Extreme Heat Hot Cities
Adapting to a Hotter World
Extreme Heat: Hot Cities
Adapting to a Hotter World
Symposium Summary Report

Writer
Bill Millard

Production Manager
Evelyn Dilworth Rosen

Editor
Gisela Garrett

Conference Photographer
Samuel Lahoz

Copy Editor
Kristen Richards, Hon. AIA

Graphic Design
MANY

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The Extreme Heat: Hot Cities—Adapting to a Hotter World symposium was held November 12th, 2015 at the Center for Architecture in New York, NY.
An Under-Recognized Threat to Our Cities

Lance Jay Brown, FAIA, DPACSA, and Illya Azaroff, AIA

In the last two decades, we have been witness to escalating weather conditions. Through the devastation caused by Hurricane Katrina in 2005 and Superstorm Sandy in 2012, we learned that we must increase our awareness and readiness for the unexpected. While we are increasingly familiar with the risks of sea level rise and the destruction caused by storms and tornadoes, one threat, a killer that strikes slowly but unremittingly, has gone less recognized: extreme heat (1).

The AIANY Design for Risk & Reconstruction Committee (DfRR) is committed to addressing major topics of risk and how they interrelate. The committee’s mission is to educate the public and train design professionals to take on the challenges we uncover. In collaboration with colleagues from other AIANY committees, organizations, and the civil service, DfRR explores topics and illuminates how they interconnect with our communities and daily lives. Our inaugural program in 2011 featured noted climatologist Klaus Jacob, who delivered a dramatic lecture about climate change and sea level rise.

Ultimately, our goal is to be proactive rather than reactive. Extreme heat is a slow-moving threat that is often difficult to recognize in our “immediate needs and desires” and crisis-based society. Distracted by our day-to-day responsibilities, we often think the future is far off, that this will not affect us, here and now. As Al Gore notes, we operate on the “quarterly report.” Our risks, however, require long-term governance and visionary thinking.

Rather than wait for the next extreme heat event and respond to its dangerous outcomes, we thought it best to tackle this specific threat now. A proactive approach prepares us for inevitable events and can alter outcomes.

To isolate extreme heat from the collection of climate-related risks is nearly impossible. As the climate changes, extreme heat is a growing risk to cities. It affects energy use, water supply and use patterns, food delivery systems, food growing patterns, and land settlement patterns, potentially leading to wars, disease, famine, and migration.

The Symposium

On November 12, 2015, DfRR brought together an amazing group of speakers representing the broadest cross-section of professions involved in climate change to highlight both the short- and long-term impacts of extreme heat and the risks we take if we fail to act. The committee organized panels and case studies in terms of scale, from the most global challenges to the most local opportunities. Conflicting and contrasting solutions were welcome, making for an oftentimes lively debate. The symposium also illuminated the unresolved and the yet-to-be-determined.

What We Heard

We heard how extreme heat alters geographic zones, allowing disease-carrying insects to thrive in
areas where they've never thrived before, changing vegetation and animal migration patterns, altering the salinity and pH of the oceans, and increasing health risks to populations worldwide. We learned, in detail, how the human body responds to heat, its limits and zones of comfort, and defined the populations most at risk. The recounting of the very deadly heat waves in Chicago (1995), with 798 deaths, and Paris (2003), with 14,800 deaths, underscored the urgency to act.

We heard about the fundamental marriage of water and heat in the environment. We learned how architecture and the full spectrum of design professions can take on environmental threats and use invention and innovation to respond, turning challenges into opportunities. We heard about new materials, new technologies, and new methods being investigated and placed in our tool box.

We learned that we can draw on practices from around the world and knowledge from our not-so-distant past to develop passive environmental strategies. We heard about the Heat Island Effect, a phenomenon that occurs when urban environments cannot shed the heat they absorb. We learned how best practices and nature-based green techniques can offset the heating of our cities. Urban design strategies, like strategic shading, can cool streets. White, green, and blue roofs can be used on the thousands of acres of flat roofs in cities like New York. Porous and light-colored paved surfaces – sidewalks and roads – ameliorate environmental impacts. The biomimetic techniques developed by Grimshaw Architects to cool buildings and Brian Stone’s research on America’s hottest city showed us small- and large-scale strategies to mitigate heat.

And we heard so much more.

Going Forward: Call to Arms, Call to Action

The symposium illuminated issues and opportunities, with a focus on the next generation of design professionals. DfRR has looked ahead 30, 50, 80, and even 100 years to prepare for potentially disastrous scenarios. The approaches reviewed here in this symposium report suggest that we – architects, landscape architects, and urban designers – can lead or be part of robust collaborative teams of scientists, health professionals, government officials, and others to help prepare for and solve rapid climate change. As with all risk-reduction strategies, interdisciplinary collaboration is the name of the game.

If we continue to view our environment as a built-to-last system, we will fail to address the rapid climate changes that are taking place. We, as an industry, must invent, innovate, and create new systems that can adapt over time.

There is much work ahead. The 2015 Paris Climate Conference (COP21), orchestrated by the United Nations Framework Convention on Climate Change, concluded with an agreement to “reaffirm the goal of limiting global temperature increase well below two degrees Celsius, while urging efforts to limit the increase to 1.5 degrees.” As the first agreement of its kind, it represents the beginning of a new era. Extreme Heat is a call for the design professions to use their skills to address this pressing issue. Our hope is that the symposium and publication will provide architects and those on the path to licensure with a better understanding of how to serve the health, safety, and welfare of humankind.

And we heard so much more.

