Building the Resilient City

A ULI Conference Report

Urban Land Institute

MacArthur Foundation

THE KRESGE FOUNDATION

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About the Urban Land Institute

The mission of the Urban Land Institute is to provide leadership in the responsible use of land and in creating and sustaining thriving communities worldwide. ULI is committed to

- Bringing together leaders from across the fields of real estate and land use policy to exchange best practices and serve community needs;
- Fostering collaboration within and beyond ULI's membership through mentoring, dialogue, and problem solving;
- Exploring issues of urbanization, conservation, regeneration, land use, capital formation, and sustainable development;
- Advancing land use policies and design practices that respect the uniqueness of both the built and natural environments;
- Sharing knowledge through education, applied research, publishing, and electronic media; and
- Sustaining a diverse global network of local practice and advisory efforts that address current and future challenges.

Established in 1936, the Institute today has more than 34,000 members worldwide, representing the entire spectrum of the land use and development disciplines. Professionals represented include developers, builders, property owners, investors, architects, public officials, planners, real estate brokers, appraisers, attorneys, engineers, financiers, academics, students, and librarians.

ULI relies heavily on the experience of its members. It is through member involvement and information resources that ULI has been able to set standards of excellence in development practice. The Institute has long been recognized as one of the world's most respected and widely quoted sources of objective information on urban planning, growth, and development.

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About ULI's Urban Resilience Program

The Urban Resilience Program works to help communities prepare for increased climate risk in ways that allow not only a quicker, safe return to normalcy after an event but also an ability to thrive going forward. Through careful land use planning, wise investment in infrastructure, and smart building design, communities can protect investment, create value, and be more robust when facing adverse events. The Urban Resilience Program is funded in part through a generous grant from The Kresge Foundation.

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Letter from the Chief Content Officer

Dear Reader:

In September 2014, the Urban Land Institute convened a group of leading professionals from across sectors and disciplines to explore how the real estate industry—and those affiliated with it—can build cities that are resilient in the face of climate change.

Over two days in San Francisco, ULI and its Urban Resilience Program showcased the Institute's ongoing engagement and commitment to resilience. ULI recognizes that bold leadership is needed to foster more resilient and more energy-efficient cities around the world. Gatherings such as the Building the Resilient City conference are an important part of ULI's mission to transform markets, catalyze innovations, and share cutting-edge knowledge related to urban resilience.

The Building the Resilient City conference was a foundational experience for ULI and its members. But make no mistake: the conference was only an important first step in ULI's long-term efforts to foster resilient cities. Like ULI's work following Superstorm Sandy, the dialogue that took place in San Francisco is giving shape to the Urban Resilience Program and is helping frame a broader suite of activities under ULI's Center for Sustainability.

This report not only presents the conference's key takeaways, but also delves deeper into the ideas and projects discussed there to provide a lasting resource and help extend the dialogue on resilience.

ULI's diverse members are on the vanguard of the real estate industry and are instrumental in helping change how cities are built for the future—built for whatever climate change brings their way. You are a vital part of ULI's work on resilience, and we hope you will continue to contribute to all the critical work ahead.

Sincerely,

Kathleen B. Carey
Executive Vice President and Chief Content Officer
Urban Land Institute

Introduction: Resilience Fundamentals

The Urban Land Institute convened its first major meeting focused on resilience on September 4–5, 2014. The San Francisco conference brought together several hundred leading real estate, development, finance, planning, and policy professionals to explore strategies for building resilient cities.

In her opening address, Rebecca Smyth, West Coast director of the Coastal Services Center, a branch of the National Oceanic and Atmospheric Administration (NOAA), explained how sea-level rise exacerbates the severity of high tides—a normal occurrence that can now have catastrophic consequences. NOAA estimates that sea levels have risen 0.12 inch per year since 1992 because of warming oceans and melting glaciers and polar ice caps. "When we talk about climate change, we can't talk about it as a future state anymore," she said. "We have to talk about it as a new normal to plan for and invest in today."

Smyth said that NOAA takes a systems-based approach to coastal resilience, which includes addressing risks to wastewater and urban stormwater infrastructure, transportation networks, and energy grids. In addition, uneven social and economic vulnerabilities across communities and fragile ecosystems further complicate the ability of coastal regions to recover after severe weather events. The biggest challenge to climate mitigation based on a systems approach is the

When we talk about climate change, we can't talk about it as a future state anymore. We have to talk about it as a new normal to plan for and invest in today.

—REBECCA SMYTH, WEST COAST DIRECTOR OF THE COASTAL SERVICES CENTER

REBUILD BY DESIGN

The "Big U" plan developed by Bjarke Ingels Group for HUD's Rebuild by Design competition uses green infrastructure. The plan would create a wide berm with trees and plants along the edge of Manhattan at the Battery. The design creates areas for walking and other forms of recreation in a green space that would hinder and manage water intrusion during storms.

current silo-type structure of government funding, where each component that needs to be fortified (rail systems, wetlands, and power and sewer lines) is funded from a different government source.

The most successful approach that cities and regions can take to adapt to climate change will combine "gray" (constructed) and "green" (natural) infrastructure, Smyth also noted. The U.S. Army Corps of Engineers, for example, promotes what it calls SAGE (Systems Approach to Geomorphic Engineering) that embraces both built and natural solutions to coastal resilience. Smyth called on the audience to "change how we view green infrastructure and nature-based solutions as part of our defense against hazards," especially sea-level rise, and to employ dual-benefit solutions.

Defining Resilience

ULI has joined with a number of industry partners to define resilience as "the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events." Representing more than 750,000 professionals drawn from such organizations as the American Institute of Architects, the American Planning Association, and the U.S. Green Building Council, the statement also affirms that the "promotion of resilience will improve the economic competitiveness of the United States."

Although ULI endorses this definition of resilience, it recognizes the ongoing debate about what resilience is and supports continued dialogue to explore the full contours of resilience—both what it means and what actions need to be taken. The Building the Resilient City conference facilitated that discussion and others. Speakers shared their perspectives on resilience, panelists delved deep into nuances, and audience members asked probing questions. (Some of the differing viewpoints that emerged are featured on the next page.)

Inherent in those views is a degree of uncertainty. Indeed, as many of the conference speakers suggested, uncertainty is the new normal. In addition to climate change and severe weather volatility that is resulting in greater numbers of fires and floods, conference participants spoke about escalating volatility in other areas—including real estate markets, housing prices, and world political structures—added to macrotrends, such as population growth, migration to the coasts, income inequality, health disparities, and globalization, all of which work to create a more uncertain world.

The incidence of calamitous weather-induced events can buffet any city, any country. And it is an "absolutely observable phenomenon," said Harriet Tregoning, director of the U.S. Department of Housing and Urban Development (HUD) Office of Economic Resilience. She noted that this country's incidence of national disaster declarations is increasing. From 2011 through 2013, the United States experienced more than 200 presidentially declared disasters. The cost of climate change in the United States is estimated to be $1.7 billion per year and in 2050 is projected to reach $4.4 billion, according to Alex Kaplan, vice president for global partnerships at Swiss Re.

Thoughts on Resilience

Prepare for the unexpected: Hamid Moghadam, CEO of San Francisco–based industrial real estate company Prologis Inc., said resilience addresses "all the bad things that can occur beyond your control," including natural disasters such as floods and earthquakes, as well as urban decay, which can also affect the value of a real estate investment. "Although few investors and operators currently use the term 'resiliency,' many have built capacity to contend with natural disasters when they strike," noted Moghadam.

Maximize value for investors: "Just like 'sustainability' was a new word in our real estate investment vocabulary a decade ago, 'resilience' is just beginning to enter our vocabulary," said Lynn Thurber, chair of both LaSalle Investment Management and ULI. She views resilience as "part of everything we do to maximize value to our investors and the assets that we own and manage on their behalf." But we "have to figure out how to connect that principle [of fiduciary responsibility] to the bigger picture of resilience at the community level" and how to use those resilience measures to reduce costs or to enhance the performance of the portfolio over time, Thurber observed further.

Capacity to persist in the face of change: According to developer Jonathan Rose, president of the Jonathan Rose Companies, "The key to resilience is the inherent capacity of systems to reorganize and adapt to complex changes by creating new structures and behaviors. In systems thinking, this adaptation process is called self-organization; in biological systems, this power is called evolution."

Part of a bundle of amenities: According to Harriet Tregoning, director of HUD's Office of Economic Resilience, the often-used phrase "location, location, location" is actually about the amenity attributes of a particular place. Investors consider amenity-related attributes—access to transportation, a well-educated workforce, and housing choices, as well as the resilience of a place—in their decision on whether to acquire a particular property. In that sense, "resilience, which is part of the bundle of real estate attributes of a particular place, is an important economic asset that contributes to the enduring value of a place and gives people the confidence to invest in a particular community," said Tregoning.

Shared opportunity: A few months after the conference, ULI announced that Dr. Judith Rodin, president of the Rockefeller Foundation, had been chosen as the 2014 recipient of ULI's J.C. Nichols Prize for Visionaries in Urban Development. Under Rodin's leadership at the University of Pennsylvania, where she was president from 1994 to 2004, the university became more integrated into its Philadelphia community through a strategy designed as an interlocking series of programs to address the area's security, education, housing, and economic development needs, with the university taking the lead role as developer and facilitator. "My vision is a more resilient society, one where greater opportunity is shared by more people," Rodin said. "Throughout my life and career, it has always mattered to me that people feel empowered to participate in decision making—in outcomes that affect their lives. My work enables that vision to be actualized."

Just like "sustainability" was a new word in our real estate investment vocabulary a decade ago, "resilience" is just beginning to enter our vocabulary.

—LYNN THURBER, CHAIR, URBAN LAND INSTITUTE, AND CHAIR, LASALLE INVESTMENT MANAGEMENT

Risks

In addition to loss of life, injury, and illness, the economic loss and dire effects on business from disasters such as Superstorm Sandy and Hurricane Katrina are well documented.

The Risky Business Project—a partnership of Bloomberg Philanthropies, the Paulson Institute, and the TomKat Charitable Trust—focuses on publicizing the economic risks of climate change. The *American Climate Prospectus* prepared for the Risky Business Project warns that if the United States continues on its current path, "by 2050 between $66 billion and $106 billion worth of existing coastal property will likely be below sea level nationwide, with $238 billion to $507 billion worth of property below sea level by 2100." The report, which was released in June 2014, found that property losses from sea-level rise in the United States will be highest on the southeastern and Atlantic coasts, where sea-level rise is higher.

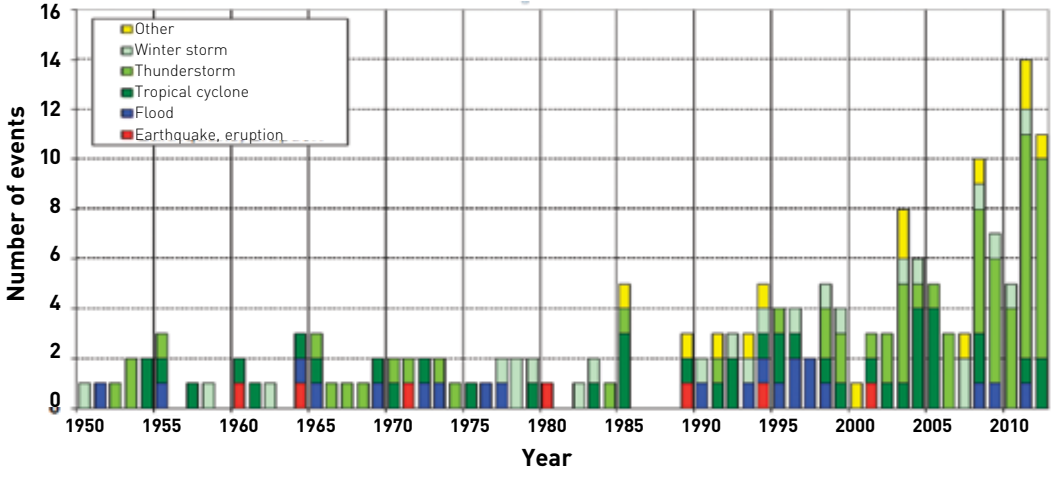
Regarding extreme heat, the report projected that labor productivity of outdoor workers—in construction, utility maintenance, landscaping, and agriculture—could be reduced by as much as 3 percent by the end of the century, especially in the Southeast. The drought in California has led to the loss of 100,000 jobs, according to Jim Wunderman, president and CEO of the Bay Area Council in San Francisco. If the drought lasts a decade, it could cost the state $500 million, he added.

Likewise, the effects of hurricanes, tornadoes, floods, and the like on transportation infrastructure can also wreak havoc on the economy. Extended airport closures can be disastrous for cities. Many airports are located on the outskirts of cities on what was originally cheap, oftentimes undesirable, land that may be prone to flooding. But those inexpensive and easy locations pose significant risk to airports around the world. For example, the United States' National Climate

The number of natural catastrophes causing $1 billion in economic losses, 50 fatalities, or both is increasing, with most concentrated in coastal regions.

Significant Natural Catastrophes

Events with $1 billion in economic losses and/or 50 fatalities



Source: Munich Re, 2013.

Disasters Ranked According to Recorded Economic Losses (United States, 1970–2012)

Disaster type	Year	Economic loss ($ billions)
Storm (Katrina)	2005	146.9
Storm (Sandy)	2012	50.0
Storm (Andrew)	1992	43.4
Storm (Ike)	2008	32.0
Storm (Ivan)	2004	21.9
Drought	2012	20.0
Storm (Charley)	2004	19.5
Flood	1993	19.1
Storm (Rita)	2005	18.8
Storm (Wilma)	2005	16.8

Source: *Atlas of Mortality and Economic Losses from Weather, Climate, and Water Extremes*, World Meteorological Association. www.wmo.int/pages/prog/drr/transfer/2014.06.12-WMO1123_Atlas_120614.pdf.

