resilient Cities, C40, Rebuild by Design, Changing Course), and social science research can assist, but bottom-up initiatives will be essential if communities are to identify and retain what they value.
- Change policies that damage ecosystems or increase social vulnerability. Municipal codes and state laws allow building in floodplains and on barrier islands or permit wetlands to be filled and replaced by inferior artificial wetlands. Gaps in regulations allow over-pumping of groundwater. State and federal environmental regulators, water supply agencies, the Army Corps of Engineers, and municipal planning boards may make some changes, but legislatures must set broader reforms.
- Recognize and reduce hazards and promote resilience. Major projects such as bridges can be designed to improve adaptation to climate change, rather than making hazards worse. Insurers, emergency responders, and utilities review their performance after disasters, a practice that others should emulate. Corporate boards must demand that firms estimate the costs and potential benefits of reducing their exposure to hazards. Federal and state regulators should request similar estimates from transportation agencies, water and electric utilities, and hospitals. FEMA and the U.S. Department of Housing and Urban Development can extend experiments allowing emergency response funds to be used for buyouts or more resilient designs, rather than rebuilding as before. State regulators and electric utilities must remove barriers to communities that wish to build solar power microgrids for backup power. Local governments should reduce hazards in the most vulnerable sites.
- Engage with the public to identify local risks and to build support for longer-term planning. Because of homeowner protests against raising premiums for the National Flood Insurance

Program, Congress will have to continue to bail out the program after catastrophic storms. By recognizing the shared benefits of harm reduction, regulators at all levels of government, nongovernmental groups, and community leaders can find some points of agreement with protest groups like Stop FEMA Now. For the near future, climate models will not be able to provide predictions down to the lot level. States, counties, and municipalities must enlist residents, emergency responders, and citizen science networks (e.g., Jersey Shore Hurricane News) as important sources of local information about changing hazards that models cannot predict. The National Science Foundation and the National Oceanic and Atmospheric Administration are beginning to encourage social science research about communication and citizen involvement in adaptive strategies, but can do much more.

- Select the right approach for the right site and communicate the limitations of each approach. Beach replenishment and artificial dunes can protect beaches for only a short while and do not protect against back-bay flooding. Engineered barriers will become more expensive and are suited only for critical infrastructure or intensively developed communities. Inland green infrastructure, such as low-lying rainwater collection sites, are helpful but filter only some of a large storm's water into the ground. The U.S. Army Corps of Engineers, consulting engineers, and municipal officials should take the lead.
- Plan to move people from dangerous shorelines and floodplains. Programs of managed retreat would be most humane and fiscally wise, despite being potentially politically unpopular. People are already retreating from the shore, household by household, with little public aid or attention. Many of them are poor or are members of ethnic minority groups, as in the Mekong Delta, Bangladesh, and rural areas of Alaska and Louisiana. Governments, engineers, landscape architects, environmental groups, and landowners can experiment with small projects. Much broader support is needed for fuller plans for managed retreat.
- Connect municipal planning to higher levels of government and coordinate actions among agencies. Cities, such as Charleston, New York, San Francisco, and Boston have begun to plan for the future climate. Smaller cities lack this planning capacity and rely on state government help. Agency missions may also conflict, as when road-building proceeds without adequately considering its possible effect on flooding. Resilience officers at the executive level of large cities and state governments could coordinate among agencies, but must be given authority to be effective.
- Link climate adaptation to climate change mitigation. Government or private efforts to plant trees, build microgrids, or restore ecosystems can serve both mitigation and adaptation.
- Sponsor people-to-people exchanges across regions. States and nongovernmental organizations can sponsor exchanges that could share information about physical changes, new practices and institutions for adaptation, and aid from governments and funders. The Lowlander Center in Louisiana, groups from Alaska native villages, and representatives of small Pacific Island nations have begun such exchanges.

## References

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*\*\* A policy position paper prepared for presentation at the conference on "The Shore's Future: Living with Storms and Sea Level Rise," convened by the Institute on Science for Global Policy (ISGP), Nov. 20-21, 2015 in Toms River, New Jersey*