VOLUME 4, 2015

Residential Architect

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NAPOLEON INTRODUCES REVOLUTIONARY NEW GAS FIREPLACE.

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New research commissioned by Napoleon revealed that today's homeowners increasingly want their homes to enhance the quality and memorability of the experiences they share with friends and family. Furthermore, architects and interior designers who are able to offer project ideas and designs that fulfill the consumer's desire for more comfort, relaxation, warmth and romance have a distinct advantage.

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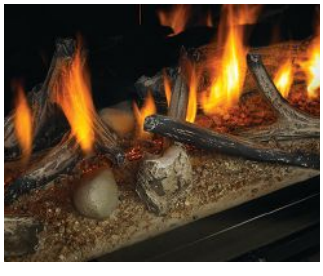

Driftwood logs and river rock media enhancement kits enable further customization to specific tastes.

"We also realized that people's moods change, and that was the insight that sparked our new product innovation. Once the new smart-phone control app hits the market a few months from now, the rest of the market will be playing catch-up."

Napoleon's new Vector LV50 linear fireplace integrates a series of LED lights that mix with the gas flame to create an infinite palate of glowing reds, blues, greens, oranges, yellows, any color imaginable.

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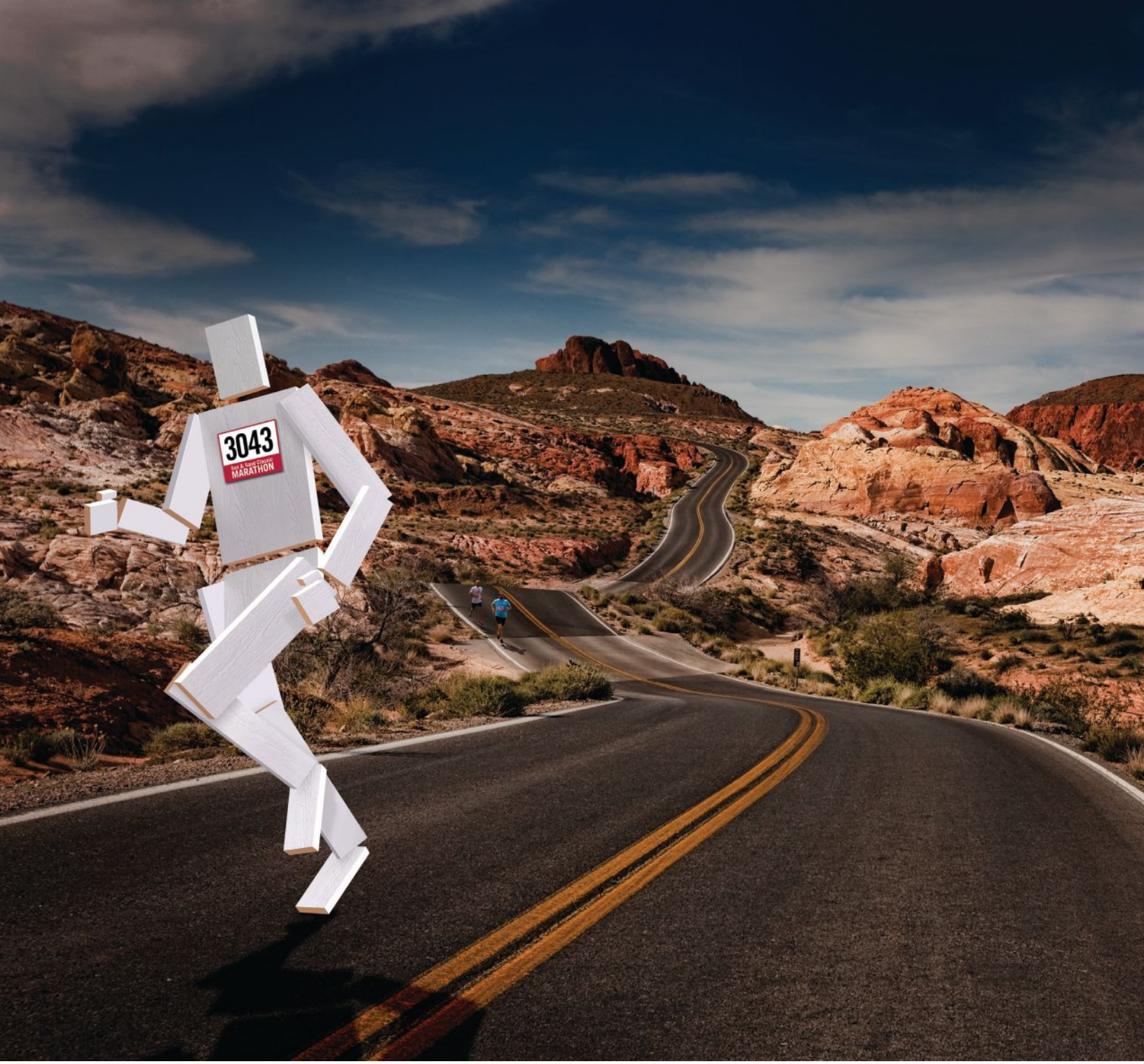