Assessment for 2014 reports, "Thirteen of the nation's 47 largest airports have at least one runway with an elevation within the reach of a moderate to high storm surge," and it predicts that sea-level rise will pose a threat to low-lying airports in the Bay Area in California, New York metropolitan region, central Florida, New Orleans, and Hawaii.

Participants at the Building the Resilient City conference discussed the importance of recovering quickly and bouncing forward from disasters to minimize disruption to business and productivity and potential job loss. It was noted that low-paid, hourly workers are especially vulnerable. If a disaster prevents those employees from getting to work, their employer may readily replace them. Likewise, if a national company decides that a recovery takes too long in a particular city where it operates, it may simply move to a new location or to a city where it already has a base. On a larger scale, cities that are slow to recover from disasters may find it increasingly difficult to attract investment.

Measuring Success

Global real estate companies, such as Grosvenor Capital Management, one of the world's largest asset management firms, are paying close attention to a city's vulnerability regarding extreme weather events caused by climate change, as well as other related factors, including a city's governance structure and access to disaster preparedness. For cities to develop effective resilience strategies, they must understand what success looks like across a broad spectrum of indicators.

The conference panel "Measuring Success" shared insights from three distinct analyses: two sets of rankings that quantitatively capture risk and preparedness of major cities throughout the world, and a third approach that gives cities a baseline tool and descriptive language to their individual resilience.

Grosvenor's 2014 ranking of 50 cities was part of the firm's three-year effort to "expand the way we think of risk and return to include . . . resiliency during the capital allocation process," said Eileen Marrinan, director of research for Grosvenor Americas. Real estate investors such as Grosvenor, as well as pension funds, insurance companies, and other long-term investors, increasingly recognize the impacts of earthquakes and rising sea levels, as well as mega-trends such as globalization and climate change, and the importance of resilience on their portfolios. They also realize that traditional methods of assessing real estate investment risk, such as standard deviation of returns, projected vacancy rate, and forecast rental rates, all "fall short in a world in which the basic patterns of the past two centuries are undergoing drastic transformation." (Source: Richard Barkham, "Investing in Resilience: Ranking the Most Resilient Cities," *Urban Land*, April 9, 2014, http://urbanland.uli.org/sustainability/investing-resilient-cities/)

In its report *Resilient Cities*, Grosvenor examined 150 data sets to develop its 50-city ranking. The report focuses on the 50 major cities where the United Kingdom–based firm holds major investments and captures not only vulnerability to climate risks but also adaptive capacity to rebuild stronger. A city's resilience is a negative function of its vulnerability and a positive function of its adaptive capacity. Cities' adaptive capacities were ranked according to strength of local governance, disaster preparedness and planning, and three additional factors.

Not surprisingly, cities in the developed world rose to the top of the ranking when their vulnerability and adaptive capacity scores were combined. Grosvenor does not confine its investments to only those cities that rose to the top, although strong scores in some U.S. and Canadian cities have, in part, driven additional Grosvenor investments in those places. (Source: *Resilient Cities: A Grosvenor Research Report*, April 2014, http://www.grosvenor.com/getattachment/194bb2f9-d778-4701-a0ed-5cb451044ab1/ResilientCitiesResearchReport.pdf)

Panelists Alex Kaplan, vice president of global partnerships, Swiss Re America Holding Corporation, and Eileen Marrinan, director of research, Grosvenor, during the "Measuring Success" plenary session.

Moreover, Grosvenor uses the report to determine development types that might enhance resilience in cities where it currently works. For example, the firm has invested in affordable housing in London, where it is based, which is in critically short supply and was deemed a significant vulnerability on the city's resilience rating.

Alex Kaplan of Swiss Re said before success can be measured, "we first need to understand risks and potential for loss." He noted that losses from natural catastrophes in the United States have doubled since 1970, due in part to urban migration to the coasts, whose geographies are most susceptible to climate change. According to Kaplan, the cost of climate change in the United States is $1.7 billion per year and is projected to reach $4.4 billion in 2050.

Swiss Re's *Mind the Risk* study (http://media.swissre.com/documents/Swiss_Re_Mind_the_risk.pdf) ranked 616 cities that are the major drivers of their countries' gross domestic products. Using the firm's proprietary mapping models, the report ranked cities according to three criteria: (a) their vulnerability to five types of extreme weather-related disasters, (b) total number of workdays lost on the basis of the city's population, and (c) the effect of those lost workdays on the national economy.

In its work on the 100 Resilient Cities initiative for the Rockefeller Foundation, professional services firm Arup defined resilience more broadly to cover such issues as epidemics, literacy, and lawlessness, in addition to climate change and the impact of natural disasters, all of which influence a city's ability to bounce back after a disaster. The intention, noted Aidan Hughes, a principal with Arup who worked on the study, was not to rank cities, but rather to give cities a framework for inventorying both their weaknesses and resilience capabilities.

As the conference demonstrated, there is no standard approach to resilience, though its interdisciplinary nature is clear. The real estate and policy worlds are discovering together what resilience means and are developing the appropriate tools, policies, and strategies to protect cities around the globe. The conference facilitated that discovery by bringing together leaders from the public and private sectors to share ideas, ask tough questions, and build professional relationships and partnerships. Discussions of emerging technologies, new insurance practices, and design innovations proved that resilience strategies must constantly evolve as new information is gained. Most of what is needed to meet the challenges of a rapidly changing climate requires the evolution of land uses, building typologies, regional infrastructure, energy efficiency, and bold, courageous leadership over decades.

This report synthesizes the key takeaways of the conference and provides additional information about the ideas, places, and projects discussed in San Francisco. The conference report comprises three key themes: "Value Creation and Risk Mitigation," "Lessons in Planning and Leadership," and "Building a Resilient Energy Infrastructure." To ground concepts in reality, place-based examples are woven throughout the report. In addition, appendixes to the report include profiles of four experts who spoke at the conference and summaries of the 15 conference sessions.

KEY THEME
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Value Creation and Risk Mitigation

In the plenary session titled "Resilience and the Real Estate Industry," moderated by ULI chief content officer Kathleen Carey, panelists made the case that resilience maximizes value. Lynn Thurber suggested that resilience is part of her fiduciary obligation to her investors, while Jonathan Rose said that "as good asset managers, those of us who create more adaptability and resiliency in our buildings [will see] those buildings be more successful."

People will remember how your organization reacted in a time of difficulty and whether you had the capability of getting your customers back on line.

—HAMID MOGHADAM, CEO OF PROLOGIS

Participants at the conference emphasized the importance of integrating resilience programs within a company that extends well beyond the due diligence process of making an initial investment decision or when a disaster strikes. Hamid Moghadam observed that "although few investors and operators currently use the term 'resiliency,' many have built capacity to contend with natural disasters when they strike." He predicted that in the future, resilience will be integrated into the property investment/management process and will be treated as a building system—much like plumbing.

Complex Interconnected Networks

Several presenters at the conference looked to natural systems—with their integrated and complex internal connections—to understand the interconnected nature of cities and the need to create holistic, integrated, systems-based resilience programs. The more you interconnect the different related systems, the healthier and more resilient your larger overall system will be, noted environmentalist and entrepreneur Paul Hawken.

On the other hand, that web of interconnections contributes to the ripple effect of natural disasters. When a disaster hits a vulnerable neighborhood, the aftereffects oftentimes disrupt many other sections

Jonathan Rose and Lynn Thurber at the "Resilience and the Real Estate Industry" plenary session.

of the city. Rose said it is essential to recognize that cities function as interdependent networks.

He gave the example of installing generators for elevators in existing residential developments that his firm owns. He soon discovered that if he could not access an adequate supply of diesel fuel to run the generators—which was the situation following Superstorm Sandy—the generators were useless. As part of developing their resilience programs, property owners and investors need to assess the local and regional lifeline systems in place and their capacity to handle adverse events.

Likewise, in a discussion of how capital providers weigh risk and evaluate potential investments, participants emphasized the importance of taking a holistic approach and of examining the larger context before investing in a particular property. It is important to ask: what is the character of the city or county government where the property is located? For example, has the city developed a long-range resilience plan? If not, the private sector might very well choose to invest in a community that is better prepared, noted Nicholas Stolatis, senior director of global sustainability and enterprise initiatives at TIAA-CREF.

One type of risk that is extremely important to investors is that of business continuity, which is closely tied to the degree to which a municipality's systems are integrated and its ability to recover from a catastrophic event. The financial services industry, where one lost day of work can be devastating, has long been concerned about that issue. If a city cannot supply water following an event, you cannot open your building, noted Gary Holtzer, senior managing director and global sustainability officer at Hines.

Likewise, the recovery of a property is of small consequence if staff cannot take buses or the train or drive on roads to reach their jobs. That reality came to the forefront during Superstorm Sandy, noted Michael Spies, senior managing director of Tishman Speyer, when it became clear that Tishman Speyer needed to look well beyond its buildings. We realized that "we couldn't do it alone," he said, and needed to work with government on the recovery effort.

Pricing Risk

The extensive damage that ensued from Hurricane Andrew in 1992 jolted the insurance industry into recognizing that there was insufficient capital to cover a major shock. In the conference session "Evolving Economics of Pricing Risk to Buildings," it was noted that this recognition prompted most large insurers to stop insuring coastal properties starting in 1992. Like real estate investors, insurance companies (many of which are also investors) have developed extensive modeling systems that include resilience components, to guide them in assessing risk and pricing insurance. But contrary to Shakespeare, when it comes to pricing risk of weather-related disasters, the past is not prologue.

The increasing incidence of such disasters and their escalating damage and costs have no historical precedent to turn to for guidance. Although panelists agreed generally that the knowledge of insurance companies about vulnerabilities and catastrophic risks is much deeper than before and is steadily increasing, the data, in many instances, are still inadequate.

Data are especially thin for locations where penetration of the insurance industry has not been extensive over a long period, for example, in some places in Africa and India and other developing parts of the world. Also, data are oftentimes more easily attainable for larger areas—a city or region—but less so for individual properties at the site-specific level. The models need to include additional information; a good example is the U.S. Geological Survey's 2014 earthquake hazard maps. Panelists predicted that open-source modeling of catastrophic events would make detailed information on site-specific locations more readily attainable.

Concern was voiced about the trend of some developers and property owners to build only to the level of life-safety codes and, in the case of damage from a disaster, to rebuild, rather than invest in costlier building resiliency measures. Is that model more cost-effective than paying more initially for a higher standard of construction? Would a risk-differentiated pricing approach be appropriate and useful in those situations? It was noted that risk-differentiated pricing has never caught on in the United States, due in large part to the system whereby states regulate the insurance industry.

In addition, large public insurance companies contend that they are not sufficiently nimble to readjust their pricing quickly in response to mercurial weather-related catastrophes. Furthermore, the insurance

companies say that the idea of risk-differentiated pricing is generally unpopular. Therefore, it is up to the insured to force the issue of risk-differentiated pricing, noted Andy Thompson, who heads Arup's global catastrophe risk and insurance services.

Capacity to Recover

The amount of time it takes to recover from a natural disaster and bounce forward to create new opportunities is oftentimes related to the strength of the interdependent networks and interconnected relationships one has established. For example, strong customer service and close communications between property management staff can be critical in a disaster. How can property managers join with their tenants and vendors to better prepare and accelerate recovery? Moghadam noted that Superstorm Sandy flooded 23 warehouses owned by Prologis in the New York–New Jersey region. But because the company had a disaster plan in place that included advance communications about disaster planning with their facilities management people and tenants, Prologis was back operating within 48 hours, and, in fact, assisted competitors in the area to resume operations.

Conference participants also noted that with the advent of ever more sophisticated, technically complicated building systems, the knowledge and skill sets of building staff can also influence recovery time at a property. In that sense, "Sandy was a reputation builder for the company," according to Moghadam. He warned, "If you can't reach your tenants within a reasonable time and meet their needs, your reputation is trashed. People will remember how your organization reacted in a time of difficulty and whether you had the capability of getting your customers back on line."

Caution against Specialization

Several presenters at the conference voiced concern about creating a resilience specialty and so-called Department of Resilience within companies. Just as more cities are appointing resilience officers, so are more companies creating departments of resilience. Those actions, however, run the risk of promoting a silo mentality and a failure to integrate climate risk policies and practices throughout the fabric of an organization. In Moghadam's earlier example, a key to his firm's quick recovery from Superstorm Sandy was that Prologis had educated its workers and included many different segments of the firm in its resilience planning program, including local property management staff and tenants, instead of relegating resilience planning responsibility to one individual or a small team within the firm.

According to urban planner Peter Calthorpe, one of the greatest obstacles to achieving a more holistic, comprehensive approach to resilience planning is "specialization: individuals solving one problem at a time when what you really need is generalists solving six problems simultaneously."

Peter Calthorpe, 2006 winner of the ULI J.C. Nichols Prize for Visionaries in Urban Development.

Creating Good Places

Besides reducing risks and damage from potential weather-related events, making resilient places opens the opportunity to simultaneously create multiple benefits beyond resilience and, thus, contribute to making a better place. As Harriet Tregoning noted, no one wants to use public money, including federal disaster relief funds, to derive only a single benefit. The emerging view, as voiced by Tregoning and others, is that resilience is an amenity and part of the bundle of attributes that makes a place competitive, that makes a "place of enduring value both for the people who live there and for the people you want to come and invest there," said Tregoning.

Harriet Tregoning speaking to attendees following her keynote address on HUD's Office of Economic Resilience.

One way to generate multiple benefits is to leverage green infrastructure and environmentally sensitive design with resilience measures. That was the focus of the conference panel "Getting More Bang for the Buck: Leveraging Green Infrastructure to Create Value and Reduce Risk," which explored a number of strategies for combining resilience with green infrastructure to create additional value.

