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Using Smart Growth to Adapt to Climate Change

By Megan M. Susman

Communities around the country, from rural places to major cities, are using smart growth and green building strategies to create more economic opportunities, offer more housing and transportation choices, promote equitable development, and improve quality of life. These same strategies, with some tweaks, can make neighborhoods and cities more resilient to current and projected climate change impacts, including flooding, sea-level rise, extreme heat, drought, and wildfire.

The multiple benefits that smart growth and green building approaches bring can help build public support for actions that also help communities adapt to a changing climate. For example, making streets safer for all users and adding green elements that reduce stormwater runoff accomplish climate change-related goals such as reducing greenhouse gas emissions by making less-polluting transportation options more appealing, lowering ambient air temperatures, and reducing localized flooding. For residents, these actions also create a more pleasant, safer place to walk and bike, and for businesses, a more attractive street brings more customers.

Zoning and building codes and related policies provide a particularly useful vehicle for working climate change considerations into regular municipal processes. When the codes are updated, the local government can incorporate the most up-to-date climate observations and projections. Provisions in these regulations that support smart growth and green building can also provide a foundation for climate change adaptation.

The U.S. Environmental Protection Agency (EPA) recently released *Smart Growth Fixes for Climate Adaptation and Resilience*, a guidebook to help local government officials, staff, and boards identify smart growth strategies that can help them prepare for and adapt to climate change. This article introduces some of the land-use and building policy and code changes that are discussed in the publication, which communities across the country are using to meet their needs and circumstances. Policy options include overall strategies that can help communities adapt to multiple climate change impacts. Others are more specific to a single hazard. All can help communities achieve multiple environmental, economic, health, or social goals.

OVERALL STRATEGIES

Determining appropriate locations for development and conservation helps communities prepare for climate-driven changes, and flexible zoning can help communities respond to these changing conditions. Furthermore, renewable energy can both improve resilience and reduce greenhouse gas emissions.

Federal Resources

A number of federal resources can help communities explore regional and local climate change projections:

- The 2014 national climate assessment report, *Climate Change Impacts in the United States*, includes observed changes and projected impacts on regions and sectors (nca2014.globalchange.gov).
- The U.S. Climate Resilience Toolkit links to climate change resources across the federal government (toolkit.climate.gov).
- The National Oceanic and Atmospheric Administration's Climate Explorer tool offers graphs, maps, and data of observed and projected temperature, precipitation, and related climate variables for every county in the contiguous United States (toolkit.climate.gov/tools/climate-explorer).
- EPA's Scenario-Based Projected Changes Map, an easy-to-use mapping tool, provides local projected changes in annual total precipitation, precipitation intensity, annual average temperature, 100-year storm events, and sea-level rise (tinyurl.com/hsc72ba).

Designate Locations for Protection and for Growth

Including regional climate change projections—which local governments can get from a metropolitan planning organization or from federal tools—in planning documents and land-use maps will help communities understand where housing, transportation, businesses, and services could be vulnerable to flooding, sea-level rise, drought, or wildfire. The local government can use that information to identify land that is currently vulnerable or projected to become more vulnerable to these impacts. That land could be designated for protection or less intensive development. Areas that are less vulnerable—and well-connected to existing development—could be designated for growth and economic development.

For example, the Southeast Florida Climate Compact, a collaboration among Broward, Miami-Dade, Monroe, and Palm Beach counties, developed a *Regional Climate Action Plan* that suggested municipal and county comprehensive plans designate Adaptation Action Areas (the areas most vulnerable to sea-level rise and other impacts and prioritized for investment to reduce their risk), Restoration Areas (undeveloped areas that are vulnerable to climate change impacts and that should be prioritized for acquisition to keep them undeveloped), and Growth Areas (areas that are at a higher elevation and already have infrastructure, where growth should be directed) (SFRCCC 2012).

Local governments could also choose to locate new municipal buildings in less vulnerable areas that are close to the people they serve and easy for people to reach on foot, by bike, by public transit, or by car. Locating buildings with emergency functions—such as hospitals, police and fire stations, and emergency shelters—in places that are less likely to be hit by a flood or wildfire and that people can easily get to even without a car, improves access to critical services. Putting municipal buildings in places where they are less likely to be damaged by natural hazards also protects the public investment.