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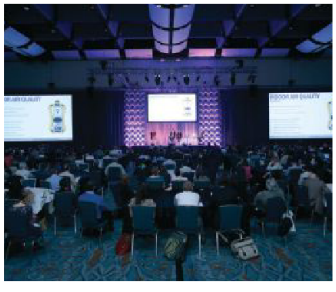

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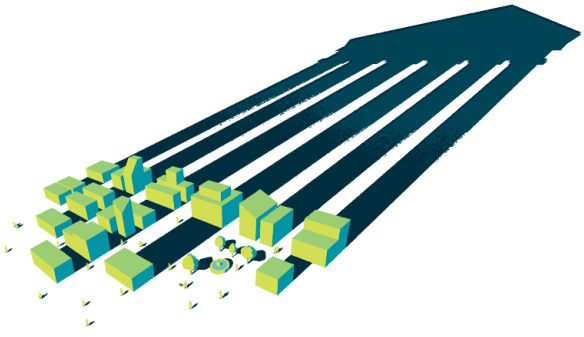

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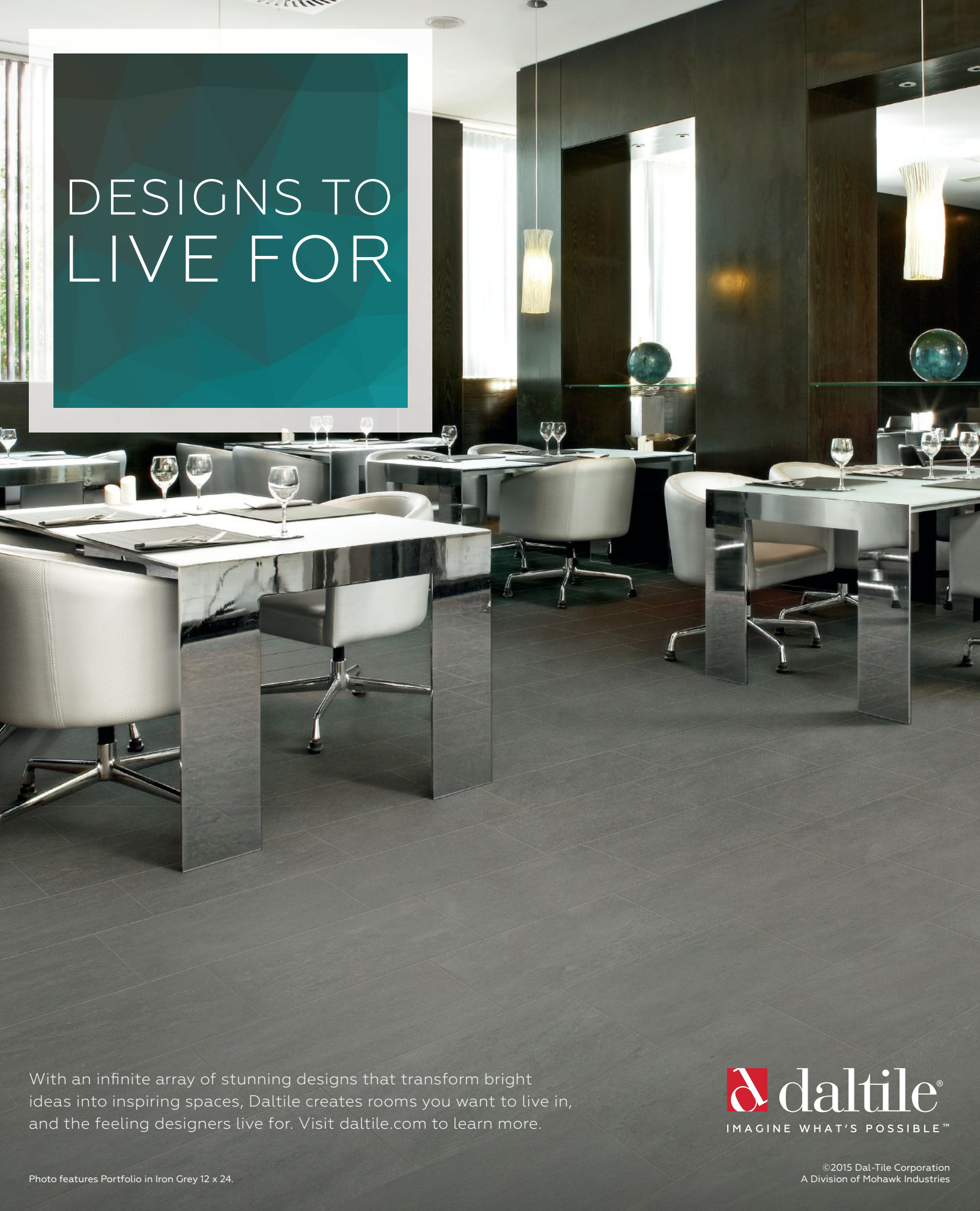