Many green strategies and nature-based solutions that are part of the defense against severe weather hazards, especially sea-level rise, can also bring additional benefits. Wetlands, for example, which reduce the impacts of flooding and tides, can also improve water quality, provide animal habitats, and boost local tourism economies. It was also noted that designers of urban parks have long recognized the necessity and benefit of making parks resilient to flooding and severe weather-related occurrences, as well as making them models of green infrastructure and attractive destinations.

Panel members also discussed the importance of building consensus around the topics of green infrastructure and resilience on a large scale, beyond the scope of an individual project. To accomplish that objective, people need to feel engaged in the effort. Landscape architect Thomas Woltz related that one essential role he plays is that of storyteller. He regularly invites professionals from other disciplines (botanists and cultural historians, for example) to participate in public presentations to educate people about the context of a particular project. That approach gives people a narrative about the larger place

where they live. Woltz quoted environmental activist Wendell Berry's observation that "if you don't know where you are, you don't know who you are."

Designers can play a useful role in helping make somewhat abstract notions of resilience more understandable. They can also illustrate what such mitigation measures might look like, as well as provide an understanding of the multiple benefits that can be generated beyond resilience. One panel member noted that it is often a challenge to excite people about large infrastructure projects. After all, it is hard to make people fall in love with a pipe that is buried beneath the ground. Panel members agreed that the argument for a greener infrastructure is more convincing if one can show the additional benefits that can be derived from an improved stormwater management system, such as reducing heat-island effect and saving water.

Brooklyn Bridge Park, Brooklyn, New York

Landscape architect Michael Van Valkenburgh incorporated resilient elements into his design of Brooklyn Bridge Park. Eventually encompassing about 85 acres and 1.3 miles of the Brooklyn waterfront, the park seeks to preserve the dramatic character of the industrial waterfront while reintroducing self-sustaining ecosystems to the site and investing it with new social, recreational, and economic benefits.

The park's resilient performance during Superstorm Sandy made it a model for waterfront development in the city. The combined strategies of elevated and varying topography, appropriate plantings, soft edges, and durable materials were key to creating a more resilient waterfront. Although the park mitigated the damage, several nearby sites still flooded, including many of the residential and commercial development sites that are situated on the park's urban edge and are at or slightly below the 100-year floodplain.

The Brooklyn Bridge Park Corporation is working with developers of sites to incorporate as many resilient features as feasible. Those flood-prevention measures include raising the ground elevation above floodplain levels, adding redundant mechanical and electrical systems, placing mechanical and electrical equipment on higher floors, and using damage-resistant materials on the ground floor and in the basement.

TWO TREES MANAGEMENT

Hunter's Point South, Queens, New York

A new waterfront park, Hunter's Point South in Queens, will include more than ten acres of landscaped waterfront parkland, new retail amenities, and community facility space. Designed by Thomas Balsley Associates, Weiss/Manfredi, and Arup, the park was created as part of the much larger Hunter's Point South redevelopment of an old industrial sector that will eventually have 5,000 new units of housing, 60 percent of which will be affordable to middle-income families.

ARUP, THOMAS BASLEY ASSOCIATES, AD WEISSL MANFRED

Designed to handle storm surges and flooding, the park at Hunter's Point South is built to drain quickly while keeping certain areas above water. When it was under construction, the park flooded in 2012 during Superstorm Sandy and drained as planned. A marsh, which was made of native species able to withstand periods of salt-water inundation, was specially designed to deal with flooding. The roots of the marsh plants, in combination with a riprap edge, help prevent erosion.

The Marina Barrage and Reservoir, Singapore

The Marina Barrage and Reservoir, which opened in 2008, were the centerpiece of Singapore's $2 billion campaign to improve drainage infrastructure, reduce the size of flood-prone areas, and enhance the quality of city life. The Marina Barrage has nine operable crest gates, a series of enormous pumps, and a 10,000-hectare catchment area that is roughly one-seventh the size of the country.

SHINY THINGS

In addition to protecting low-lying urban neighborhoods from flooding during heavy rains, it also eliminates the tidal influence of the surrounding seawater, creating a rain-fed supply of freshwater that currently meets some 10 percent of Singapore's demand. Moreover, by stabilizing water levels in the marina basin, the barriers have produced better conditions for water sports. The marina's public areas—sculpture garden, green roof with sweeping skyline vistas, Sustainable Singapore Gallery, and water-play space—also strengthen the city's tourism economy.

Using Private Development to Pay for Resilience and Build Housing

In his closing address, Jim Wunderman, chief executive officer of the Bay Area Council, encouraged coastal cities and regions in the Bay Area to view development of waterfront areas as a way to combat the effects of climate change while also creating jobs and providing much-needed housing in the area.

He criticized the all-or-nothing campaigns of some environmental advocacy groups that stymied several large waterfront projects. Rather than fighting all development of any coastal properties, environmentalists, according to Wunderman, should recognize that private developers sometimes have the deep pockets and access to capital—which many cities do not have—to construct the costly mitigation measures that are needed to better protect shorelines.

In addition to those environmental and resilience benefits, some large, mixed-use developments located near transportation hubs and other amenities also address the housing shortage plaguing the Bay Area, where population and employment growth outpaces available housing. As an example, he cited redevelopment of Treasure Island, one of the largest sites in the area.

Treasure Island, San Francisco, California

The $1.5 billion Treasure Island/Yerba Buena Island project, slated to start construction in late 2014, is redeveloping the 450-acre Naval Station Treasure Island to create 8,000 residential units, 240,000 square feet of commercial space, hotels, and 300 acres of parks and open space.

The developer Wilson Meany is using an "adaptive management strategy" to deal with potential projections for sea-level rise in San Francisco Bay. Initially, the grade of the site will be raised three feet above the 100-year high tide and will be built to withstand 36 inches on top of the 100-year high watermark or baseline. "This may not happen, but if it does, we will build a levee at the perimeter," noted Kheay Loke, senior development manager on the project. (Source: "Addressing Rising Sea Levels in South Florida and the California Coast," *Urban Land*, September 2014)

WILSON MEANY

An overarching message of the conference was that resilience adds value to cities, properties, businesses, and portfolios. Incorporating interconnected and holistic resilience into development projects reduces risk, enhances the value of real estate holdings, and ultimately helps make cities stronger and better places to live. Although pricing risk remains challenging, and it is often difficult to communicate the value of resilience, cities and businesses are both better off if resilience is ingrained in business planning and development projects and when its myriad benefits are communicated to the public.

KEY THEME
2

Lessons in Planning and Leadership

A key lesson learned from Hurricane Katrina, Superstorm Sandy, and other drastic weather events is that no one strategy will solve the problem. Redundancy of different protective and adaptive approaches is essential. When Katrina battered New Orleans in 2005, the devastating city-wide flooding actually came after the hurricane had already started to let up. Weakened by the storm, the levees gave way in a few places. Instead of flooding a relatively small area near the breaks, polluted water inundated 80 percent of the city.

That is why Thomas Fisher, architect and dean of the College of Design at the University of Minnesota, and others contend that Katrina was no "natural" disaster. "While no one intentionally designed the New Orleans levee system to cause such catastrophic damage, we did not design it to ensure that it would not happen either," Fisher said in his book *Designing to Avoid Disaster*, which was cited at the conference.

Overreliance on any one strategy—whether it be levees and pumping systems or revetments on oceanfronts—is a recipe for disaster. Overreliance on any one strategy also gives people a false sense of security. The National Oceanic and Atmospheric Administration uses a "systems-based" approach for coastal resilience to climate change, one that encompasses risks to wastewater and urban stormwater infrastructure, transportation networks, and energy grids, noted Rebecca Smyth. Smyth said that the most successful approach that cities and regions can take to adapt to climate change will combine "gray" (constructed) and "green" (natural) mitigation measures.

Some places distinguish between gray and green measures. The rebuilding strategy devised by Greater New Orleans Inc. calls for creating a new flooding adaptation system that combines a number

[Through Rebuild by Design, we came to understand that it is essential to] assess the capacity of your community and make human capital a key part of your resiliency action plan.

—MARILYN JORDAN TAYLOR, DEAN OF THE SCHOOL OF DESIGN, UNIVERSITY OF PENNSYLVANIA

of resilient/sustainable elements, including gardens and bioswales, interconnected with canals and ponds. Created by New Orleans–based Waggonner & Ball Architects, along with a team of Dutch water infrastructure experts, the plan starts with seven demonstration projects across three parishes. One project calls for designing canals with more gradual edges than current designs, which would allow water to be raised and lowered more easily on a seasonal basis in response to rainfall levels and which would also have the aesthetic benefit of looking more welcoming.

Land Use Strategies

For many city planners, a first line of defense is a zoning and regulatory approach to strategically steer density to specific locations and to use land more efficiently. Resilient cities require dynamic and adaptive land use approaches in contrast to the rigid single-use zoning regimes that have ruled cities for years.

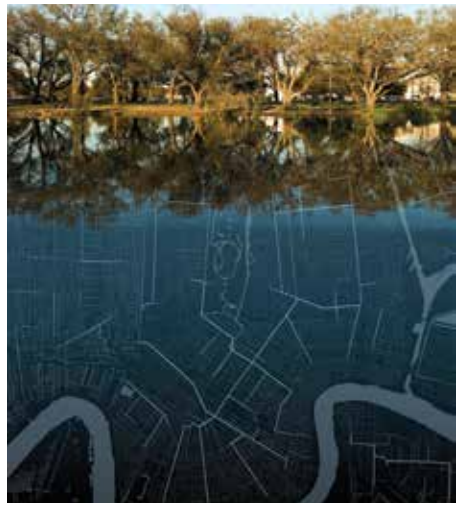
Berkeley-based planner Peter Calthorpe noted that "changing the urban footprint can have an enormous impact on reducing the carbon footprint and influence on climate change." Says Calthorpe, "Redirecting future growth is one of the most important things we can do for resiliency in the U.S." Because it is so much more difficult to retrofit, "getting it right in the first place, really counts," said Calthorpe, especially in cities in China and other rapidly growing places.

WAGGONNER & BALL

Smart-growth advocates, who have long called for placing the densest areas close to subway stops or bus lines, are taking on the challenge of retrofit. Smart-growth advocate Harriet Tregoning, director of HUD's Office of Economic Resilience and former planning director of the District of Columbia, led a major overhaul of the city's zoning code to permit greater densities close to the city's Metro stations so that one can easily get around the District without using a car.

Also, nearby Washington suburbs are urbanizing and encouraging mixed-use development and more walkable streets. The most famous example is probably Tysons Corner in Virginia. Montgomery County in Maryland rewrote its zoning code to encourage more dense development close to transit. Parking minimums were cut, and housing towers were allowed in many formerly commercial zones near county Metro stations.

Similar land use approaches can be used to limit development in flood-prone areas and to coax people to live on higher ground. "We need to stop thinking that our environments need extraordinary measures," said Calthorpe, who advocates a systemic land use solution that would essentially channel development to high



The Greater New Orleans Urban Water Plan integrates infrastructure planning and urban design across three hydrological basins. It proposes a new investment model for public works wherein spending on streets, canals, pump stations, and stormwater detention basins enhances the public spaces that are so vital to life in the region and yields opportunities for economic growth and development.

ground. But that approach is much easier to implement for new, rather than existing development. (See Kevin Findlan, *The Price of Resilience: Can Multifamily Housing Afford to Adapt?* NYU Furman Center, July 2014, http://furmancenter.org/files/NYUFurmanCenter_ThePriceofResilience_July2014.pdf.) Moreover, for some development types, such as airports, that require vast tracts of land, building in dense, urban locations may not be feasible.

Regional Perspective

Conference participants agreed that to be effective, resilience strategies must be regional in scope. After all, weather-induced disasters do not respect jurisdictional boundaries. Implementing a region-based resilience strategy was an important lesson that emerged from the Rebuild by Design competition. A regional resilience program calls for a regional entity to implement the program, which is transparent, accountable, and authorized to take action.

Greater New Orleans Inc., the New Orleans area's regional development economic agency, has led the charge in creating the city's new urban water management plan. Instead of creating higher, stronger levees, the idea is to use existing levees and restored wetlands to create a new city waterscape resembling that of Amsterdam. The action plan is a regional endeavor that engages Orleans Parish and nine other parishes in the area.

Relationships and Social Networks

Social networks can play an important role in saving lives and helping people recover. Sociologists like Eric Klinenberg have studied the effect that solid, place-based social networks can have on saving lives in a natural disaster. Klinenberg wrote about that phenomenon in his January 7, 2013, *New Yorker* article "Adaptation: How Can Cities Be 'Climate-Proofed'?"

Increasingly, governments and disaster planners recognize the importance of social infrastructure: the people, places, and institutions that foster cohesion and support. "There's a lot of social-science research showing how much better people do in disasters, how much longer they live, when they have good social networks and connections," says Nicole Lurie, a former professor of health policy at RAND's graduate school and at the University of Minnesota, who has been President Obama's assistant secretary for preparedness and response since 2009.

Following Superstorm Sandy, for example, neighborhood groups were activated quickly around New York City's five boroughs. Community-based groups that had deep roots in such areas as Brooklyn and the Rockaways were able to tap into existing relationships and get assistance to places that needed it, even as national relief organizations and government fell short. One such group was the Rockaway Beach Surf Club, which immediately following Sandy became a distribution point for relief

Bayview, San Francisco, California

Bayview's resilience planning at the neighborhood level addresses resilience issues through the eyes of G.L. Hodge, as noted by Justin Gerdes in his June 2014 *Citiscope* article "San Francisco's Bayview Plans for Resilience at the Neighborhood Level."