1. Extreme heat is only now a major risk identified by the White House and the National Resilience Framework (NRF). It is high priority with the Centers for Disease Control and Prevention, US Department of Defense, US Department of Health and Human Services, United Nations, World Health Organization, and Offices of Emergency Management from around the country.
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From the Mayor’s Office

Daniel A. Zarrilli, PE, Senior Director, Climate Policy and Programs

Climate change will cause rising temperatures and more frequent and intense heat waves, posing a growing challenge in New York City, especially for our most vulnerable residents. In Mayor de Blasio’s One New York: The Plan for a Strong and Just City (OneNYC), the City is focused on initiatives to better understand and mitigate the effects of extreme heat in our communities, and we know that the risk of death from extreme heat is highest among those without adequate cooling, in neighborhoods with higher poverty rates, and where there is less land covered by trees and other vegetation.

Extreme heat meets at the intersection of science, public health and safety, and quality of life in cities and exacerbates social vulnerabilities. It therefore requires interdisciplinary responses—and any response to extreme heat must include residents impacted by heat, policy-makers, architects, urban designers, and landscape architects. With this program Extreme Heat: Hot Cities – Adapting to a Hotter World, DfRR and the design community have provided a call to action for the design community to play a role in solving this challenge.

The symposium was a convening of leaders to focus on urban heat management and needed responses by built environment and design experts to the immediate impact of heat waves. The City of New York is committed to convening and learning best practices from stakeholders who are working to address the risks associated with extreme heat, as shown with the launch of the City’s Urban Heat Island working group.

The dialogue from this symposium brought a new focus to heat risk planning in cities, and provided a stage for us to come together around concrete actions. We look forward to forging new partnerships and advancing strategies to reduce heat vulnerability for all New Yorkers.
Human beings can remain healthy and active only within certain bounded temperature ranges. Though individuals and cultures have historically been able to adapt to Earth’s wide climatic variety, there are limits to these adaptations, and knowable consequences when those limits are exceeded. Expanding research on the causes, forms, and complications of thermal extremes in the Anthropocene era supports a recognition of extreme heat events as a clear and present danger to human health and well-being. Extreme Heat: Hot Cities – Adapting to a Hotter World, organized by the Design for Risk and Reconstruction Committee (DFRR) of the American Institute of Architects New York, marks a convergence of disciplines that focus on heat waves as a health hazard, at both local and global scales. As the program’s November 2015 symposium underscored, heat waves are increasing as the climate changes, yet they are remediable through adjustments in the built environment and its associated social systems.

The urban heat island effect exacerbates global-scale rises in temperature, and local heat waves are increasing in both severity and frequency. Particularly in urban hardscape environments, where populations face other sources of vulnerability involving access to cooling, mobility, medical care, and social, cultural, and economic resources, heat waves have become an early and critical front in the struggle against deleterious climate-change effects. Architects, planners, engineers, public officials, scientists, scholars, and the business sector are accordingly developing strategies that pursue the nonexclusive aims of climate adaptation and mitigation in urban settings. Together, these endeavors constitute a distinct domain of knowledge and practice: urban heat management.

This field builds on best practices that are already in place within healthy communities. Leaders in the architectural, engineering, and construction (AEC) industries recognize that a stable community engages a triad of sustainability: it is resilient socially, economically, and ecologically. Some other industries have yet to accept these goals fully, and AEC professionals have a responsibility and opportunity to advocate for policies that elevate the sustainable standards of the built environment. The benefits from these practices are not limited to improved temperature ranges in our cities; they extend to the entire planet.

Adaptive Mitigation

Historically, there has been resistance to investing in climate change adaptation on the grounds that it would divert resources supporting mitigation. Adapting to higher global temperatures, some hold, would be a capitulation to interests that are implicated in greenhouse gas emissions, or to a cynical fatalism about humanity’s future, or both. However, the experts that assembled at the Extreme Heat symposium reject the zero-sum assumption that the relation between adaptation and mitigation is fundamentally adversarial. Instead, taking a term from speaker Brian Stone, the two integrate through adaptive mitigation. This strategy recognizes that both components are imperative and that action on both fronts can be mutually reinforcing.

As a strategy, adaptive mitigation recognizes that climate change adaptation and mitigation are both imperative and that action on both fronts can be mutually reinforcing.

Adaptive mitigation comprises many interventions that advance multiple aims. Such aims include reforestation and regreening of urban environments (cooling local sites through evapotranspiration and shading while improving carbon balance and air quality), compact
transit-oriented development (reducing both automotive greenhouse gas emissions and waste heat), and coverage of heat-absorbing infrastructure, such as parking lots, with photovoltaic panels (reducing heat concentration in asphalt by shading while providing renewable energy). The design, engineering, and planning professions, symposium speakers contend, have the opportunity to generate win-win scenarios that address these aims and amplify incentives for their expansion.

**Health Priorities and the Climate-Science Consensus**

For urban dwellers, local heat waves bring global-scale rises in temperature close to home, and they do not spare disbelievers in such phenomena. The hottest year in which global temperatures have ever been recorded was 2015, according to National Oceanic and Atmospheric Administration (NOAA) data. With the exception of 1998, a strong El Niño year like 2015 that is tied for sixth hottest, 15 of Earth’s 16 warmest years on record occurred in the 21st century. Heat waves are not just inconvenient but deadly, and their increasing hazards call for purposeful, scientifically guided action by all relevant professional sectors. Even skeptics of the data can recognize the health risks associated with extreme heat, and acknowledge the importance of engaging in adaptive mitigation.

Expanded awareness of acute heat stroke and heat-exacerbated chronic disorders is no longer the exclusive province of medical personnel, but a matter for design, engineering, and planning professionals to consider in their creation of healthy, sustainable communities. Detailed studies of individual heat waves and their geographic vulnerability patterns show correlations between the distribution of community resources and rates of morbidity and mortality in heat-affected neighborhoods. These correlations underscore the importance of proactively bolstering and restoring societal safety nets wherever they are in disrepair. Human health corresponds with the built environment, and its promotion is inseparable from environmental justice.