Flexible Zoning

Flexible zoning codes, such as dynamic zoning or floating zones, can help communities adapt more nimbly to changing conditions. Dynamic zoning includes triggers in the code that change the code requirements automati-

cally when conditions hit a certain threshold (Elliot 2009). Dynamic zoning provisions let a community approve a code that fits its current conditions but that will change based on some empirical future condition. One law expert notes that, "gradual and adaptive regulations . . . can minimize harms and takings compensation requirements" while giving property owners some certainty about how they can expect to use their property once certain thresholds are passed (Byrne 2012).

A floating zone is a zoning classification that is not tied to a specific area (Blanchard and Nolan 2013). Developers can request to have the zone applied to their parcels, perhaps in exchange for financial or procedural incentives. Although it is not a floating zone, Keene, New Hampshire, has a Sustainable Design and Energy Efficient Development overlay zone (§§102-1430–1438) that promotes compact development and energy efficiency and could be a model for a floating zone in other communities.

Local Renewable Energy

Reducing greenhouse gas emissions is an important climate adaptation strategy because it ultimately reduces our impact on the climate and thus the amount of change to which we will have to adapt. Local, clean, renewable energy resources have well-known greenhouse gas reduction benefits, but they can also be valuable in building resilience to disruptions to the power grid caused by natural hazards, or energy prices that might become volatile. Encouraging on-site renewable energy generation and storage gives people cleaner, more reliable electricity and can provide backup power if the grid goes down.

The Department of Energy's SunShot Solar Outreach Partnership worked with the American Planning Association to develop guidance on incorporating solar-friendly provisions into planning documents and regulations (Morley 2014). Amending codes or adopting ordinances that allow solar, solar thermal, wind, and other renewables on individual properties gives property owners clear direction on what is allowed, giving them peace of mind that their investment is legal and alleviating protests from neighbors. For example, Aurora, Illinois's Alternative Energy Systems ordinance defines and clearly illustrates solar, wind, and geothermal system generation limits, setbacks, permitted system heights, and noise limits (§4.4-9).

Solar gardens, small community installations that serve local customers who buy or lease shares, productively use lots that might otherwise be difficult to develop because of their shape, environmental contamination, or other factors. By one estimate, about half of households and businesses cannot install rooftop solar systems because they do not own the structure or do not have enough roof space to meet their power needs (Feldman et al. 2015). Shared solar installations give these people and businesses the chance to buy clean power that can keep running if the grid is disrupted. Pairing a solar installation with energy storage improves resilience even more. Local governments can encourage solar gardens by defining them as a specific use in the zoning code (Morley 2014).

Fort Collins, Colorado, worked with Clean Energy Collective to build the Riverside Community Solar Array, a solar garden on the city-owned site of a demolished former pickle plant. The site lies at the edge of a compact residential neighborhood, but a railroad running through it as well as contamination from its industrial past made it impractical to develop. Using it for the solar garden and incorporating public art let the city turn it into a gateway welcoming people to Fort Collins. Before ground was even broken on the array, it was sold out, and its capacity was doubled to meet demand (Hois 2015).

FLOODING AND EXTREME PRECIPITATION

Green infrastructure techniques can reduce localized flooding while also beautifying streets and helping developers meet stormwater retention requirements. In places that require elevation in floodplains, design guidelines can help maintain community character and ensure access to elevated buildings.

Green and Complete Streets

Green and complete streets design standards make streets safe and comfortable for pedestrians, drivers, bicyclists, and transit users. Green and complete streets incorporate green infrastructure such as street trees, permeable pavement, curb inlets, and planter boxes to capture, slow, filter, and absorb stormwater runoff. These green features beautify the street and cool the air. Green and complete streets are designed to make walking and biking easier and more appealing, which reduces pollution from vehicles, helps people incorporate physical activity into their daily routines, and gives more transportation options to people who cannot drive or choose not to. Hundreds of communities across the country have adopted complete streets policies, and clear guidance on how to incorporate green infrastructure elements can help ensure that complete streets also reduce stormwater runoff. Boston's *Complete Streets Design Guidelines*, for example, have explicit guidance on

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Green and complete streets with bike infrastructure, trees, and planted areas are safer and more pleasant for all users.

how to incorporate elements such as street trees, stormwater planters, and rain gardens (Boston 2013).

Retaining Stormwater On-Site

Local governments can require new development to retain all stormwater on-site through a site plan requirement. Developments could meet the requirement through green infrastructure elements and reducing the overall percentage of impervious surface. A stormwater runoff credit-trading program would allow new development projects to purchase credits for off-site mitigation.