SIMON TUNBRIDGE /FLICKER/CC

Seasoned in the area of disaster planning, Hodge managed a Kmart store in Fremont, across San Francisco Bay, when the Loma Prieta earthquake hit in 1989 and later managed another Kmart in the economically distressed Los Angeles neighborhood of Compton, when race riots broke out and the National Guard used the store as a command center.

Although Hodge has retired from the retail business, he puts his disaster planning skills to work as the administrator of Providence Baptist Church of San Francisco. Serving one of the poorest neighborhoods in the city, the church runs a full program of essential services including after-school programs, a food bank, Wednesday evening community dinners, and a nightly homeless shelter in the church gymnasium. The American Red Cross and local nonprofit groups offer disaster pretraining for the congregation, as well as cardiopulmonary resuscitation training for church staff and the public.

Hodge's church may be the only one in the country that has a line item in its budget for disaster preparedness.

and rebuilding resources and a critical meeting point for the community (as recounted in the *New Yorker* article "Adaptation").

Robin Barnes, executive vice president of Greater New Orleans Inc., noted in the panel discussion on Loma Prieta, Katrina, and Sandy, "Through the Rearview Mirror," that 9/11 changed how the United States looked at disaster recovery. According to Barnes, there was more engagement in nonprofit work following 9/11: "It was the first time that nonprofit organizations came to be valued for their expertise in disaster recovery." The role of nonprofits was also critical to helping New Orleans residents after Katrina and remains an instrumental part of the city's revitalization.

Bolstering social resilience was one of the lessons to come out of the Rebuild by Design competition. We came to understand that it is essential to "assess the capacity of your community and make human capital a key part of your resiliency action plan," noted Marilyn Jordan Taylor. Taylor, former ULI chair and dean of the School of Design at the University of Pennsylvania, was a special adviser on Rebuild by Design. Increasingly recognizing the benefits of those social connections, more

communities are facilitating and helping forge social connections as part of their resilience planning in advance of a disaster.

The importance of bolstering human capital as a resilience strategy has also been embraced by the U.S. government. Shortly after he took office, President Obama introduced a new National Health Security Strategy that emphasized preparedness and resilience, calling for participation of the "whole community," including government agencies, corporations, civic organizations, and citizens. "It was a pretty big evolution in our own thinking, to be able to put community resilience front and center," RAND's Nicole Lurie says (quoted in *New Yorker* article "Adaptation").

Caring for the Most Vulnerable Populations

An additional piece of resilience is anticipating the needs of cities' lower-income populations and implementing strategies to better protect them from natural disasters and help them recover more quickly. Harriet Tregoning noted that as part of its responsibility to house and care for the country's most vulnerable populations, HUD recognizes that natural disasters have a disproportionate impact on poor people. Disaster preparedness is behavior that is frequently associated with higher education levels. People with lower socioeconomic status are less likely to receive information about disasters and are less likely to receive or believe the warnings.

Disasters like Hurricane Katrina threw into sharp relief the relationship between socioeconomic status and resilience. The hurricane drew attention to the fact that vulnerable neighborhoods in cities like New Orleans experienced a form of slow-motion disaster every day. When he was a U.S. senator in 2005, President Obama said, "The people of New Orleans were not just abandoned during the hurricane, they were abandoned long ago." Katrina, he said, should "awaken us to the great divide that continues to fester in our midst" and inspire us to "prevent such a failure from ever occurring again."

Before HUD built housing for low- and moderate-income residents, people tended to live in neighborhoods that did not drain well, were previously sites for hazardous materials disposal or noxious uses, places where land was less costly. It is little wonder that the Lower Ninth Ward in New Orleans, struck hard by Katrina, is one of the lowest-lying areas of the city, and its residents are predominantly African American. Residents who must leave their apartments in low-income housing projects because of flooding, for example, oftentimes experience difficulty finding replacement housing that is centrally located to jobs and transportation. It is much easier for middle- and higher-income residents to rebound sooner from natural disasters.

There is also the matter of getting to work following a disaster. Employers of low-paid, hourly workers might not hold a job for an employee who might be unable to return to work for several days. For those reasons and others, HUD has made a major commitment to assist communities in recovery from natural disasters. Between 2000 and 2013, HUD invested over $1 billion in long-term disaster recovery

efforts. That enormous sum exceeds HUD's annual appropriation in any given year and represents a generous rain of federal dollars to communities that would not otherwise receive that relief. Likewise, at the local and state levels, recovery programs that pay special attention to vulnerable residents and workers are key components to an effective resilience program.

Building Partnerships

Just as "philanthropy was key to the Rebuild by Design competition," said Tregoning, so is public/private partnering integral to HUD's current competition. The National Disaster Resilience Competition encourages localities to enlist corporate, philanthropic, nonprofit, and academic partners to execute their plans and to ensure that they "have skin in the game," noted Tregoning. That approach will help ensure that the whole community is invested in the resilience effort and that the projects will help communities make lasting changes in the way they prepare for the future. Following up on the success of Rebuild by Design, the new competition will offer nearly $1 billion to select communities with major disaster declarations between 2011 and 2012.

Arverne by the Sea, Queens, New York

Unlike most neighboring developments that were hard hit by Superstorm Sandy in October 2012, Arverne by the Sea, a master-planned, mixed-use community along Rockaway Beach next to the Atlantic Ocean, survived with minimal water and wind damage and no fire damage. Designed with a wide selection of resilience mitigation features and only half complete when Sandy struck, Arverne by the Sea is the area's poster child for responsible development.

The community's first line of defense against storms is the wide beach, the boardwalk, and the dunes. Beyond fortifying those natural and infrastructure barriers, the most important step the developers took to protect the community from storms was to raise the grade of the site. More than a half million cubic yards of fill dirt was brought in to raise the entire site by an average of eight feet, raising most of the site well above the 100-year floodplain. Homes were elevated another three feet.

ARVERNE BY THE SEA LLC

Additional resilience measures included angled buildings for wind protection and extra-durable building materials. Although the development lost power during Sandy, electricity was restored more quickly than in other Rockaway communities because of the underground power lines and the fact that water did not reach the electrical meters.

In a conference panel discussion of the development, Peter Cavaluzzi of Perkins Eastman emphasized that the resilient features are "hidden but in plain sight." The developers deliberately avoided using hard resilient infrastructure that might block views or interfere with using the beach. (For additional details, see ULI's case study on Arverne by the Sea, http://uli.org/case-study/uli-case-studies-arverne-sea-new-york/.)

1450 Brickell, Miami, Florida

In 2005, Alan Ojeda, founder and CEO of Rilea Group, began planning the second phase of 1450 Brickell, a two-acre project on Brickell Avenue in central Miami. Climate adaptability was a primary concern in the design of this 586,000-square-foot mixed-use office building just a block from Biscayne Bay. The impact of Hurricane Wilma, which struck Miami in 2005, was severe along Brickell Avenue, and numerous high-rise buildings lost windows and were out of commission for some time.

ROBIN HILL/1450 BRICKELL

Since the developer was planning an office building with a glass curtain wall, he focused immediately on how to create a structure that was more resilient than those that had been damaged. Consequently, Ojeda had his design team research impact-resistant glass and redesign the building to incorporate glass and structural framing systems that would eventually result in a Leadership in Energy and Environmental Design (LEED) Gold–certified building that was extremely resistant to hurricanes.

The building, which was completed in 2010, is today 100 percent leased. While it was under construction, the financial crisis hit, and a distressed environment ensued throughout the Miami area. Spending the extra money to install impact-resistant windows throughout the building during a financial crisis was risky, but the high quality of the physical space and backup power systems set the building apart and helped lease up the building completely, when others in the area did not. (For additional details, see ULI's case study on 1450 Brickell, http://uli.org/videos/uli-case-studies-1450-brickell/.)

Waterbuurt West, Amsterdam, the Netherlands

To accommodate more housing in densely populated Amsterdam, the city is creating the neighborhood of IJburg on artificial islands made of sand in IJmeer Lake. Part of the neighborhood, dubbed Waterbuurt, is zoned for floating houses.

For the Waterbuurt West district, local developers had a local architectural firm design 75 residences—some floating, others perched on dikes. The dwellings include rental and for-sale units for a wide range of incomes. For the floating houses, concrete tubs sunk a half story into the water support one, two, or three dwellings each. Jetties provide access, and boardwalks surround each structure. Completed in 2011, the houses were built at a shipyard and towed into place on the water.

LUUK KRAMER

The consensus at the Building the Resilient City conference was that it is essential to pack the resilience quiver with as many different mitigation arrows as possible. Neither cities nor businesses should rely on a single, static strategy. An integrated approach, complete with various levels of redundancy, is important as is continually strengthening systems and tools and building partnerships across sectors and within regions. Finally, cities must be aware of the needs of their most vulnerable populations and must work together to build cities in which all their communities and businesses are resilient to climate change.

KEY THEME
3

Building a Resilient Energy Infrastructure

Beth Heider, chief sustainability officer of Skanska USA, who moderated the panel "Investments and Opportunities in a Resilient Energy Grid," challenged panelists to consider whether resilience is a moral argument or a business case to create value. Mark Crowdis, who has worked extensively in the renewable energy field and was deeply moved by his experience volunteering in New Orleans following Katrina, said there is a strong "moral case to help our fellow human beings and enhance our environment."

On the other hand, panelists focused on the strong business case for pursuing resilience in cities, especially on the need to consume less energy and to create a more consistently reliable energy supply system. Panelists were generally encouraged by the high level of innovation in energy resources and distribution generated primarily by the private sector, but they noted that implementation of more resilient energy programs required increased collaboration between the public and private sectors and a new leadership strategy based on partnering.

We have an aging grid based on a centralized distribution system that is vulnerable to weather-related events—when one part of the system fails, this can bring down the entire system. We need to think about decentralizing our whole power production and infrastructure system.

—PHIL PAYNE, CEO OF GINKGO RESIDENTIAL

Conservation

An important part of the discussion of both sustainability and resilience revolves around the issue of "greater supply" for more electricity from renewable sources. But the other side of the equation is to create less demand and derive greater benefits from using fewer resources. A main challenge to energy conservation is that "people don't have an understanding of our ecological limits," according to environmentalist and entrepreneur Paul Hawken. "Although it's difficult to predict these limits and predict when they will run out, it doesn't mean that they don't exist," he added. The consensus was that having a better understanding of ecological limits is essential to building more resilient cities.

A big hurdle to conservation is human nature, according to John Macomber, who teaches finance at Harvard Business School as well as courses there on sustainability. Several conference participants referred to Macomber's work. Macomber notes that the "less demand" solution, especially on an individual scale—live in a smaller house, set your thermostat lower in the winter, and so on—raises behavioral aspects that seem largely to emphasize preaching about lifestyle choices. (Source: Harvard Business School website, www.hbs.edu/faculty/Pages/profile.aspx?facId=92011)

But on a larger scale, some sectors of the economy, for example, the health care industry, which is energy intensive, are clearly interested in conserving energy. In the panel "Energy and Resilience: Mitigation and Adaptation Combined," architect Robin Guenther, who specializes in sustainable health care design at the New York office of Perkins+Will, said that 8 to 10 percent of the carbon footprint in the United States is attributable to the health care industry, which is equivalent to the carbon footprint of Germany or the United Kingdom. "If health care were a country, it would be the tenth-largest consumer of energy in the world," said Guenther.

Not surprisingly, energy conservation is especially important to the health care industry, and that creates opportunities. Guenther said that cities view that situation as low-hanging fruit for their resilience programs: "When a city sets a carbon reduction target, one of the first calls they make is to hospitals."

Utility companies, which tend to be stuck in older business models, oftentimes view conservation as a mixed bag. Energy conservation measures historically resulted in less revenue for utilities. In many places where the affluent and the poor pay the same utility rates, there is pressure to keep rates low, which further pressures utilities to keep capital investment down. Such pressures explain the reasoning to repair and replace power lines following a hurricane or severe storm rather than to invest additional money to place the lines underground.

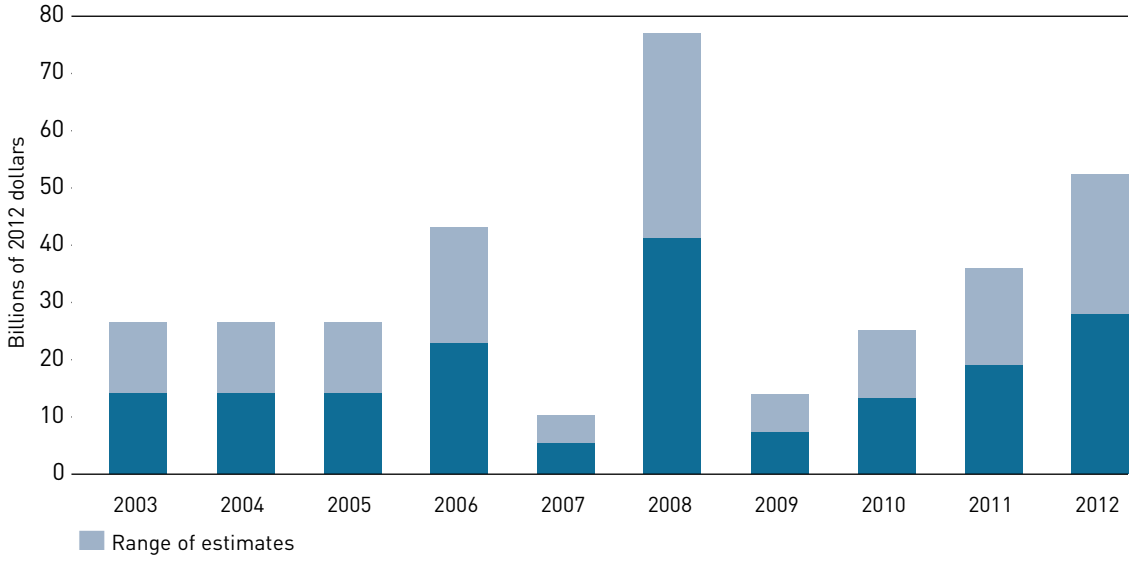
More recently, some cities, including Washington, D.C., have been exploring opportunities to use incentives to encourage utilities there to conserve energy. John Coster, who has been working with the District on that effort, noted that lowering energy demand significantly in the city, perhaps by as much as 30 percent, could quickly enhance reliability with the current structure and produce considerable savings.