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was to integrate the natural beauty of this home's waterfront locale.

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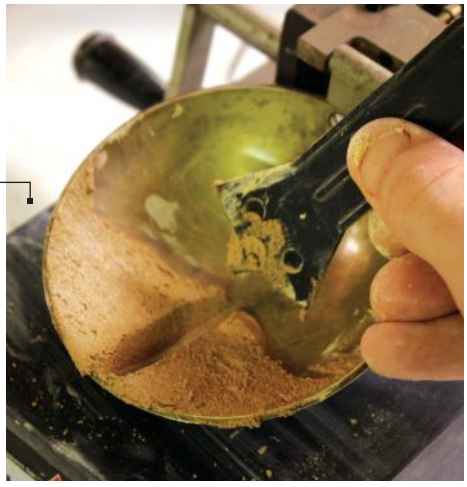
UP FRONT

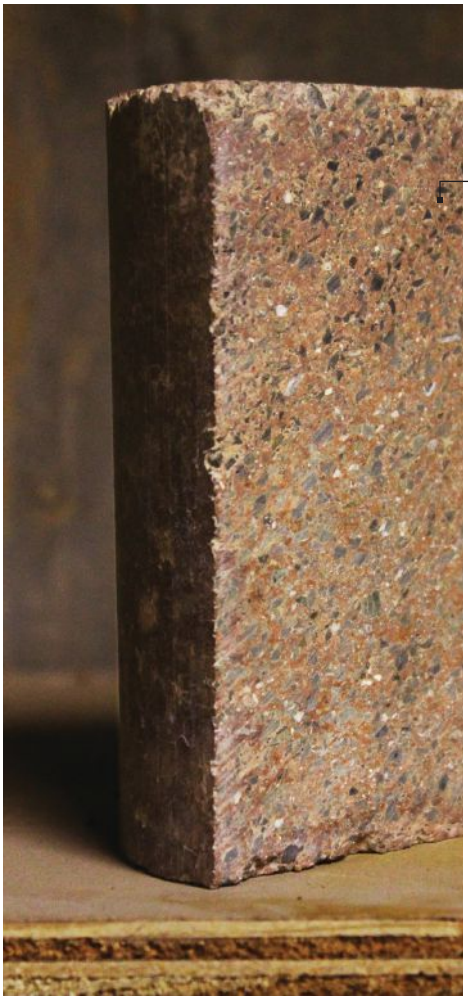
RICK SOMMERFELD

Each year, 400,000 people visit Monument Valley in Utah for the sandstone buttes and mesas, but the Mexican Water Chapter of the Navajo Nation wanted these travelers to stay and contribute to the local economy. They approached Design Build BLUFF, a design/build graduate program at the University of Utah, along with students and staff from the University of Colorado Denver, to design and construct a pair of rentable 300-square-foot cabins. Made of rusted steel and reclaimed barn wood, the structures follow Navajo tradition with their eastward-facing entrances. On the north side of each cabin, a cantilevered patio provides shade during the summer. Inside, concrete floors, sinks, and counters offer a contrast to more warm-toned reclaimed barn wood on the walls. —**CHELSEA BLAHUT**



To gauge how the material will change during fabrication, the team measures the liquid limit of clay minerals used in one of the geopolymer mixes.