**Human health corresponds with the built environment, and its promotion is inseparable from environmental justice.**
or the relative benefits of green and cool roofs in different settings), and all commentators support expansion and refinement of the knowledge base. Viewing health-oriented data as an essential signal and climate politics as noise, one of the clearest recommendations throughout the symposium is the need for a higher signal-to-noise ratio in the growing discourse about climate and heat.

**Viewing health-oriented data as an essential signal and climate politics as noise, one of the clearest recommendations throughout the symposium is the need for a higher signal-to-noise ratio.**

**Biomimetic and Neotechnic Design**

Organisms have been able to adapt to hot ecological niches for much longer than humans have been deploying mechanisms toward similar ends. Inspired by this ability, many design professionals study nature’s methods of conserving and employing water, using shade and circadian rhythms, managing energy transfer, and maximizing the efficiency of forms. The resulting biomimetic strategies characterize many advanced buildings and materials, which are achieving high energy-conservation performance in even the hottest of sites. Of the AEC industries’ biomimetic advancements, especially notable are: the attainment of net-zero energy input/output balance in both new construction and retrofits; the use of solar heat gain to (paradoxically) cool a building; the potential of photovoltaic panels to power condensation and irrigation systems that then transform desert sites into agricultural production centers; and the role of selected plant species in assisting with graywater treatment and thermal management when integrated into building systems.

Alongside the use of natural models and natural building components, strategies for heat management draw from the formal vocabularies of indigenous architectural traditions in hot regions. Aided by contemporary parametric design tools, design professionals are crafting site-specific forms that use prevailing winds and internal airflow patterns to passively augment cooling. The era
Complexity and Interdependencies

Extreme heat calls for situationally-specific approaches that are informed by both short- and long-term considerations, and that fully weigh the nuanced implications of the approach. One conundrum recognized by several symposium speakers is that mechanical air conditioning, the most immediate form of relief during an acute heat wave, also contributes to waste heat and energy consumption. Outside of the rare settings where renewable energy sources are dominant, mechanical air conditioning also contributes to greenhouse gas emissions. Similarly, green (vegetated), cool (white or silver), and blue (water-capturing) roofs may constitute low-hanging fruit for cities seeking cost-effective ways to increase urban albedo. However, some preliminary observations suggest that the resulting temperature differentials are conducive to underside moisture condensation, or that the light reflected off a roof may still result in a warmer atmosphere, among other concerns. Urban density is often cited as a positive counterforce against climate change, since denser habitats amplify efficiencies in transportation, winter heating, and other energy-using, carbon-generating activities. Yet urban environments maximize vulnerability to heat hazards, as evidenced in the 1995 Chicago heat wave, the 2003 European heat wave, the thermal aspects of Hurricane Katrina in 2005, and other high-mortality events. As New York City experienced during Hurricane Sandy, interdependent infrastructure systems, such as electrical grids and transportation, can be very vulnerable to cascades of failure. These illustrations of complexity and interdependency imply that truly interdisciplinary work has critical, concrete value in this field. That so many symposium participants call for collaboration among professions is neither an accident nor an automatism, but a purposeful collective recognition that heat management is not a category of problem for which any single magic-bullet solution can suffice.

Incrementalism and Catastrophes

The “frog in boiling water” story, famously recounted by Al Gore in An Inconvenient Truth, continues to have important metaphoric power. While herpetologists have pointed out that frogs do not actually remain in water as it warms, the story poignantly conveys the different responses evoked by a gradual change and a sudden shock. In the context of the current state of urban heat management, these responses manifest as abstract recognition of hazards requiring an eventual response and shock-hardened actions that are immediate, drastic, and disruptive.

Preparation and resilience, as articulated by the symposium speakers and regularly by DfRR leadership, call for a steady acceleration in these conceptual negotiations between gradual and emergency responses. Urban catastrophes such as Hurricane Sandy reveal the weaknesses in infrastructural and social systems, while generating (if only momentarily) public and political support for investments that prevent or mitigate a recurrence of similar events. It is essential to reinforce and extend these periods of recognition and resolution beyond the immediate aftermath of a catastrophe, so that public attention does not erode and the political will to marshal resources constructively is preserved.

Heat as Potential Asset

There may be an optimistic way of viewing the immense amount of excess heat in today’s urban environments, as emphasized by Anna Dyson and Chris Benedict, among
The benefits of heat-conscious design at the single-building scale will aggregate, impacting neighborhood, municipal, and regional scales.

other symposium speakers. By recognizing heat as a form of energy that can be redirected rather than wasted, a range of heat-recapture technologies offers the possibility of improving on currently dominant energy technologies in both performance and sustainability. Such technologies can be found in the energy-recovery ventilators of Passive House buildings, in the recirculating systems of integrated capillary-tube façade panels, and in high-efficiency solar heat collectors.

As advances in material science and green chemistry enable greater thermal efficiency on the single-building scale, the benefits of heat-conscious design will aggregate to impact neighborhood, municipal, and regional scales, and beyond. To successfully make heat an asset in a single building project is to move us one step closer to harnessing heat’s positive impacts globally. In addition to embracing the urgency of hazard remediation, urban heat management involves recognizing long-range opportunities to re-engineer the built environment in ways that conserve, apply, and honor the gifts of the sun and the Earth.

Implications for Advocacy and Action

Extreme heat events are becoming more frequent, making it critical for architects, planners, engineers, public officials, scientists, scholars, and the business sector to mobilize. The varieties of evidence and discourse offered at this symposium point to the following forms of action:

Design should support the capacity of a building or infrastructural project to manage critical resources (thermal and electrical energy, air, water, information) more efficiently and in ways more conducive to health. Design should draw from the full range of available strategies, from traditional/vernacular forms that use shading, orientation, passive ventilation, and thermal massing, to more contemporary technologies and materials, such as photovoltaics, hydrologic innovations, green chemistry, waste-heat recovery/reuse and other Passive House techniques, and biophilic/biomimetic principles. In this arena, architects have the opportunity to take leadership roles both in preliminary design phases and in post-occupancy phases.