Energy Assurance

In addition to conserving resources, having ready access to a consistently reliable source of uninterrupted energy—called energy assurance—was also examined by conference participants. That issue became especially important to the finance industry when Superstorm Sandy shut down Wall Street.

Likewise, health care professionals and researchers in the pharmaceutical and biomedical fields, who work in laboratories and other spaces that require a consistent energy source, have long been concerned with

Estimated Costs of Weather-Related Power Outages



Source: "Economic Benefits of Increasing Electric Grid Resilience to Weather Outages," Executive Office of the President, August 2013.

the need for energy assurance. As grid outages have become more sustained and severe, the health care industry is moving in the direction of on-site generation.

Recent weather-induced disasters in cities that have severely disrupted transportation networks have made it abundantly clear that if trucks cannot travel on roads to deliver diesel fuel, there had better be alternative energy sources for more reliable backup power generation. Moreover, Guenther observed that diesel generators are prone to fail when they operate for extended periods. "They were never intended to run for seven or nine days," she said.

Redundancy is a key component of energy assurance. Says Guenther, "It was a mistake to define efficiency as the elimination of redundancy, which prompted us to do away with operable windows when [air conditioning] became available." Today, we are building sustainable buildings with operable windows to let in fresh air and reduce opportunities for sick building syndrome to set in. We now recognize that redundancy is essential to resilience. It is also good business. Guenther noted that when health care providers shop for space to own or rent, they frequently want facilities that have operable windows and daylighting so that they can continue operating when their grid power supply is disrupted.

According to Guenther, the current approach in hospital construction is to design for "when [not if] the levees fail, rather than relying on infrastructure that will keep the water out." The design assumption is that in a calamitous weather event, one needs to count on everything going wrong. That is the adaptive strategy.

Spaulding Rehabilitation Hospital, Boston, Massachusetts

Resilience planning and sustainability were key design considerations in Spaulding Rehabilitation Hospital, which opened in Boston in 1993. Built on a remediated brownfield parcel in the Charlestown Navy Yard, the $225 million hospital, which achieved LEED Gold certification, replaced an older rehabilitation facility in a different location.

The architects Perkins+Will took innovative steps to prepare for climate change and storms. The primary electrical services were located on the rooftop and powered by a fuel pump that was secured in a flood-proof vault with a 150,000-gallon tank. Operable windows were installed in all of the patient rooms and activity spaces for natural ventilation and to allow constant airflow in the event that mechanical systems were interrupted. The ground floor and all openings into the garage were raised 2.5 feet above the current 500-year floodplain elevation to safeguard against projected sea-level rise over the life of the building. Around the perimeter, the landscape walls function as artificial "reefs" in the event of a major storm surge.

PERKINS EASTMAN

In addition to hospitals, pharmaceutical companies, and businesses in the biomedical field, energy efficiency is of paramount importance to the finance industry. John Coster, green business officer at Skanska USA, who earlier in his career was responsible for worldwide data center strategies for development and operations at Microsoft and CenturyLink, noted that the "Holy Grail" of data is creating systems that are consistently dependable. In that way, the energy field can tap into some of the assurance mechanisms that are already being used in other industries.

Mark Crowdis, who helps businesses devise and implement renewable energy systems, noted that in some instances, we can assign a value to assurance and measure the cost of an event that disrupts energy reliability and access to energy sources. Businesses in the food industry, for example, can readily quantify the cost associated with spoilage if refrigerators stop working, just as data centers can quantify losses from work hours lost during power outages. Such power disruptions offer the opportunity to educate people about the costs of business interruption risks. That is a way to get people to understand that implementing a resilience plan to minimize potential disruptions is a sound business solution, much in the way we view insurance.

As previously noted, mitigation measures to enhance energy capability need not be overly complicated or technical. Contrast the different approaches to designing power grids in the United States and the Netherlands. In the United States, most distribution lines are elevated on wooden poles and exposed to wind, heavy rain, and falling tree branches. In the Netherlands, the lines are mainly underground and encased in water-resistant pipes. Instead of the system of hub and spokes used in the United States, the Dutch grid is circular so if a line goes out in one direction, operators can restore power by bringing it in from another source.

After Superstorm Sandy, lower Manhattan experienced a five-day blackout because the walls protecting Con Ed's substation on the East River were not high enough to stop the storm surge and prevent the resulting equipment explosions. Geophysicist Klaus Jacob says that all could have been prevented simply by placing the substation on a high platform and using more underwater cable. "These are just moderate investments, in the millions of dollars. It's a small price to pay for more resilience," he says. Jacobs wrote a 2009 report on climate risks to New York City with eerily accurate predictions of what would happen to the city's infrastructure during a major storm surge (recounted in *New Yorker* article "Adaptation").

Likewise, low-tech green strategies are also useful during power outages. "When you take the time to insulate and seal the building, occupants will remain cooler for longer or remain warmer in a cold climate in the event of a power outage," noted Roger Platt, senior vice president of global policy and law at the U.S. Green Building Council. Another simple, low-tech strategy learned from Superstorm Sandy was that changing the default emergency elevator exit floor from the ground floor to the second floor, would make it possible to use elevators in the event of flooding.

Multiple and Alternative Energy Sources

Another mitigation measure is to distribute the points of failure, which involves working with a number of different power sources, so if one fails, one can rely on another. Amy McGuire, who leads the Community Clean Energy Resiliency Initiative at the Massachusetts Department of Energy Resources, gave the example of a fire station that is looking to add solar panels to its building and connecting battery storage, as well as including diesel generation in its system. That approach allows the fire department to use clean energy to save money throughout the year, and to continue to operate in case of an emergency, so it can provide its critical services.

The option to tap into multiple energy sources is a relatively recent phenomenon, especially to alternatives and renewables, where costs have come down significantly in the past few years. Moreover, the state-of-the-art technology for alternatives and renewables has steadily risen so that more of those innovative technologies are readily available and at more realistic prices. That many of those

renewables are intermittent—more plentiful in certain climates and geographic locales and during certain times of the year—is another reason to bundle a number of them into a larger energy program. It also means that those programs need to be specially customized for different geographic areas.

Note: See the Natural Resources Defense Council website (www.nrdc.org/energy/renewables/) for an in-depth discussion of renewables, with maps for each renewable indicating where those sources are clustered.

Decentralization and District-Scale Solutions

Although great strides have been made in developing technologies for renewable energy sources, ULI conference participants noted that the heart of the problem is not the technology, but rather the energy delivery and distribution system.

Phil Payne, CEO of Ginkgo Residential, multifamily developers and property managers, observed that more problematic is the fact that "we have an aging grid based on a centralized distribution system that is vulnerable to weather-related events—when one part of the system fails, it can bring down the entire system. We need to think about decentralizing our whole power production and infrastructure system."

On the other hand, Payne conceded that one strength of the current grid is that it gives access to a consistent substantial power supply under optimal operating conditions. "Once we move to a more decentralized system," warned Payne, "for it to work, we have to improve the efficiency of our system and reduce demand."

Size and flexibility are also important. Noted Beth Heider, "You can't work around an infrastructure that is fixed and monolithic." But she also remarked that resilience solutions require working at the district scale. "What we've seen is, it isn't just what happens within the drip line of the building; to be resilient, the buildings need to be connected into district-scale solutions."

Planning and implementing resilience at the district level require partnering with public entities, where "partnership is the new leadership" model. They also require abandoning the old silo structures that have shaped energy distribution systems in the past and call for different governance structures that can carry out plans across jurisdictional borders. As an example, the Massachusetts Community Clean Energy Resiliency Initiative has been working with Lincoln Labs in Lincoln, Massachusetts, on developing a microgrid system that crosses jurisdictional lines, as well as developing microgrids in downtown Boston that cross property lines.

Prologis Rooftop Solar Project

Warehouses and distribution centers have large rooftops that typically bake in the sun all day. Taking advantage of that underused portion of the building offers a great revenue opportunity. As one of the world's largest owners of warehouses and distribution centers, Prologis leverages its real estate portfolio to host solar energy systems on its rooftops.

When it started in 2011, this program of Prologis Renewable Energy had a goal of placing solar panels on warehouse rooftops in 28 states. The lead equity investor in the project is Princeton, New Jersey–based NRG Energy, one of the largest U.S. power producers. Prologis partners with utilities or investors, like NRG, to provide renewable energy to its customers. By renting roof space and allowing those entities to host solar panels on their facilities, Prologis helps bring renewable energy to the communities where it operates.

Because Prologis's clients are warehouses and distribution centers that operate on thin budgets and do not use a great deal of power, Prologis finds that this approach is more efficient and has a greater environmental benefit than if the company used the solar panels to power its buildings. Also, the lengthy payback required for solar, contrasted with the relatively short lease terms on its warehouse facilities, acts as a disincentive for Prologis to partner with its customers and tenants within its facilities to use solar panels to power the buildings. By sending energy directly to the grid, Prologis can host larger systems and enter into long-term agreements with utilities and investors.

Merrill Lynch provided some $1.4 billion in loans for the project, which, when the project started in 2011, was the largest financing package assembled for a U.S. rooftop solar-power project, according to Prologis.

Powering Necker Island with Renewables

In February 2014, the Virgin Group, owned by Richard Branson, and NRG Energy agreed on a program through which NRG would develop a renewable energy-driven microgrid on Necker Island, Branson's home. The grid will dramatically reduce diesel fuel use on the island. Like most island nations, the British Virgin Islands, of which Necker Island is a part, produces electricity with diesel generators. Because of their reliance on imported diesel and heavy fuel oil, the islands have some of the highest electricity prices in the world. High energy costs and the risks of outages during storms make islands like Necker especially vulnerable to climate change.

VIRGIN LIMITED EDITION

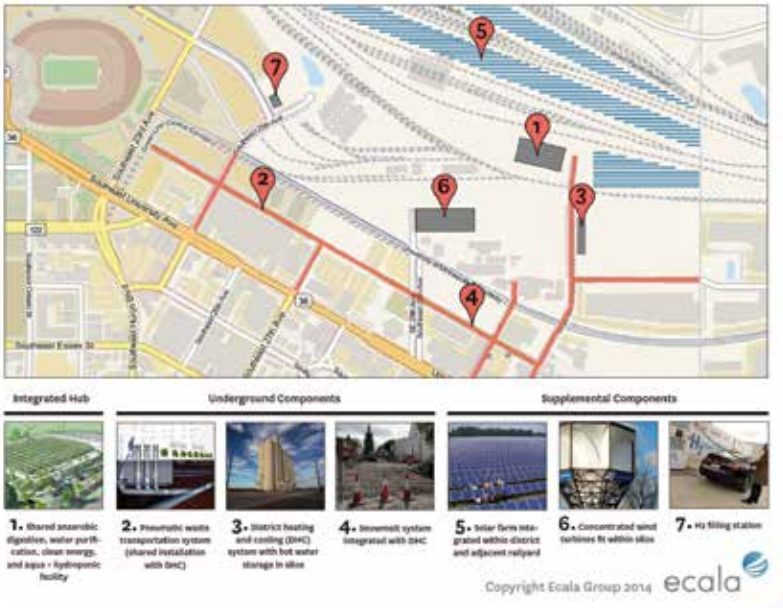
The deal between Virgin and NRG Energy is different from the power purchase agreements that corporations typically sign when installing large solar arrays. NRG agreed to reduce fuel consumption by at least 75 percent through a combination of on-site solar, wind, and battery power. Necker Island is intended to demonstrate that transitioning island nations off fossil fuels is feasible and cost-effective and that resilience is attainable for communities with varying capacities.

The initiative is part of the Ten Island Renewable Challenge, organized in part by the Carbon War Room, a nonprofit cofounded by Branson to achieve large-scale reductions in greenhouse gas emissions. Its mission is to accelerate entrepreneurial solutions to deploy profitable and scalable clean technologies across industries. (Source: Martin LaMonica, "Richard Branson and NRG Test Clean Microgrid on Private Island," GreenBiz.com, February 6, 2014)

Closed-Loop District Grid, Minneapolis, Minnesota

Minneapolis envisions development of a new mixed-use neighborhood called Prospect North that would be a dense, mixed-income research district adjacent to the University of Minnesota. The district has been evolving as a partnership that includes the city of Minneapolis, Hennepin County, the Public Housing Authority, the Mississippi Watershed Management Organization, and the University of Minnesota, among others. It would consist of a textile center, a science park with labs, libraries, three-dimensional printing hubs and incubator spaces, and housing next to the city's new Green Line light rail.

THE ECALA GROUP.



The heart of the plan is a closed-loop district grid, called an integrated utility system (IUS), that would revolve around an eight-acre hub where anaerobic digestion transforms waste into biogas. The vapors, which would be converted into electricity and hydrogen, would power the Prospect North neighborhood, while excess emissions would feed a massive greenhouse full of vegetables.