In Washington, D.C., property owners who install green infrastructure can sell Stormwater Retention Credits to large development sites, which can use the credits to meet up to half of their regulatory stormwater reduction requirements. The city also buys some credits, as paying private property owners to install green infrastructure is more cost-effective than if the city government built the green infrastructure itself (Washington, D.C. 2016).

Design Guidelines for Elevating Buildings

A well-established strategy for buildings in floodplains is to elevate the structure. In highly developed places, removing all development is not an option, and elevation might be the only way to protect people and property from floods. However, elevation is expensive, and it can create a false sense of security. People with limited mobility might have trouble getting into elevated buildings. Design guidelines or form-based standards that promote accessibility and a lively street can help mitigate some of the problems.

After Superstorm Sandy, New York City updated its zoning code to make new construction and retrofitted buildings more resilient to floods. The city planning department worked with the architecture and design community to develop principles for designing elevated, flood-resilient buildings (NYC Planning 2013). In 2013, the New York City Council adopted a flood resilience amendment to the zoning code that incorporated these design principles (New York 2013).

The principles are:

- Visual connectivity: Maintaining architectural elements such as doors, porches, stoops, and windows along the street
- Facade articulation: Ensuring that elevated buildings have interesting elements along the street instead of a blank wall
- Inviting access: Making sure that people with limited mobility can easily get in and out of the building
- Neighborhood character: Integrating elements of the existing neighborhood design when rebuilding or building new construction (NYC Planning 2013)

SEA-LEVEL RISE AND STORM SURGE

Taking sea-level rise projections into account can help planners determine where development and infrastructure might be at risk now and in the future. Knowing where the shoreline is likely to change can help local governments tailor development standards. Communities with working waterfronts can use zoning and other strategies to protect these economic and cultural assets.

Updating Flood Zone Hazard Maps

Local governments can add projected sea-level rise to flood zone hazard maps, currently based exclusively on historical events, to better plan for future conditions. This action would not affect flood insurance requirements, which would continue to use Federal Emergency Management Agency-created flood zone hazard maps. The extended coastal flood hazard zone would delineate potential inundation areas, critical emergency facilities, evacuation routes, road elevation projects, and culvert replacements. It's recommended to use minimum 50-year planning horizon that assumes a plausible range of sea-level rise projections and takes into account land subsidence and uplift a and local conditions.

The Rockingham Planning Commission is working with several communities on the New Hampshire coast to help them assess and prepare for the impacts of sea-level rise. For the town of Seabrook, the commission's vulnerability assessment included a recommendation to create a flood hazard overlay district that includes the areas projected to be at higher risk in the future in addition to the areas mapped by FEMA's Flood Insurance Rate Maps. This district would include performance-based standards to protect against flooding. The assessment also recommends using this overlay map to educate property owners about risks from sea-level rise and storm surge (Rockingham Planning Commission 2015).

Context-Sensitive Designations

Context-sensitive shoreline classifications can set appropriate development standards for different settings. King County, Washington, updated its Shoreline Master Program land-use policies to include eight new classifications that fit the varied shoreline. Regulations for the classifications range from very low-impact development for sensitive lands to flood prevention measures in areas where higher levels of development are appropriate. These classifications are incorporated into the county's comprehensive plan (King County 2016). These context-sensitive levels of development protect the most sensitive areas while still allowing development where it makes sense.

Working Waterfronts

Working waterfronts are often vital parts of a coastal community's identity and economy, and sea-level rise can threaten their viability. Recognizing and supporting these working waterfronts protects a sense of place and community history, and clusters similar industries together, which can spur innovation and collaboration. However, communities should be careful of concentrating noisy, polluting industries in low-income neighborhoods. Also, consider resilience provisions that protect active working waterfronts from pollution releases in a storm surge or temporary inundation. Measures might include elevated material storage or redundant flood protection measures to avoid exposing nearby populations or ecosystems to pollution releases.

Portland, Maine, has a historic working waterfront but found it challenged by aging infrastructure and the threat of sea-level rise. The city needed to find funding to keep infrastructure in good repair and prepare it for the rising sea. An overlay zone, adopted in 2010, allows compatible non-marine uses to locate on the working waterfront. The city also encourages incremental improvements where possible to prepare for sea-level rise (National Working Waterfront Network 2015).

EXTREME HEAT

Communities can help protect their residents from extreme heat by identifying and improving the hottest parts of neighborhoods, helping particularly vulnerable people stay cool in a heat wave, and encouraging new development to use materials that cool hard surfaces.