Building codes should enforce and encourage sustainable, resilient, and thermally protective standards. Specific areas to be addressed include energy management (including renewable sourcing and net-zero energy input/output balancing), cool roofs, cool pavements, vegetative canopy cover and other shading strategies, access to energy-efficient air conditioning, air quality, maximum indoor temperatures, graywater reuse, and other thermally relevant variables. Changes in code should incorporate best practices based on the most reliable contemporary research and incentivize continued research and elevation of standards.

Policies at the community, regional, and national scales should foster steady-state sustainability, mitigation of heat island effect, and acute event resilience in social, economic, and environmental manners. Top priority topics include: access to emergency cooling centers, medical preparedness, public education and outreach about heat-related hazards; appropriate urban densification; energy-efficient transportation, natural disaster or blackout preparation and response, inter-agency and inter-city coordination, social cohesion, behavioral/cultural adaptations, equitable services and attention to the needs of highly vulnerable populations, reforestation and urban regreening, ecosystem restoration, and regionally specific biodiversity management. Policy should also encourage and enforce ongoing research into the thermal, public health, and climatic effects of all relevant practices by the AEC industries, public and private entities responsible for infrastructure, and other social sectors.
The Adaptive Triad of Science, Policy, and Design

Today’s public sector and AEC professionals have the chance — or, arguably, the obligation — to translate the best available information into practices that foster heat resilience. At the beginning of the symposium, the National Oceanic and Atmospheric Administration’s (NOAA) Hunter Jones explained the current state of knowledge about the 20th-century history and 21st-century projections of rising temperatures. Jones also outlined efforts by NOAA, such as the new National Integrated Heat and Health Information System, which will help organize this evolving knowledge base into forms that citizens and institutional stakeholders can apply in making decisions. In particular, northern regions (historically the less heat-prepared part of the United States) should anticipate a future of rising average temperatures and more frequent, longer, and more humid heat waves. In addition, these regions can expect to experience less relief from nocturnal cooling than in the past.

New York City’s public sector, long aware of the region’s acute vulnerability to the urban heat island effect, addresses heat management through multiple programs coordinated by the Office of Recovery and Resiliency. A policy overview by Kizzy Charles-Guzman, deputy director of Social Economic Resilience, emphasized specific thermal adaptation measures that are being taken, within the context of a comprehensive effort to strengthen New York’s built environment and social structures. The 2012 experience with Hurricane Sandy made it abundantly clear to today’s New Yorkers that advanced preparation for natural calamities saves lives and conserves quality of life. The City’s evolving strategic plans (currently guided by Mayor Bill de Blasio’s One New York document) emphasize the inseparability of equity and resilience, the need for actions at the local scale, the utility of a “vulnerability index” in planning interventions, and the value of multi-partner collaborations.

Broad-based efforts to adapt components of the built environment to thermal extremes are already under way. Andrew Whalley, AIA, of Grimshaw Architects shared how some of the firm’s projects draw on established strategies from regional cultures long accustomed to heat, while also incorporating more recent advances in engineering, materials, and parametric design. Biophilia and biomimesis are integral to such projects’ performance, driven by close observation of natural processes. Organisms and ecosystems occupying the Earth’s hottest regions, Whalley noted, have much to teach us about evapotranspiration, heat sources and sinks, water management, circadian rhythms, and other responses to solar gain.

Read the full takeaways from Jones, Charles-Guzman, and Whalley at designforrisk.com.

Urban Heat: From Region to Building

Adaptation to climate change and mitigation of that change necessarily coincide, members of the symposium’s first panel contend. To address both aims successfully, we must intervene on multiple scales. Regional-scale shifts in transportation modes, as Jeffrey Raven, FAIA, pointed out with particular reference to New York City’s energy plan, can reduce both greenhouse gas emissions and waste heat; single-building design strategies that increase energy performance have similar effects when replicated. Technological strategies informed by natural models and by detailed rethinking of materials’ energy-managing properties show promise of scaling up from small units (e.g., bricks) to larger systems, Jason Vollen suggested. This potential is amplified when these technologies are considered alongside behavioral adaptations. BASF’s
Amy Patel expanded on this prompt with a discussion of products whose physical properties contribute to the emerging industrial sector of green chemistry. Chris Benedict, focusing chiefly on the building level, examined the fundamental energy inputs and outputs of various building components, drawing the logical connections to Passive House design principles.

To address both climate change adaptation and mitigation successfully, we must intervene on multiple scales.

A comparable rethinking of existing construction practices animated Wolfgang Riede’s accounts of his company’s efforts to improve on components and practices that were developed under unsustainable assumptions. It is clear that even when faced with a tide of skepticism within an established industry, such as concrete panel design and fabrication, process improvements are possible and necessary. The Global Cool Cities Alliance’s Kurt Shickman reflected on the relationship between economic incentives and aspirations of improvement at the civic scale, offering principles of value to policymakers everywhere who strive to reconcile financial calculations with the physical and biological costs and benefits that different built forms present to communities and ecosystems. Moderator Anna Dyson pointed out a common theme among the panelists’ comments: that “the large majority of urban heat island effects are accruing as a result of the replacement of

We are inheritors of the late modern tradition of treating a building as a steam engine, or a kind of closed system, and pretending we’re going to minimize the loss of energy that comes in through fossil fuels, when really…it’s an open system.

natural systems or living systems with hard surfaces [and] engineered surfaces.” Dyson acknowledged the corollary that human technological applications may always lag behind nature’s counterparts, but might still usefully harness the efficiency of biological processes that transform both energy and information.