Joshua Foss, president of the Ecala Group, which would design the integrated utility system, stated that resilience is exactly the goal of the IUS, which is meant to "future-proof cities." The IUS would create its own microclimate and, according to Foss, would have a heating system that warms the streets and sidewalks, eliminating the need for snowplows. (Source: Rachel Dovey, "Minneapolis Has a Plan for the Most Resilient Neighborhood in the Country," *Next City*, October 15, 2014)

A theme that ran throughout the conference was that efforts to strengthen and achieve resilience have the potential to unlock tremendous opportunities to preempt disaster, as well as to rebuild and enhance cities. To do so, cities must work with a host of partners to both increase supply and decrease energy demands. To maximize business production and quality of life, energy must be consistently reliable and uninterrupted. The systems that provide that energy should become less centralized over time and should work to mitigate the impact of outages.

Conclusion: Time to Act

In his Nobel Prize lecture, Al Gore quoted an African proverb: "If you want to go quickly, go alone. If you want to go far, go together." The former vice president says that the world needs to "go far, quickly."

The Building the Resilient City conference had a similar takeaway message: to protect cities, buildings, and communities, the real estate industry, together with designers, policy makers, and planners, must not delay in working to build partnerships, to gain public and financial support, and to create needed design and technological innovations.

There is a lot to do, but the time to act is now. The conference attendees urged one another and their colleagues to work toward the following broad goals:

- Make resilience mainstream;
- Incorporate sustainability considerations into all development projects;
- Adopt resilience planning into underwriting models;
- Create new, more effective technical design strategies; and
- Foster regional collaboration at the local government level.

Mission Creek, on the eastern waterfront of San Francisco, is rapidly developing from a former rail yard to a vibrant, mixed-use area called Mission Bay, with a new university research campus, new jobs, offices, housing, parks, and retail. The area is one of the city's lowest-lying and is vulnerable to flooding, as mobile tour participants saw.

Appendix 1
Speaker Profiles

Hamid Moghadam

CEO, Prologis
ULI Conference Cochair

Hamid Moghadam's life is a lesson in resilience. He learned to transform difficult, adverse situations into unexpected opportunities that helped him build a successful company.

Growing up in Iran, he enrolled at the age of 16 at the Massachusetts Institute of Technology, where he earned a bachelor's and a master's degree in engineering before attending Stanford Business School. Moghadam knew he wanted to go into real estate and expected to return to Iran to join his family's real estate business. But his plans changed when the shah was overthrown in 1979, and all his family's assets were taken over by the new Islamic-led government. He told *New York Times* reporter Patricia R. Olsen, "It was clear that because I was modern, Western-educated and secular, I could not be successful there."

But he was not finding success in the United States either. Just as he was looking for a job in the early 1980s, the American Embassy employees had been taken hostage. Iran was on television for 444 days, and the United States was in a recession. Sending out his résumé to more than 30 companies, he received more rejections than interviews. He had no money. He had a student visa but was not yet an American citizen. As Moghadam told *Wall Street Journal* reporter Rachael Feintzeig, "If you're an employer and you're in the middle of a recession . . . why would you take a chance on some kid from Iran with a funny name who doesn't have a work permit?"

He went to work for one of his professors at Stanford who had started one of the early companies in real estate investment management. Two years later, Moghadam started AMB with two partners. Despite having just $50,000 in capital and no business, they secured a line of credit and slowly attracted advisory clients. None of the AMB partners drew a salary the first year. AMB Property Corporation grew to be one of the nation's largest industrially focused real estate investment trusts before it was acquired by Prologis Inc., where Moghadam has served as chairman and CEO since 2012.

In 1999, Moghadam made a series of bold moves that pared the company of most of its retail holdings and focused on the type of warehousing and distribution centers that e-commerce companies want—sophisticated centers near airports and other distribution hubs that can speedily handle high turnover. He recognized that as the internet changed sales from a wholesaler-to-retailer-to-customer mode to direct sales from the wholesaler to the customer, it was increasingly important to locate those warehouses in major metropolitan areas with big transportation portals and where customers live.

That move was one of a series of dramatic transitions—or, in Hamid's view, "evolutions"—that he led at AMB. When AMB Property Corporation started in 1983, it planned to provide investment advisory services but soon morphed into a workout business and gained a good reputation for helping investors revive underperforming assets. Anticipating the collapse of the office building market in the late 1980s, Moghadam recognized that overbuilding in that market would lead to soaring vacancy rates and redirected AMB's investments to focus on industrial parks and shopping centers. When the company went public in 1997, some 15 percent of its portfolio consisted of strip malls, a mix that helped make the company resistant during downturns in other real estate sectors.

Changes in market conditions and the emerging importance of e-commerce influenced Moghadam's decision to sell AMB's retail holdings. Moghadam told the *San Francisco Business Journal* that a "good business person is one that always challenges all of the assumptions all the time and changes course accordingly." That combination of business acumen, prescient ability to identify

trends, and flexibility to change course and adapt in response to altered circumstances has served him well. Moghadam used those skills to make AMB one of the nation's most sustainable and resilient real estate companies in the world.

Prologis was the only real estate company on the Global 100 list of the world's most sustainable corporations announced by Corporate Knights, the Toronto-based media and investment research company, at the World Economic Forum in Davos, Switzerland, in 2013.

Because of the resilience measures that Prologis implemented well in advance of Superstorm Sandy, the 23 warehouses owned by the company in the New York–New Jersey region that were flooded when Sandy hit were up and running again within 48 hours. In that regard, Superstorm Sandy was a "great reputation builder for us," Moghadam noted at ULI's recent resilience conference. Lining up services and paying for those services in advance are also important according to Moghadam. For example, he noted that when disaster hits, everyone needs roofers. To ensure that it has roofers on call in case of a potential disaster, Prologis includes those expenses in the cost of doing business. It's also a good resilience strategy.

But Moghadam emphasizes that "returning value to shareholders must be the ultimate aim of resiliency initiatives," likening that goal to Prologis's commitment to sustainability: "The reason we focus on it is very simple: it reduces operating expenses for our customers," he said. "Lest you think we're doing it for a public service reason, we're not. It's a very selfish, shareholder-oriented thing, and it happens to be good for the environment. But good alone is not sufficient in business. It's got to be economically sensible as well. If there is an economic incentive to do the right thing, people will do it. The challenge is coming up with 'the right, effective incentives,'" he adds.

Patrick Otellini

Chief Resilience Officer
City and County of San Francisco

San Francisco's Patrick Otellini stepped into the role of the world's first chief resilience officer in April 2014. His position, the first of 99 others to be filled in cities around the world, is part of the Rockefeller Foundation's 100 Resilient Cities Centennial Challenge. Its $100 million investment will fund 100 chief resilience officers, as well as other initiatives in selected cities, to build more resilient cities. Three Bay Area cities—Berkeley, Oakland, and San Francisco—were among the first 33 global cities selected under the program.

It is no accident that a number of Bay Area cities, where local and regional planning around earthquake risk and climate change has been going on there for years, made the first cut. A 2014 report by the Bay Area Joint Policy Committee found that more than 40 cities and counties in the Bay Area have completed climate action plans to reduce greenhouse gas emissions—and a growing number of those plans have added resilience and climate adaptation initiatives. A handful of cities, including Berkeley and San Francisco, have taken an additional step to incorporate climate change risks into their hazard mitigation plans.

Before becoming the city's first resilience czar, Otellini had been San Francisco's director of earthquake safety for two years, which he will continue to oversee in his expanded role. He first developed public policy experience and knowledge of the city's inner workings when he served on the city's Soft Story Task Force—retrofitting wood structures for earthquake protection—convened by then mayor Gavin Newsom. Before that, he spent a decade in the private sector, managing complex building, fire code, and planning issues.

Although the Bay Area has long been concerned with seismic safety, Otellini notes that "we've come

to realize that resilience is so much more than preparing for the 'Big One.' It's about making sure we're also better at energy assurance, like protecting our infrastructure, rebuilding our city's seawall to be able to adapt to climate change—all these things are major concerns."

A fourth-generation San Franciscan, he notes that the Rockefeller program helps bring a global platform to what some cities have learned through difficult firsthand experience. As he told *GreenBiz*, "We saw it after [Hurricane] Katrina in New Orleans, and after several other disasters, that it isn't about surviving anymore, about just making it through the disaster. It's about recovery, it's about thriving after the disaster."

When asked by *GreenBiz* how the role of chief resilience officer differs from that of chief sustainability officer (which in San Francisco is the head of the Department of the Environment), Otellini responded:

> It's different because resiliency is an all-encompassing term. At some point, it actually becomes such an encompassing term that it's very hard to define. It's not just sustainability. It's not just seismic safety. It's not just energy assurance. It's all of these things together. I think we'll see [chief resilience officers] serving as point people for other departments doing the work. The nice thing is that it's not my job to be the expert on sea level rise. It's my job to know what our city experts are saying, and to help them coordinate not just regionally but nationally, even internationally.

One of his messages at ULI's Building the Resilient City conference was the importance of addressing the resilience of existing housing stock and retrofitting homes before a disaster hits. If low- and moderate-income housing and rent-controlled homes are wiped out by a disaster in San Francisco, or in other cities, thousands of residents will need housing and will have to compete for market-rate units that they cannot afford. "Whereas retrofits can occur while people stay in their homes," Otellini said. That affordable housing in most cities tends to be built in undesirable, low-cost areas, for example, in floodplains or other problematic locations, further exacerbates the vulnerability of older, affordable housing in a hurricane or torrential rains, for example.

Jonathan Rose

President, Jonathan Rose Companies
ULI Conference Cochair

More Renaissance man than technical specialist, Jonathan F.P. Rose has a vast range of interests. He earned a bachelor's degree in psychology and philosophy from Yale University and a master's degree in regional planning from the University of Pennsylvania. Rose began his professional life founding Gramavision, which recorded and distributed some of the most progressive musical acts of the 1980s, including jazz guitarist John Scofield and the Kronos Quartet. The scion of a notable New York real estate family (his uncle Daniel, ULI governor, is founder of ULI's Rose Center for Public Leadership), Rose started his own real estate firm, Jonathan Rose Companies, in 1989, whose mission is to "repair the fabric of communities."

The firm has spurred more than $1.5 billion worth of development, spread out over the many projects in its portfolio throughout the country. Rose is one of the nation's foremost developers of affordable environmentally sensitive, socially conscious housing. His firm's work also touches many aspects of community health, working with cities and not-for-profits to build not only housing but also civic, cultural, educational, and infrastructure open space. Rose launched the nation's first green transit-oriented acquisition and redevelopment fund in 2005.

Vice chair of the Enterprise Community Partners, he started the Frederick P. Rose (Jonathan Rose's father) Architectural Fellowship to assist recent architecture school graduates in directing their skills in the service of low- and moderate-income communities. The fellowship is managed and administered by Enterprise Community Partners, a national, nonprofit housing and community development organization.

The firm's mixed-income multifamily Via Verde development in the South Bronx combines workforce co-ops with low-income rental apartments

DAVID SUNDBERG

Solar panels on the Via Verde, the Bronx, New York.

and boasts a host of wellness and ecofriendly features, including ready access to transit, a rainwater collection system, and a series of interconnected green roofs where a garden club grows produce for residents. Rose told *Metropolis* magazine that Via Verde "makes palpable this idea of integration," bringing together "the well-being of people, of the city, and nature." The development has garnered numerous awards, including ULI's 2013 Global Award for Excellence. Rose's colleague John Norquist, former Milwaukee mayor and leader of the advocacy group the Congress for the New Urbanism, says that Rose has been "trying to change the whole system." (Source: Ian Volner, "Game Changer: Jonathan F.P. Rose," *Metropolis*, January 2014.)

Rose's modus operandi—integrating wellness with nature and the city—also describes his approach to resilience, including creating neighborhoods with durable social networks, which he calls "cognitive resilience," that can withstand severe environmental disruptions like Sandy. His book on resilient cities, *The Well Tempered City*, will be released by HarperCollins in 2015.

Rose also cofounded the Garrison Institute with his wife Diana, where he founded the Climate, Mind and Behavior program, which hosted in October 2014 the sixth annual symposium The Well-Behaved Building: Developing Community, Well-Being and Resilience in Buildings. Rose taps into the work of neuroscientists and mental health professionals like psychiatrist Dan Siegel, who leads workshops at the Garrison Institute. After all, the resilient city is much like a healthy mind, according to Rose and Siegel, where such characteristics as flexibility and adaptability, as well as a harmonious state of balance, help buffer both communities and individuals from the inevitable shocks and challenges that life throws their way. That coherent flow of energy and information through the mind creates integration, a state of well-being, and ultimately builds resilience.

Harriet Tregoning

Director, Office of Economic Resilience
U.S. Department of Housing and Urban Development

Harriet Tregoning's unswerving interest in land use strategies, transportation options, and their effects on the environment started when she was growing up in a suburb of St. Louis. She lived within walking distance of her school but could not walk to it because she would have had to cross a highway that separated her home from the school. These days, she rarely uses a car in Washington, D.C., where she has lived most of her life.

Tregoning began her professional career at the U.S. Environmental Protection Agency (EPA), where she eventually headed the Hazardous Waste Management Division. One day, she had an epiphany: it made no sense for EPA to be so worried about pollution when it was not paying any attention to land use, which was changing everything. She convinced EPA to let her establish a Development, Community, and Environment Division at the agency. From there, she convened the Smart Growth Network of private, public, and government groups that drew up ten principles for the emerging smart-growth movement.

Meanwhile, Maryland Governor Parris Glendening convinced Tregoning to join his administration with the promise of having the power to change any item in the $23 billion state budget that affected sprawl. The two succeeded in changing the decision to locate a new campus for University of Maryland at a dairy farm, getting it moved to abandoned city lots in Hagerstown instead. She served as Maryland's secretary of planning and then as the nation's first state-level cabinet secretary for smart growth.

Tregoning was lauded for her holistic approach—joining health, real estate development, environment, and social issues—to make the concept of smart growth more palpable and understandable. When Glendening left office in 2003, Tregoning made him president of the Smart Growth Leadership Institute within Smart Growth America. Together, Tregoning and her husband Geoff Anderson founded the Smart Growth America advocacy organization, which he has led for many years.