Mapping and Remedying Hot Spots

Extreme heat is exacerbated in built-up areas by the heat island effect. Buildings, roofs, and pavements absorb the sun's heat and create

hotter ambient air temperatures than surrounding areas. "Hot spots" are areas where temperatures are particularly high because of large expanses of dark, paved surfaces or a lack of vegetation. Once a local government has identified hot spots, it can prioritize pilot projects in these places to reduce ambient temperatures by adding trees and other vegetation and reflective, light-colored, or permeable pavement, which can also help reduce stormwater runoff. The projects can help the community figure out which materials and techniques work best for sites such as parking lots, alleys, and streets part of its climate adaptation actions, Chicago mapped its hot spots, including overlaying a map of heat-related 311 and 911 calls to "assess the correlation between urban heat islands and heat stress-related issues." The city directs cooling and energy efficiency efforts such as cool and green roofs to those places (Chicago 2008).

Helping Vulnerable People and Neighborhoods

Extreme heat puts people at greater risk for heat exhaustion, heat stroke, and heat-related death, and it can exacerbate chronic illnesses such as respiratory and cardiovascular diseases. Pregnant women; children; and low-income, elderly, homeless, or chronically ill people are the most susceptible to these health risks (Sarofim et al. 2016). Many of the most susceptible are also the least able to adapt on their own, because they lack the money to better weatherize or even cool their homes, they have mobility issues that make it difficult to go somewhere safe during a heat emergency, or they aren't aware of how deadly an extended heat wave can be. Working with trusted messengers in communities with particularly vulnerable populations can help local government better understand what people need and work with them to develop strategies for heat waves and other emergencies.

Mapping hot spots in vulnerable neighborhoods can help a community prioritize locations for cooling centers where people can go to escape the heat. Cooling centers can be civic buildings such as libraries, community centers, or public pools; some private businesses might agree to let people spend the hottest hours of the day in their buildings. Cooling centers should be easy for even people with limited mobility to reach—for example, in or close to apartment complexes with many elderly residents or next to public transit stops. The local government should clearly mark cooling centers and do ongoing outreach to make sure vulnerable residents know where they are and how to reach them.

Cooling centers might also be emergency shelters in severe storms or other natural disasters, or their convenient location might make them a good rendezvous point in case of a city- or neighborhood-wide evacuation. Having a single location in the neighborhood would be easier for residents to remember, so local governments might want to consider strengthening cooling centers to withstand high winds, seismic damage, and flooding, as well as locating them outside of areas that are at high risk of flooding or wildfires. Cooling centers should have backup power or use passive survivability measures that will keep the building safe if the power goes out.

Cooler Hardscapes

Hard surfaces don't have to generate a heat island. The community could amend its site plan requirements and design guidelines to better adapt hardscape areas to extreme heat. Requirements could include a certain amount of light-colored or permeable paving in hardscape areas or planting trees to shade sidewalks, streets, and parking lots and increase overall tree canopy. These elements would also capture and filter stormwater and beautify the public realm.

Glenview, Illinois, has design guidelines for trees and other vegetation in parking lots to clearly show what is acceptable. It includes guidance on tree placement, species, and maintenance (Glenview n.d.).

DROUGHT

Development that is planned with an understanding of current and future water supplies, along with water efficiency and reuse strategies, can help communities continue to provide adequate water for new growth.

Aligning Land-Use Planning and Water Management

Compact development uses less water per household and reduces the burden on existing water supply infrastructure, making water delivery more efficient. Shorter pipes mean less opportunity for leaks, and water pumped shorter distances does not have to be pumped as forcefully, which also reduces leakage. In addition, smaller lots use less water outdoors because they have less lawn to irrigate (U.S. EPA 2006). Integrating water resource management with land-use planning helps ensure adequate water for the growth the community has planned and that the growth happens in places that make the best use of the community's water infrastructure.

The Albuquerque Bernalillo County Water Utility Authority works with the city of Albuquerque, New Mexico, and surrounding Bernalillo County to help align water resources with growth plans. The water authority's Water Resources Management Strategy includes a policy to link land-use planning with water management. Specific actions under that policy include working with the city and county to update the comprehensive plan and other plans to ensure that development aligns with infrastructure, basing its capital planning on the city and county's growth plans, and supporting infill and compact development (ABCWUA 2016).