Because clay tends to shrink when dry and swell when wet, a strain gauge is used to achieve a precise reading on changes to the geopolymer unit.



A saw-cut test sample of northern California fabricator Watershed Materials' prototype geopolymer masonry unit, which uses natural clay in place of cement.

Technology Natural Minerals Turn Concrete Green

Getting the energy-intensive Portland cement out of masonry units has long been the goal of sustainable building-product manufacturers and researchers. But the most promising alternatives so far—among them flyash and blast-furnace slag—are byproducts of other complex industrial processes. That could soon change. New research from the National Science Foundation with Napa, Calif.–based fabricator Watershed Materials shows promise for cement-alternative binders made of minerals derived from natural clay. In recent testing, their novel concrete material reported compressive strength of 7,000 psi—double that of typical concrete—while resisting water and chemical erosion. The alternative binder relies on geopolymerization, a chemical reaction in which an industrial byproduct or natural material (in this case, the minerals found in clay) is combined with an alkali (such as lime or lye) and allowed to harden at a lower temperature than typical concrete masonry units and on par with that of other geopolymer cures, rendering the final product durable and water-resistant. The team is currently working on scaling production. —**HALLIE BUSTA**

RA **Read more about the new technology at bit.ly/newconcrete.**

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Bath

Designer: Lightvox Studio
Location: Phoenix
Description: The 2,100-square-foot House on Marion, which Lightvox Studio completed in 2014, rests at the foot of Camelback Mountain in Phoenix. In the master bathroom (above), a 1-foot-by-4-foot Velux skylight brings warmth and luminance to the custom shower enclosure.

1 Fixtures from Hansgrohe: Raindance E 360 Air one-jet showerhead (rain head); Axor Starck (shower heads and thermostatic valves).

2 Cube Collection tub from Wetstyle.

3 Limestone wall slabs from Arizona Tile.

4 More La Gamma collection porcelain floor tiles from Caesar Ceramiche.

5 Linear S-TIF 6560-PS drain by Infinity Drain.

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Sustainability 2015 LEED for Homes

In August, the U.S. Green Building Council (USGBC) released the list of winners of its 2015 LEED for Homes Awards, recognizing five sustainable residential projects, as well as developers and builders who focus on green building. Michael Maltzan Architecture's Star Apartments in Los Angeles (above) took home the award for Outstanding Affordable Project. Winners must have either completed an outstanding project in the previous year or proven themselves to be leaders in the field of sustainable residential building. The USGBC reports that nearly 196,500 residential units are currently participating in LEED, with more than 82,000 projects having already earned the LEED for Homes certification. Of those certified projects, 43 percent are considered affordable housing. —**CAROLINE MASSIE**

RA **Read more about the Star Apartments and the other award winners at bit.ly/2015LEEDforHomes.**

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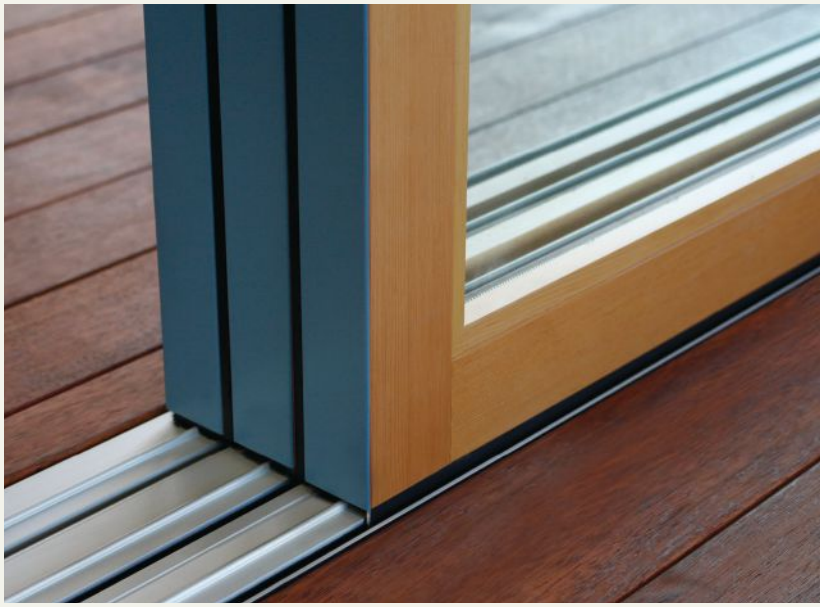
Slim Frame. Midcentury French furniture designer Pierre Paulin designed this minimalist occasional table in 1959 for Thonet. Ligne Roset is bringing the table back with a black-lacquered steel wire base that supports an MDF top finished with a cherry veneer. The CM 191 measures 55″ long, 18.5″ wide, and 14.6″ tall. *ligne-roset-usa.com*

Hot Finds Contemporary furniture, finishes, and fixtures that refresh modern interiors with playful forms.