Tregoning next moved to direct the District of Columbia's Office of Planning. Although she never aspired to be a zoning maven, Tregoning recognized that planning required making difficult choices about how to use land and that development patterns vis-à-vis transportation choices inextricably shape the environment and affect climate and energy use. To that end, she launched a major rezoning program in the district—the first in 50 years—attempting to corral dense development close to transit and make Washington a walkable, bikeable, livable, globally competitive, and sustainable city.

At the same time, her office planned revitalization of the poorest parts of the District. Collaborating with her transportation colleagues to bring the largest bike-sharing program to the nation's capital, Tregoning walks or bikes her smart-growth talk. Most days, she rides on her collapsible bike to the Metro station close to her home in the District's Columbia Heights neighborhood and rides Metro to meetings or her office.

Also, Tregoning dared to challenge the district's strict height limits in some neighborhoods to encourage more residents to live and work close to Metro stations. Her efforts resemble those of former New York City planning director Amanda Burden, who, working in a city that was experiencing similar unprecedented growth, completely overhauled the city's zoning code to direct the densest development close to transit stops.

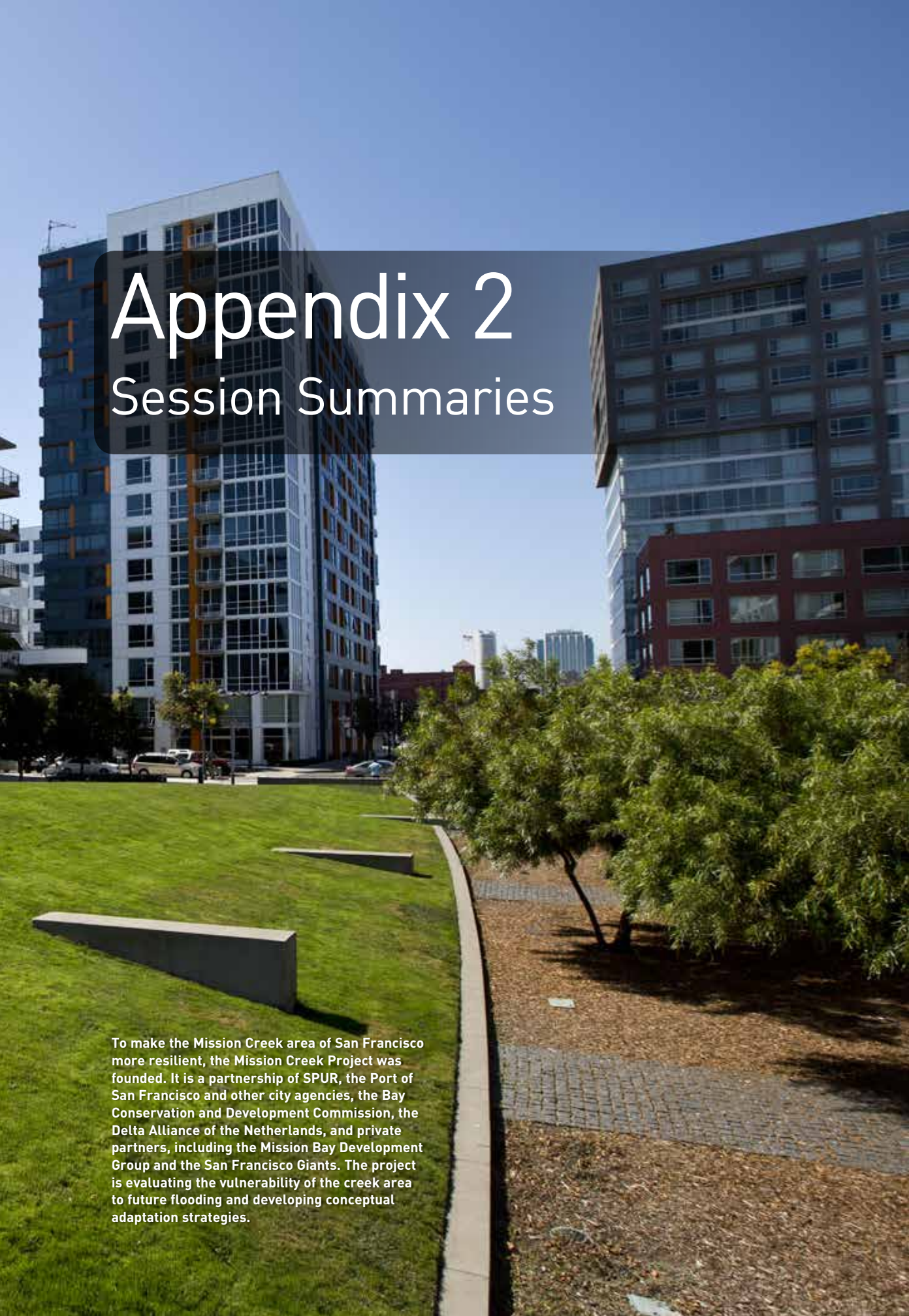
Tregoning's efforts to ease Washington's height limits in strategic spots ultimately did not fly, but her efforts to guide density to make it possible to get around the city easily without driving were a roaring success. And many people would agree that she succeeded in her ambition to make Washington more urbane and alive, more like Paris or Rome (she said). After heading planning for the District through two administrations, Secretary of Housing and Urban Development Shaun Donovan asked her in early 2014 to direct HUD's Office of Economic Resilience.

Tregoning's experience working at almost every level of government serves her well in her new position at HUD. Throughout her career, she has promoted smart growth by forming partnerships with government entities, public institutions, businesses, and public sector advocacy groups. Her expertise in public/private partnering is invaluable to her work heading the National Disaster Resilience Competition for HUD, which follows up on the agency's Rebuild by Design competition.

The new competition promises nearly $1 billion in federal community development block grants to communities across the United States devastated by floods, hurricanes, severe storms, and tornadoes and that were declared major disasters between 2011 and 2013. The $1 billion in federal aid addresses a spectrum of community needs beyond disaster preparedness and relief and challenges states and localities to examine whether they have the right mix of housing, transportation choices, and amenities and sufficient economic diversity so that job loss and industry relocation do not become additional causalities of environmental disasters.

Just as "philanthropy was key to the [Rebuild by Design] competition," says Tregoning, so will public/private partnering be integral to HUD's current competition. "It's frustrating that we are hopelessly stovepiped at the federal government level. No one wants to get federal transportation money and only get transportation benefits," she says. Seeking to change that situation, Tregoning, notes that an important goal of HUD's current competition is to reap amenities from the federal investment to build an overall better place."

Appendix 2
Session Summaries



To make the Mission Creek area of San Francisco more resilient, the Mission Creek Project was founded. It is a partnership of SPUR, the Port of San Francisco and other city agencies, the Bay Conservation and Development Commission, the Delta Alliance of the Netherlands, and private partners, including the Mission Bay Development Group and the San Francisco Giants. The project is evaluating the vulnerability of the creek area to future flooding and developing conceptual adaptation strategies.

Resilience Fundamentals

The State of the Climate Address

In her opening address, Rebecca Smyth, West Coast director of the Coastal Services Center, a branch of the National Oceanic and Atmospheric Administration, explained how sea-level rise exacerbates the severity of high tides—a normal occurrence that can now have catastrophic consequences. NOAA estimates that sea levels have risen 0.12 inch per year since 1992 because of warming oceans and melting glaciers and polar ice caps. "When we talk about climate change, we can't talk about it as a future state anymore," she said. "We have to talk about it as a new normal to plan for and invest in today." NOAA takes a systems-based approach to coastal resilience to climate change, Smyth said, which includes addressing risks to wastewater and urban stormwater infrastructure, transportation networks, and energy grids. In addition, uneven social and economic vulnerabilities across communities and fragile ecosystems further complicate coastal regions' ability to recover after severe weather events.

She also noted that the most successful approach that cities and regions can take to adapt to climate change will combine "gray" (constructed) and "green" (natural) infrastructure. The U.S. Army Corps of Engineers, for example, promotes what it calls SAGE (Systems Approach to Geomorphic Engineering) that embraces both built and natural solutions to coastal resilience. Smyth called on the audience to "change how we view green infrastructure and nature-based solutions as part of our defense against the hazards and changes, especially sea-level rise and use" and to employ dual-benefit solutions.

Measuring Success

For cities to develop effective resilience strategies, they must understand what success looks like across a broad spectrum of indicators. The panel shared insights from three distinct analyses: two sets of rankings that quantitatively capture risk and preparedness of major cities throughout the world and a third approach that gives cities a baseline tool and descriptive language to their individual resilience.

Global reinsurance giant Swiss Re's *Mind the Risk* ranks 616 cities that are the major drivers of their countries' gross domestic products. Using the firm's proprietary mapping models, the report ranks cities according to three criteria: (a) their vulnerability to five types of extreme weather-related disasters, (b) total number of workdays lost based on the city's population, and (c) the effect of those lost workdays on the national economy.

Grosvenor's *Resilient Cities* report grew out of a three-year study by the investment firm to "expand the way we think of risk and return to include . . . resiliency during the capital allocation process," said panelist Eileen Marrinan, director of research at Grosvenor Americas. The report focuses on 50 major cities where the United Kingdom–based firm holds major investments and examines not only vulnerability to climate risks but also adaptive capacity to rebuild better. Cities' adaptive capacities were ranked according to the strength of local governance, a robust sector of nongovernmental organizations and community organizations, access to technology, disaster preparedness and planning, and access to capital and funding mechanisms.

Professional services firm Arup, in partnership with the Rockefeller Foundation's 100 Resilient Cities initiative, developed the *City Resilience Framework* that identifies 12 key indicators of what it calls a city's "immune system." The framework categorizes 150 variables across four broad categories: (a) health and well-being, (b) leadership and strategy, (c) economy and society, and (d) infrastructure and environment. Resilience is defined broadly to cover such issues as epidemics, literacy, and lawlessness, as well as climate change and the impact of natural disasters, all of which can hinder a city's ability to rebound after a disaster. The intention, notes Aidan Hughes, a principal with Arup who worked on the study, was not to rank cities but rather to give cities a framework for inventorying their weaknesses and resilience capabilities.

Value Creation and Risk Mitigation

Resilience and the Real Estate Industry

The panel opened with a discussion of why the topic of resilience matters to the real estate industry. First, resilience is important to preserve the value of one's real estate investment. Investors cannot insulate themselves from naturally occurring, oftentimes sudden, environmental disasters, but they need to have a plan for addressing and minimizing such risks. Second, panelists recognized that strengthening resilience can also be viewed as an opportunity to build value. "As good asset managers, those of us who create more adaptability and resiliency in our buildings [will see] those buildings be more successful," according to developer Jonathan Rose. Moreover, resilience measures can reduce costs and enhance portfolio performance over time.

Much the way "'sustainability' was a new word in the real estate investment vocabulary a decade ago, 'resilience' is just beginning to enter our vocabulary" today, said Lynn Thurber, chair of ULI and of LaSalle Investment Management. As part of their fiduciary responsibility to preserve and enhance the value of clients' investments, the more savvy real estate investors recognize the opportunities to use resilience to reduce costs and to enhance the performance of their portfolios over time.

Panelists also discussed the importance of integrating resilience programs within a company and extending well beyond the due diligence process of making an initial investment decision or when a disaster strikes. Prologis CEO Hamid Moghadam noted, "Although few investors and operators currently use the term 'resiliency,' many have built capacity to contend with natural disasters when they strike." He predicted that in the future, resilience will be integrated into the property investment/management process and will be treated as a building system—much like plumbing.

Hitting the Moving Target: Entitlement and Resilience across the United States

One difficulty of resilient design and construction is that that the changing climactic conditions—whether they be rising coastal waters that steadily shrink shorelines or increasing storm severity—are moving targets, whereas the entitlement process is fixed in time. How to design a building to withstand future changes in the weather is a challenge. In addition, many regulatory regimes are overly rigid. Some resilience features, such as elevating buildings near shorelines that result in taller structures, may require code adjustments or zoning exemptions. A number of conference participants spoke about the need for more flexible regulatory regimes that can accommodate and adapt more easily to changed climatic conditions.

Unlike most neighboring developments that were hard hit by Superstorm Sandy in October 2012, Arverne by the Sea, a mixed-use apartment community along Rockaway Beach in Queens, New York, which was half completed when the storm hit, survived with minimal water and wind damage and no fire damage.

Designed with a wide selection of resilience mitigation features, the community's first line of defense against storms is the wide beach, the boardwalk, and the dunes. Beyond fortifying those natural and infrastructure barriers, the most important step the developers took to protect the community from storms was to raise the grade of the site.

In a conference panel discussion of the development, the developer described how more than a half million cubic yards of fill dirt was brought in to raise the entire site by an average of eight feet, raising most of the site well above the 100-year floodplain. Individual homes were elevated another three feet. Additional resilience measures included angled buildings for wind protection and extra-durable building materials.

Although the development lost power during Sandy, electricity was restored more quickly than in other Rockaway communities because of the underground power lines and the fact that water did not reach the electrical meters. The designers note that some resilience measures raised regulatory issues and increased project costs. For example, every cubic yard of fill had to be tested, which was costly. (For additional details, see ULI's case study on Arverne by the Sea, http://uli.org/case-study/uli-case-studies-arverne-sea-new-york/.)

Evolving Economics of Pricing Risk to Buildings

Although panelists generally agreed that the knowledge of insurance companies about vulnerabilities and catastrophic risks is much deeper than before and is steadily increasing, the data,

in many instances, are still inadequate. Data are especially thin for locations where penetration of the insurance industry has not been extensive over a long period, for example, in some places in Africa and India and other developing parts of the world. Also, data are oftentimes more easily attainable for larger areas—a city or region—but less so for individual properties at the site-specific level.