The more granular the knowledge that humans can attain about natural operations, the greater our capacity to conserve energy, air, water, and other resources through our cities’ artificial systems – particularly in what Benedict termed “the mushy, gushy, icky stuff on the inside of the building, down in the boiler room and circulating through the building.” Much energy wastage inevitably takes the form of heat, so it follows that minimized waste will help reduce the heat that artificial systems create. Every process from the molecular level to the wider circulations of resources, which Raven described as “regional metabolism,” remains accountable to basic Newtonian conservation of energy. “We are inheritors,” Dyson noted, “of the late modern tradition of

Jeffery Raven describing regional metabolism
treat a building as a steam engine, or a kind of closed system, and pretending we’re going to minimize the loss of energy that comes in through fossil fuels, when really, it’s an open system.”

Read the full takeaways from Raven, Patel, Vollen, Benedict, Rieder, and Shickman, as well as panel moderator Anna Dyson, at designforrisk.com.

Urban Heat and Urban Landscapes

Local heat island phenomena, not always directly correlated with global warming-related events, are common endpoints for a host of interlocking processes. Important variables for assessing these local processes include the level of urban forestation, cited by Emily Nobel Maxwell as critical to evapotranspiration and cooling; the aggregate effects of site-specific microclimates, discussed with case studies by Pippa Brashear; and the repertoire of diverse plant species that have adapted to a city’s particular conditions, a special interest of Ed Toth. Cities need to keep all of these variables, and more, in mind when assessing the contribution of their landscapes to heat island effects.

Brian Stone’s comments at the outset of this panel included a key definition: “urban heat management lessens the risk of heat-related illness through land cover change and reduced waste heat emissions.” The sequence of terms may subtly indicate priorities: the primary concern, protecting human health, requires holistic intervention in landscapes as well as implementation of heat-reducing measures. Health depends on complex systems and feedback loops within entire environments, not just temperature-specific improvements. Reinforcing the importance of human health impacts, Reginald Blake cited observations by the New York City Panel on Climate Change that heat and humidity will combine to elevate mortality and morbidity over the coming decades. Though these burdens are systemic, they fall unevenly on different population segments. Considerations of environmental justice call for increased attention and research, he said, ideally culminating in high-resolution mapping of neighborhood-level vulnerabilities, including air quality and mold. Nobel Maxwell also pointed out that while flooding causes greater damage to infrastructure, “extreme heat is the number one weather- and natural disaster-related threat to human health in the country.”

After hearing several examples of manufactured replacements of natural systems leading to unsustainable urban heat island effects, moderator James Russell provocatively conjectured that perhaps “the suburbs have got it figured out: less of a heat island effect, lots more green cover.” Russell followed up by asking, “Should we actually not be thinking so hard about densification, and think of de-densification?” Stone emphatically rejected this inference on the grounds that “most environmental problems tend to be minimized with increased density,” including stormwater generation, energy consumption, relative emission levels, and the losses of species habitat and migratory corridors associated with sprawl. “The heat island,” he continued, “is the one exception.” In other words, the relative thermal comfort associated with low-density development comes at too high a cost in other areas.
Cities are components of wider natural systems, rather than exceptions to them. The ecosystems that are here don’t stop existing because the region is now highly urbanized.

While the panelists agreed that density is generally a positive step toward achieving a symbiotic relationship with nature, they also acknowledged that we are far from achieving that symbiosis. Viewing cities as components of wider natural systems rather than exceptions to them, Toth advocated a management approach rooted in the recognition “that nature is here, that functioning ecosystems are here, that biological processes are here, and that they don’t just stop existing because it’s highly urbanized.”

In keeping with the sentiment that even the most focused objectives and outcomes exist within a larger context, Brashear noted that discrete disasters provide opportunities to study long-range aspects of change and resilience. For example, the relation between acute events and chronic processes was particularly salient in the August 2003 northeastern power blackout, which was triggered, as Stone noted, by a heat wave.

Read the full takeaways from Maxwell, Brashear, Toth, Stone, Blake, and Russell at designforrisk.com.

Urban Heat and Health

Physicians and physiologists understand the human body’s responses to extreme heat better than architects or other professionals do. As heat waves increase in intensity and frequency, however, gaining an understanding of these responses and the conditions that cause them is becoming more critical for the AEC community. Awareness of these bodily processes empowers us to better help our communities thrive despite rising temperatures; it underlies and justifies the adaptive mitigation measures taken on collective levels. Emergency physician Elan Levy gave the largely nonmedical audience a practical overview on the topic: when air temperatures exceed core body temperature and/or humidity prevents sweat from evaporating, particularly in someone who is unacclimatized to hot conditions or influenced by age, medications, or disease, a cascade of dysfunctions impairs the cardiovascular, respiratory, and central nervous systems. The result is heat stroke, either exertional or non-exertional; the latter is “classical” heat stroke, and involves dehydration.

Heat waves as severe as the 2003 Parisian event, which Richard Keller profiled in depth, result in mortality that is disproportionate to expectations. We should be able to improve our predictions, however; vulnerability to hyperthermia is not random. That said, it is also not simple: along with the intuitive associations with old age, infirmity, and poverty, heat vulnerability also varies with aspects of building and district design, social support networks, and demographics. For example, high-rise buildings with fragmented social cohesion patterns correlate with high health risks. “One of the key challenges of heat waves is that they really do target the people who are most difficult to reach,” noted moderator Eric Klinenberg, who called for neighborhood designs that are more conducive to the social networks that safeguard vulnerable populations, sometimes even more so than physical infrastructure. Klinenberg, who studied the 1995 Chicago heat wave in depth, extrapolated from Chicago’s three-day event and the longer 2003 European heat wave that a comparable event in any American city would strain its hospitals and other systems to the breaking point. In 1995, half of Chicago’s hospitals went on bypass status, rejecting and redirecting further emergency patients. Power-grid failures, such as those experienced during Sandy, would incapacitate our current elevators and water pumps, turning high-rise residences into deathtraps.