Building Energy and Water Benchmarking

Benchmarking programs provide solid data on energy and water use that help municipalities set a baseline and determine progress toward reducing energy and water use. Communities can pass an ordinance or encourage building owners to use a benchmarking program by emphasizing the cost savings of using energy and water more efficiently and by offering incentives.

Denver's voluntary Watts to Water program encourages commercial buildings to use Portfolio Manager, an Energy Star online reporting system, to measure their energy and water use. The building owners get free technical support and educational programs, public recognition, and access to rebates and other programs to help improve building operations (Watts to Water 2016). After roughly four years, the program had signed up more than 140 participants representing 30 million square feet of commercial real estate and was saving more than one million gallons of water annually (Young and Mackres 2013).

Rainwater Harvesting

To avoid using potable water for irrigation, some communities mandate rainwater harvesting for all new commercial construction. Keep in mind, however, that, some jurisdictions prohibit harvesting to keep local watersheds healthy or due to water rights conflicts.

Tucson, Arizona's Commercial Rainwater Harvesting Ordinance, a model other jurisdic-

tions have used, requires a new commercial development built starting in 2010 to meet at least half its landscape watering needs with captured rainwater. Developers must submit site plans that include a rainwater harvesting plan and a landscape water budget (Tucson 2008). The ordinance is part of a suite of initiatives aimed at conserving water, including educational programs, demonstration projects, and rebates for water-efficient appliances and practices, that have helped reduce Tucson's water consumption to its 1989 level even as its population grew by about 60 percent (Tucson Water 2015).

WILDFIRE

In wildfire-prone areas, compact, well-connected development can be safer for residents and firefighters. Clustering development also makes it easier to maintain open space as a control line to protect developed areas from fire.

Compact Development

As the devastating November 2016 fire in eastern Tennessee showed, drought greatly raises the wildfire risk by making vegetation drier and giving the fire more fuel. Communities generally develop fire hazard maps based on factors such as fuel loads and where fires have happened in the past. One study, however, found that homes that were in a more compact development pattern and located in already developed areas were less likely to be destroyed by a wildfire, and suggested that "empirically based maps developed using housing density and location better identify hazardous locations than fuel-based maps" (Syphard et al. 2012).

Promoting or requiring compact development in comprehensive plans, area plans, zoning codes, and subdivision regulations can keep more homes away from the wildland-urban interface, where they are more at risk. It also helps meet other community goals, including making it easier for people to get around without a car if they choose, mixing uses to strengthen the town center, and preserving land for agriculture, recreation, or ecological functions. (One cautionary note is that buildings that are closer together make it easier for a fire to spread, so fire-resistant materials and techniques are important in compact neighborhoods.)

Douglas County, Colorado, for example, promotes compact development in designated urban areas and encourages lower-intensity land uses in areas more susceptible to wildfires. Its comprehensive plan recommends siting facilities that serve many people, such as places of worship, schools, employment centers, and residential development, away from areas at high risk of wildfire (Douglas County 2014).

Clustered, Well-Connected Development

Local governments often use zoning codes or subdivision regulations to require new development to be clustered, have good connections to existing development, have multiple entry/exit points, and be well-connected internally. Clustering allows homes to share defensible space such as a greenbelt around the development that can act as a control line to stop fire from spreading (Florida Department of Agriculture and Consumer Services 2010).

Internal and external connections make it easier for residents and visitors to walk and bike around the neighborhood and to get to destinations outside the immediate area. If a wildfire hits, these connections make it easier for residents to evacuate and give firefighters multiple routes into, out of, and around the development, which helps keep them safer by giving them more escape routes.

Open Space as a Control Line

Local governments can also acquire open space between wildlands and developed areas to preserve as a control line. The state of Florida suggests a Community Protection Zone at least 100 to 300 feet wide that could be used for amenities such as hiking trails or community gardens (Florida Department of Agriculture and Consumer Services 2010). Making the green space an amenity for residents helps ensure that it will be properly maintained. If the space includes green infrastructure techniques, it could also help manage stormwater runoff and protect water quality.

CONCLUSION

Keeping people safe and securing the community's future prosperity are goals everyone can agree on. The climate is changing and will continue to change. The development planned and built today will be on the ground for decades. Incorporating climate change projections into planning activities now can help make sure that the buildings approved today will be safe and pleasant for residents in a changed future climate. Using smart growth and green building strategies that use limited resources wisely, support economic opportunities, and protect our health, water, air, and land can help make the case even stronger by improving neighborhoods now and strengthening them for the future.

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IS YOUR ZONING READY FOR A CHANGING CLIMATE?

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