Panelists concurred that models need to include additional information, for example, the 2014 U.S. Geological Survey earthquake hazard maps. Panelists predicted that open-source modeling of catastrophic events would make detailed information on site-specific locations more readily attainable.

Another discussion topic was the trend of some developers and property owners to build below life-safety codes and purchase insurance to cover the gap. Is this model more cost-effective than building up to code? In this instance, risk-differentiated pricing would seem to be appropriate. However, risk-differentiated pricing has never caught on in the United States, due in large part to the system, whereby individual states regulate the industry. Also, large public insurance companies contend it would be difficult to readjust their pricing quickly to respond to unpredictable weather-related catastrophes. Furthermore, the insurance companies say that the idea of risk-differentiated pricing is generally unpopular.

The extensive damage that ensued from Hurricane Andrew in 1992 apparently jolted the insurance industry into recognizing that there was insufficient capital to cover a major shock. Instead of offering risk-differentiated pricing for disaster-prone areas such as coastal regions, most large insurers stopped insuring coastal properties and left that responsibility to government. Therefore, it is up to the insured to force the issue of risk-differentiated pricing, according to Andy Thompson, who heads Arup's global catastrophe risk and insurance services.

Inside the Investment Committee: How Capital Providers Weigh Resilience

Panelists emphasized the importance of taking a holistic approach and of evaluating the larger context before investing in a particular property. It is important to determine the character of the city or county government where the property is located. For example, has the city developed a long-range resilience plan? If not, the private sector will invest instead in another community that is better prepared, noted Nicholas Stolatis, senior director of global sustainability and enterprise initiatives at TIAA-CREF.

Equally important to investors is the degree of business continuity, which is closely tied to a municipality's ability to recover from a catastrophe. For example, if a city cannot supply water following an event, you cannot open your building, noted Gary Holtzer, senior managing director and global sustainability officer at Hines. Likewise, the recovery of a property is of small consequence if workers and customers cannot take transit or drive on roads to reach your business.

That reality came to the forefront during Superstorm Sandy, noted Michael Spies, senior managing director of Tishman Speyer. In addition to government, other stakeholders need to be engaged in the resilience conversation: mom-and-pop developers, utilities, small businesses, and professional staff who operate increasingly complex technologically advanced buildings. The financial services industry, where one lost day of work can be devastating, has long been concerned about a city's ability to recover from an event.

Getting More Bang for the Buck: Leveraging Green Infrastructure to Create Value and Reduce Risk

Panelists explored a number of strategies for combining resilience measures with green infrastructure and environmentally sensitive design to create additional value. Many green strategies and nature-based solutions that are part of the defense against severe weather hazards, especially sea-level rise, can also bring additional benefits. Wetlands, for example, reduce the impacts of flooding and tides and can also improve water quality, provide animal habitats, and boost local tourism economies. It was noted that designers of urban parks have long recognized the necessity and benefit of making parks resilient to flooding and severe weather-related occurrences, as well as making them models of green infrastructure and attractive destinations. To illustrate those points, panelists referenced a number of urban parks, including Brooklyn Bridge Park and the future public square for the Hudson Yards development in New York City.

Panel members also discussed the importance of building consensus around the topics of green infrastructure and resilience on a large scale, beyond the scope of an individual project. To accomplish that objective, people need to feel engaged in the effort. Landscape architect Thomas Woltz said that one essential role he plays is that of storyteller. He regularly invites professionals from other disciplines—botanists and cultural historians, for example—to participate in public presentations to educate people about the context of a particular project. That approach gives people a narrative about the larger place where they live.

The Business of Resilience

In his closing address, Jim Wunderman, chief executive officer of the Bay Area Council, said that coastal cities and regions in the Bay Area should view private development of waterfront areas as a tool to combat the effects of climate change while also creating jobs, spurring economic growth, and providing much-needed housing. The Bay Area Council has long promoted a pro-growth agenda in a region where environmental groups have stymied many development projects. He noted that flooding, wildfires, and sea-level rise are as inevitable as earthquakes in the Bay Area and that urban development can help mitigate their impacts through sustainable design and infrastructure. The solution to addressing those environmental events is not to retreat and stop building but instead to invest in "solutions that are consistent with proper urban planning and design and with economic growth so that we can all keep succeeding," he said.

In addition, Wunderman observed that private developers have the capital to provide vital shoreline protection through a combination of natural and constructed infrastructure, as well as wetlands restoration, which local government cannot pay for. To illustrate that point, he cited two new mixed-use developments in the Bay Area—Brooklyn Basin in Oakland and another on Treasure Island—that include measures that will accommodate future sea-level rise. Likewise, urban development projects near transportation hubs and other amenities also address the housing shortage plaguing the Bay Area, where population and employment growth outpace available housing.

Lessons in Planning and Leadership

How to Rebuild by Design

Former ULI chair Marilyn Jordan Taylor highlighted key themes that emerged from Rebuild by Design, the multistage design competition sponsored by President Barack Obama's Hurricane Sandy Rebuilding Task Force. The competition was established in 2013 to develop innovative and robust responses to natural disaster planning. Taylor, dean of the School of Design at the University of Pennsylvania, served as a special adviser to the competition.

To foster resilience on a regional scale, the competition departed from the usual competitive grant model. Instead of responding to a defined problem with a solution for one site, Rebuild by Design encouraged interdisciplinary teams of designers, architects, engineers, and real estate advisers to identify interdependencies, vulnerabilities, and opportunities across the region. The competition favored exploration and discovery rather than meeting prescribed criteria.

The competition revealed a number of sobering observations about future resilience planning efforts, including the following: population growth will continue in high-risk areas, and many people stay in harm's way; government's capacity to finance rebuilding efforts is limited and diminishing relative to the risks we are facing; and the lack of consensus about investments and next steps to take will erode momentum and adaptation efforts.

"As we get further in time from the event, the sense of need for fundamental change diminishes," Taylor said. "We may think it won't happen again, but most likely we are wrong."

Breaking Down Barriers and Building Partnerships

Harriet Tregoning, director of HUD's Office of Economic Resilience, laid out the specifics of the National Disaster Resilience Competition that promises nearly $1 billion in federal aid to the more than 200 communities that had a major disaster declaration from the federal government in 2011–2013. Launched in October 2014, the competition has already generated enormous interest among all 50 states and 17 additional localities

eligible to apply. The $1 billion in HUD community development block grants that the competition offers will reward ideas that address a spectrum of community needs beyond disaster preparedness and relief. Those additional needs include the right mix of housing, availability of transportation choices, amenities, and sufficient economic diversity so that job loss and industry closure do not become additional causalities of natural disasters. According to HUD, resilience planning needs to be woven into daily decision making on how tax dollars are spent in localities and states.

Building on its 2013 Rebuild by Design competition, HUD organized the competition in two phases: the first focused on risk assessment and planning, and the second focused on design and implementation of the plans. The competition encourages localities to enlist corporate, philanthropic, and nonprofit partners to execute their plans to ensure that the whole community is invested in the resiliency effort and that the projects will help communities make lasting changes in the way they prepare for the future.

Through the Rearview Mirror: Leadership Lessons from Loma Prieta, Katrina, and Sandy

The close tie between resilience and economic development was an important theme of this discussion. On the ten-year anniversary of Hurricane Katrina, New Orleans is experiencing an energy boom, and businesses are looking to expand in the area. Some 90,000 jobs in the area (the New Orleans region has a workforce of 650,000) are water related. Yet the city continues to sink because of water draining through the levees. Meanwhile, the city's main economic development entity, Greater New Orleans Inc., has embarked on an ambitious resilience planning effort to slow the water that is draining from the levees and to create additional amenities for the area. Reducing flood costs and lowering insurance expenses are of paramount importance to the business community.

In the case of Superstorm Sandy, which resulted in more than $19 billion in damage, 73 percent of the structures (mostly single story) affected by the storm were built before current codes were implemented. The challenge of retrofitting existing structures was as important as ensuring protection of new coastal buildings. Damage to existing buildings from earthquakes is also a main concern in the Bay Area. Patrick Otellini, newly appointed chief resilience officer for the city and county of San Francisco, noted the importance of focusing at the community level. As an example, he mentioned San Francisco's soft-story ordinance, which applies to the many wood-frame apartments and condos that were built in the area with tuck-under parking or open commercial space on the first floor, softening and weakening that level and making it likely to lean or fall over in earthquakes.

A large percentage of those buildings are rent controlled and frequently house people with the fewest resources after quakes, and thus they are most likely to need shelter for the longest periods. Some local governments in the Bay Area have undertaken inventories of soft-story structures in their communities and have also explored a number of financial and land use incentives and requirements to encourage retrofitting those vulnerable buildings.

The Human and Social Dimensions of Resilience: Bouncing Forward into Communities of Opportunity

Panelists explored how resilience is woven throughout the fabric of a community and the lessons offered from studying the resilient qualities of natural systems. Much like cities, natural systems are integrated and complex with myriad internal connections. It is that complexity and interconnectedness that allow rapid response and adaptability in the face of change. Panelists concurred that resilience strategies should be whole-system solutions that simultaneously consider land and water consumption, environmental degradation, carbon emissions produced by cars, and respiratory health issues.

Berkeley-based planner Peter Calthorpe's first line of response to making a city more resilient is to cluster growth in dense urban areas close to amenities and transportation nodes and, in the case of flood-prone cities, channel development to high ground. He noted that China is creating the world's megacities. Some 350 million Chinese people are projected to move to new cities in the next 10 to 15 years, where the current building strategy in those cities is high-density sprawl. He said that changing the way those new cities are built is critical to lowering their carbon footprint and making them resilient. Panelists agreed that

getting it right in the first place is far less difficult than correcting big mistakes later. But in reality, in most parts of the world, a primary concern is retrofitting existing structures and making older cities into stronger, resilient, desirable places to live and work.

Best Practices in Resilience Planning from Across the San Francisco Bay Area

Panel presenters discussed key findings from two forums that were convened by the San Francisco ULI District Council in July 2014. The forums focused on three separate planning initiatives in three different regions of the Bay Area that aim to increase the resilience of their subregions. One initiative, Silicon Valley 2.0, is a countywide effort in Santa Clara to map areas and facilities experiencing sea-level rise, flooding, and excessive heat. A second initiative, Adapting to Rising Tides, a multijurisdictional effort led by the San Francisco Conservation and Development Commission along the western shoreline of Alameda County, is to identify areas and systems of facilities affected by sea-level rise. A third countywide effort in Sonoma County will formulate and implement programs that address the threat of climate change.

First, the ULI panel found that scale was key and that addressing resilience is best accomplished at the subregion level rather than by a single jurisdiction. Second, governance is essential to implementing the resilience planning programs. The panel also observed that resilience planning needs to be embedded within the larger general plans, capital improvement plans, zoning, and so forth. Funding for resilience programs needs to be ongoing, and the public and private sectors need to partner on those initiatives. Third, the ULI panel called for more precise data and more in-depth information to inform risk assessment and provide a platform for resilience implementation.

Building a Resilient Energy Infrastructure

Energy and Resilience: Mitigation and Adaptation Combined

Panelists examined energy and resilience from the perspective of joining mitigation with adaptation strategies. A central theme of that discussion was the importance of redundancy. They noted that the health care industry, which is especially attuned to this concept, builds redundancy into the design of hospitals and their power systems. Architect Robin Guenther, who specializes in designing health care facilities, noted that the current approach in hospital construction is to design for when the levees fail rather than to rely on infrastructure to keep out the water. That approach involves placing main electrical services on the hospital rooftop, encasing fuel pumps in a flood-proof vault, and designing patient rooms and activity spaces for natural ventilation in case mechanical systems stop working. It also involves installing backup energy systems to fill in when one system fails.

Panelists agreed that one of the biggest incentives for using those adaptation and mitigation measures is to save money and prevent irreparable loss. For example, medical campuses, where billions of dollars' worth of research is conducted, can readily quantify the staggering loss that comes from a power failure and the lack of alternative backup systems.

Steve Campbell cited the example of warehouses that Prologis owns in densely built locations in Japan. Those warehouses were designed as multistory buildings with seismic elevators. During the earthquakes in the past several years and subsequent tsunamis, those warehouses experienced practically no damage and fared much better than many of their competitors. As a consequence, Campbell noted, the Prologis warehouses quickly shot to 100 percent occupancy. That result was a strong affirmation that the 3 percent to 5 percent additional cost made those adaptation and mitigation measures well worth the expense.

Investments and Opportunities in a Resilient Energy Grid

Energy assurance—having ready access to a consistent, reliable source of uninterrupted energy—is

of primary concern in building a resilient energy grid. Health care professionals and researchers in the pharmaceutical and biomedical fields have long recognized the importance of energy assurance. As grid outages have become more severe and sustained, many hospitals are moving in the direction of on-site generation.

Panel member Mark Crowdis, who works with businesses to implement renewable energy systems, noted the benefits of being able to assign a value to assurance and to measure the cost of an event that disrupts energy reliability and access to energy sources. Data centers, for example, can calculate losses from work hours lost during power outages, and the food industry can readily quantify costs associated with spoilage when refrigerators stop working. Such power disruptions, according to Crowdis, offer the opportunity to educate people about the costs of business interruption risks and that implementing a resilience plan to minimize potential power disruptions is sound business practice, much the way we view insurance.

Many utilities are uncomfortable with the notion of their customers providing their own energy. Panelists examined the increasing occurrence of "grid defection" as an opportunity to catch the attention of utility companies and to coax them to question their antiquated business models. Panelists explored opportunities for engaging the more than 3,000 utility companies in the United States, which are mostly entrenched in a capital-based tariff structure, and challenging them to adopt more innovative models that drive private business.

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