Dr. Elan Levy, Attending Physician of the Lenox Hill Hospital Emergency Department, elaborates on causes of heat stroke.
Fortunately, analysis of past mortality patterns and infrastructural failures can inform future decisions about communities’ design and character. Sociologist and filmmaker Sabrina McCormick, having observed the state of heat-related research and preparation in several U.S. cities, noted that most adaptation programs are in the early stages of development. Though New York City is “ahead of the curve” in some ways, our public cooling center approaches face perceptual obstacles, she has found, and the need for better heat education matches that of other cities. New York City officials Tom Matte and Melissa Umberger, of the respective Departments of Health and Emergency Management, elaborated on some of the city’s efforts to combat heat-related illnesses, as well as thermal exacerbation of chronic disorders, specifically citing easier access to cooling for high-risk populations and multi-faceted informational campaigns as top priorities.

Post-Sandy New York, Matte underscored, is indeed planning for future scenarios with post-emergency canvassing operations, among other carefully thought out measures. When considering the tendency for heat waves to worsen multisystem stresses – Keller cited the combination of heat, prolonged drought, forest fires, and power outages in 2003, resulting in €4 billion in agricultural losses in Europe – those measures become even more urgent priorities. “We’re about to invest a lot of collective resources over the next decades in climate security,” Klinenberg summarized. He then warned: “If we do climate security the way we did homeland security, we’re in big trouble.”

Read the full takeaways from Keller, Matte, Umberger, McCormick, and Levy, as well as panel moderator Eric Klinenberg, at designforrisk.com.

Vulnerability to hyperthermia is neither random nor simple: along with the intuitive associations with old age, infirmity, and poverty, heat vulnerability also varies with aspects of building and district design, social support networks, and demographics.

Urban Heat and Infrastructure

Striking images of buckling rail lines and melting asphalt underscored extreme heat’s effects on the infrastructure that makes modern life possible, particularly the often interconnected systems of water, power, sanitation, and transportation. Having reviewed multiple urban systems nationwide, Rae Zimmerman paid particular attention to the transportation sector, noting that many high heat-risk areas map closely onto connection and transfer points in rail, highway, and commodity-trading networks. Dmitry Smirnov, an atmospheric scientist at the civil-engineering firm Dewberry, shared some recent progress in the airport sector, and introduced the types of climate-vector data that airport operators are using to protect their assets against heat stress. Such methods quantify the vulnerability of airport facilities and, arguably, provide proof-of-concept testing for future tools. It would be very powerful for AEC professionals to be
able to examine urban-scale vulnerabilities at such high resolution, for example.

The Metropolitan Transit Authority’s Porie Saikia-Eapen brought the transportation discussion to a local level by describing current upgrades that are helping to protect system components, conserve energy, and attract riders away from motor vehicles, a vastly less resource-efficient transportation mode. By taking some 700,000 cars off the roads daily, the MTA saves about 15 million metric tons of greenhouse gases annually, Saikia-Eapen pointed out.

In the airport sector, climate-vector data is used to protect assets against heat stress. Such methods quantify the vulnerability of airport facilities and, arguably, provide proof-of-concept testing for future architectural tools.

Urban Green Council policy director Laurie Kerr, FAIA, offered an overview of the achievements, aims, and opportunities of recent programs that have made New York City a national leader in heat island mitigation. Kerr specifically highlighted the City’s cool roof programs, greening of streets and sidewalks, and stormwater infrastructure, and provided suggestions for further interventions that would better cool our extensive paved surfaces. The large scales and granular detail involved in improving performance across all of these infrastructural sectors, noted moderator Cynthia Rosenzweig, are formidable challenges. This is especially true when considering the interconnected nature of urban systems. To succeed, Rosenzweig added, the City’s efforts will require coordinated and scientifically grounded work by interdisciplinary groups like the Office of Resiliency’s Climate Change Adaptation Task Force.

Events like Hurricane Sandy, while often detrimental, may be the strongest catalysts for improved intersystem coordination and increased attention to infrastructure financing.
improving urban infrastructure. At one point, Weisenfeld described Con Edison’s stochastic modeling work: “Monte Carlo simulations of 200,000 summers for every one of our 83 networks” help to guide upcoming system designs. He also acknowledged that events do exist beyond the scope of the models. Such black swan events, while often detrimental, may be the strongest catalysts for improved intersystem coordination and increased attention to infrastructure financing. When Hurricane Sandy knocked out a transformer and flooded rail segments, it became “the hook to get all of these systems together” – an opportunity born of necessity, observed Zimmerman. Questions from the audience reinforced the panelists’ implicit dismay at this fact. A hunger for realistic, proactive, and immediate next steps was palpable.

Read the full takeaways from Zimmerman, Weisenfeld, Saikia-Eapen, Smirnov, and Kerr, as well as panel moderator Cynthia Rosenzweig, at designforrisk.com.

Case Study, Lessons Learned, and Looking Forward

The symposium’s concluding segment included a close examination of one of the nation’s most heat-vulnerable cities: Louisville, Kentucky. The Urban Climate Lab at Georgia Tech, led by Brian Stone, has closely studied that city’s hot spots, land-use patterns, and potential for thermal improvement through regreening. With the Louisville findings illustrating the direct connections between heat island risks and public-sector action or inaction, Stone laid down certain fundamental principles of the emerging discipline of urban heat management. The field has reached a critical historical position, he asserted: a “vulnerability threshold,” beyond initial recognition of the risks but ahead of a level of instability that would make radical, disruptive responses unavoidable.

The field of urban heat management has reached a critical “vulnerability threshold.” We are beyond initial recognition of the risks, but ahead of a level of instability that would make radical, disruptive responses unavoidable.

Unwillingness to recognize the urgency of heat management is by no means confined to cities such as Louisville, or to today’s professionals. Program chair Anne Marie Sowder shared New York Times headlines relegating the idea of widespread heat-related mortality safely to the past; notably, the headlines are written before World War II, before the Interstate Highway System, before the encroachment of pavement onto large proportions of American urban land, and before recent spikes in both urban and global temperatures. Retroactively recognizing such instances of misplaced
DfRR Co-chairs Illya Azaroff and Lance Jay Brown offer concluding thoughts about the symposium, expressing both hope and concern about design’s future.

Another component, evident in the blend of enthusiastic support and sober realizations characterizing the final group discussion, is balanced circumspection in the face of knowable risks. The assumption that heat hazards are destined to become intractable would logically lead to unwarranted fatalism and paralysis. Purposeful awareness of the risks, including continued pushes for improvement and necessary adjustment, is clearly the more beneficial course of action. Kathryn Vines, head of Adaptation Research for C40 Cities Climate Leadership Group, inspired by underscoring that this course is possible. From Vines’ perspective, the state of knowledge about variables correlated with heat island effects is already sufficient for resolute action, provided the tools at hand can be coupled with the necessary political will.

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DfRR Founding Co-chair Lance Jay Brown, FAIA, also noted the importance of political will in regards to arguments raised by Al Gore about short- and long-term economic incentives, and more. Denialists can no longer ethically ignore, however, correlations between heat-wave patterns and rising mortality; health hazards from heat may change the climate-adaptation game from long-range to immediate.

Considering the NOAA data presented by Hunter Jones at the outset of the symposium, without a generational response to Brown’s all-hands-on-deck call to professional action, the conditionality of his pivotal term “unless” is practica...
**The built environment may benefit enormously by converting one of its deadliest hazards, heat, into an invaluable asset.**

Brown specifically cited the United Nations’ Sustainable Development Goals, which are being prepared for rollout at the upcoming Habitat III. Goal 11 is “make cities inclusive, safe, resilient, and sustainable.” While the language is general, the facts marshaled in connection with the goal are specific and alarming: half the human population is now living in cities (reaching 60% around 2030), 95% of urban expansion over the next decade will occur in the developing world, and soon close to a billion people will live in slums.

Tom Matte added that the advantages of ongoing global urbanization are both potent and fragile: “The single thing that people can do to reduce their carbon footprint, if they live in a suburban community, is to move to New York City and live like the average New Yorker.” He continued by noting that those who move to New York City today inherit a relatively pleasant and high-functioning city. In contrast, the majority of megacities in the developing world are currently faced with more extreme levels of heat, noise, combustion, and pollutants than other cities. Around the globe, urban density creates tremendous benefits, but it also puts people near tailpipes and the waste heat from buildings.

To reinforce a theme voiced throughout the symposium, there are ways of framing these conditions in terms that are positive opportunities rather than only causes for alarm. The urgency to rethink how cities handle heat serves is more than a warning; it can spur creativity as well. Anna Dyson has observed “a philosophical stance in the way that we use the language” regarding heat gain and associated hazards. For example, she noted, “we should be considering ourselves very lucky that so much solar energy is coming into our environment, because we could do a lot more with that solar energy.” Dyson elaborated that by developing better ways to capture, store, transform, and redistribute solar energy, we could improve our approaches to cooling, our overall electrical production, the efficiency of hot-water systems, and the performance of many of other infrastructural systems.

Similarly, we currently treat excess heat as waste or as degraded, low-grade heat, Dyson noted. There is a rich opportunity to, instead, use that heat as something valuable. She suggests an essential lesson that architects, planners, and engineers can take from nature, which transforms everything and wastes nothing: our built environment may benefit enormously by converting one of its deadliest hazards into an invaluable asset.

*Read additional thoughts from Stone, Sowder, and Vines, as well as plenary session moderators Lance Jay Brown and Illya Azaroff, at designforrisk.com.*

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Detail of heat mitigation façade, which embraces heat as an asset. Image courtesy of Grimshaw Architects.
Symposium Speakers

ILLY AZAROFF, AIA, Founder & Principal, +LAB architect PLLC; Associate Professor, New York City College of Technology; Founding Co-Chair, AIANY Design for Risk & Reconstruction Committee
CHRIS BENEDICT, RA, Principal, Architecture & Energy Limited
REGINALD BLAKE, PhD, Asst. Professor, Biological Sciences, New York City College of Technology
PIPPA BRASHEAR, Director of Planning and Resilience, SCAPE/Landscape Architecture
LANCE JAY BROWN, FAIA, DPACSA, Principal, Lance Jay Brown Architecture + Urban Design; Distinguished Professor, The Bernard and Anne Spitzer School of Architecture, City College New York; Founding Co-Chair, AIANY Design for Risk & Reconstruction Committee
KIZZY CHARLES-GUZMAN, Deputy Director, Social & Economic Resiliency, NYC Mayor’s Office of Recovery and Resiliency
ANNA DYSON, Director, Center for Architecture, Science and Ecology (CASE), Rensselaer Polytechnic Institute
HUNTER JONES, Program Specialist, Climate Program Office, NOAA
RICHARD KELLER, PhD, Professor of Medical History, University of Wisconsin, Madison
LAURIE KERR, FAIA, LEED AP, Director of Policy, Urban Green Council
ERIC KLIENENBERG, PhD, Professor and Director, Institute for Public Knowledge, NYU
ÉLAN LEVY, MD, Attending Physician, Emergency Department, Lenox Health Greenwich Village – North Shore - LIJ Health System
TOM MATTE, MD, MPH, Assistant Commissioner for Environmental Surveillance and Policy, NYC Department of Health
EMILY NOBEL MAXWELL, Director, New York City Program, The Nature Conservancy
SABRINA MCCORMICK, PhD, Assoc. Professor, George Washington University
AMY PATEL, AIA, Commercial Key Account Manager, The BASF Center for Building Excellence
JEFFREY RAVEN, FAIA, LEED AP BD+C, Assoc. Professor and Director, Graduate Program in Urban + Regional Design, New York Institute of Technology, Principal, RAVEN Architecture + Urban Design
WOLFGANG RIEDER, CEO and Founder, fibreC
CYNTHIA ROSENZWEIG, PhD, Senior Research Scientist; Co-Chair; Co-Director, NASA Goddard Institute for Space Studies; NYC Panel on Climate Change; Urban Climate Change Research Network
JAMES S. RUSSELL, FAIA, Director of Strategic Design Initiatives, NYC Department of Design and Construction
PORIE SAIKIA-EAPEN, AIA, FCIOB, Chartered CM, Director of Sustainability and Environmental Compliance, MTA HQ
KURT SHICKMAN, Executive Director, Global Cool Cities Alliance
DMITRY SMIRNOV, PhD, Atmospheric Science Expert, Dewberry
ANNE MARIE SOWDER, Assistant Professor of Construction Management and Civil Engineering, New York City College of Technology; Program Chair, Extreme Heat: Hot Cities symposium
BRIAN STONE, JR., PhD, Professor, School of City and Regional Planning, Georgia Institute of Technology
ED TOTH, Director, Greenbelt Native Plant Center and the Mid-Atlantic Regional Seed Bank, NYC Department of Parks and Recreation
MELISSA UMBERGER, Hazard Mitigation Specialist, Human Services Unit, NYC Office of Emergency Management
KATIE VINES, Head of Adaptation Research, C40 Cities Climate Leadership Group
JASON OLIVER VOLLEN, AIA, Principal, High Performance Buildings, AECOM
NEIL WEISENFELD, PE, Director of Strategic Planning, Con Edison
ANDREW WHALLEY, AIA, RIBA, Deputy Chairman, Grimshaw Architects
RAE ZIMMERMAN, PhD, Professor of Planning and Public Administration; Director, Institute for Civil Infrastructure Systems, NYU Wagner Graduate School of Public Service
The Extreme Heat: Hot Cities – Adapting to a Hotter World symposium came from the simplest offer of help. Two years ago, architect Brian Pape, AIA, a member of the AIANY Design for Risk & Reconstruction Committee as well as the Design for Aging Committee, suggested to me that both committees co-organize a program. I live in a northern city because the climate suits me, but summer in New York has been increasingly difficult, and I admit I’m part of a vulnerable age group. We brought the topic of extreme heat to DfRR. While DfRR’s programming was more often on visible risks like hurricanes and earthquakes, this invisible threat was intriguing and just as urgent. A briefing by Jeffrey Raven, FAIA, an acknowledged expert on the topic of designing against extreme heat, became the ignition point for DfRR and an ever-increasing number of AIANY committees to embark first on a very well-attended evening program and then the Extreme Heat: Hot Cities symposium. Creating that event – with the enthusiastic support of AIANY and the involvement of its staff – sparked collaboration with multiple City agencies and excellent non-profits, all tasked in some way with the safety and well-being of our region’s citizens.

We found that many design professionals, scientists, writers, manufacturers, and related organizations were already dedicated to the subject – in fact, many of them became symposium speakers and sponsors. But we also found their focus was more often on relief and recovery. They were clear on how to help in the wake of a heat wave, but less on such questions as: Why do we let these events happen? How can we avoid such disasters and even more deaths in the future? What needs to change in the way we plan, design, and build – and how? How can we create awareness and galvanize action?

Those questions inspired DfRR to zero in on how to mitigate and/or adapt to the threat of continuous, ever-hotter heat waves in the region. Since extreme heat events (EHEs) seem unavoidable, we asked our sources and speakers: What does the New York design community need to do and how fast can it mobilize to do it?

The symposium content and connections are just a start, and the clock is ticking faster. We have taken a major step, and now we know what we do and don’t know to get ahead of the threat. Keep up your own work and activism, and keep us all informed!

A digital copy of this Symposium Summary Report, extended symposium coverage, and a host of related resources can be found at designforrisk.com
Acknowledgments

The Extreme Heat: Hot Cities—Adapting to a Hotter World symposium was organized by the AIANY Design for Risk & Reconstruction Committee (DfRR) in partnership with:

AIANY Building Enclosure Council
AIANY Building Codes Committee
AIANY Committee on the Environment
AIANY Design for Aging Committee
AIANY Health Facilities Committee
AIANY Housing Committee
AIANY Planning and Urban Design Committee
AIANY Transportation and Infrastructure Committee
American Society of Landscape Architects - New York Chapter
CUNY New York City College of Technology
NYC Department of Health and Mental Hygiene
NYC Mayor’s Office of Recovery & Resiliency
NYC Office of Emergency Management
NYC Department of Parks and Recreation
NYC Urban Heat Island Working Group
The Rockefeller Foundation
The Nature Conservancy
Urban Green Council

2016 AIANY DfRR Co-Chairs
Lance Jay Brown, FAIA, DPACSA
Illya Azaroff, AIA
Joan L. Capelin, Hon. AIA

About the AIANY Design for Risk & Reconstruction Committee
DfRR is committed to creating awareness of potential natural or man-made disasters, and also to raising the capacity of design professionals to mitigate, adapt, and recover rapidly from disasters along with the broader risk-aware community. DfRR formulates programs, provides training, organizes tours, and develops professional/public partnerships that create a forum for greater risk awareness. We warmly welcome new members. To learn more about DfRR, benefit from a wealth of resources including video footage of events such as this symposium, and to join, please visit designforrisk.com.

About AIA New York
AIA New York is the oldest and largest chapter of the American Institute of Architects with more than 5,200 architect, allied professional, student, and public members. AIANY is dedicated to three goals: design excellence, public outreach and professional development. www.aiany.org