Sweet Seat. In 1954, Danish designer and cabinetmaker Frits Henningsen sculpted this armchair with graceful, curved forms—a contrast to the linear constructions of his Danish-Modern contemporaries. Carl Hansen & Son is reviving the design as the FH429 Signature Chair in a choice of solid oak or walnut with leather or fabric upholstery. The chair measures 39.4″ tall, 34.3″ deep, and 26″ wide with a seat height of 16.5″. *carlhansen.com*

Light Lines. With a name that comes from the French term "to draw," Dessiner is a collection of 4″ porcelain square tiles by designer Inga Sempé that gets its hand-painted look from subtle linework and patterning. For use indoors on the floors and walls, the collection is suitable for wet applications. The tiles come in three solid and eight patterned, neutral colorways. *annsacks.com*

Bright Light. A rotatable, rare-earth magnetic ball connects the fixture head to the matte-varnished steel frame in Magneto, a table and floor luminaire from Italian lighting brand Foscarini. The company updated Magneto earlier this year with a 5W LED light source in 2700K and a CRI of greater than 80, delivering 95 lumens per watt. It is offered in black and white finishes. *foscarini.com*



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PANG YU LIU

Technology Google Takes on Solar

Adding to the growing list of things Google knows about us is whether our homes and businesses could benefit from the addition of solar panels. Announced in August, the company's Project Sunroof combines aerial 3D models from Google Maps, historical weather data, the cost of utilities, and the value of local incentives to gauge whether covering a rooftop with photovoltaics (PVs) would result in energy-cost savings.

The online app is the project of Google engineer Carl Elkin, who previously volunteered with Solarize Mass, a Boston-based solar-adoption program targeting Massachusetts residences and businesses. In a blog post announcing the project, Elkin explained why he developed the tool: "I've always been surprised at how many people I encounter who think, 'My roof isn't sunny enough for solar,' or, 'Solar is just too expensive.' Certainly, many of them are missing out on a chance to save money and be green."

At press time, Google was rolling out the platform as a consumer tool in Boston, the San Francisco Bay Area, and Fresno, Calif. Users plug in their address and how much they typically spend on electricity. The app, in turn, shares a recommended solar installation size in square feet and kilowatts. It also offers information on purchasing or leasing the panels, as well as taking out a loan to cover the installation expenses, and the projected payback period in energy-cost savings. Finally, the app connects homeowners with local installers to do the work—along with a tried-and-true site evaluation—of getting the PVs on the roof.

But Google isn't alone. Shortly after the tech giant announced its foray into the building PV space, MIT offshoot Mapdwell made its move, naming New York City the ninth market for which its tool, Solar System, is available. Not long after, the startup struck again, adding San Francisco to the lineup as market number 10.

Mapdwell uses high-resolution, 3D satellite models and lighting detection and ranging data to determine how many kilowatt-hours of solar energy a building could generate as well as the cost to install the system versus its potential energy-cost savings. The tool considers factors such as the roof shape, shading from nearby trees and other buildings, local weather, and utility costs in the area. Users can pick a preset PV system and lay out or design their own configuration for analysis. Developed by MIT's Sustainable Design Lab in 2013, Mapdwell is now available in Boston; Boulder, Colo.; Cambridge, Mass.; Washington, D.C.; Washington County, Ore.; Wellfleet, Mass.; Lo Barnechea and Vitacura, both in Chile; as well as in New York City and San Francisco.

With Mapdwell and Google now operating in some of the same markets—including on the tech giant's home turf—we're keen to see how competition will fuel consumer interest and, ultimately, help turn solar-estimation apps into a go-to conceptual design tool for architects. —**HALLIE BUSTA**

RA To learn more about Google's and Mapdwell's solar-estimation tools, visit bit.ly/solarapps.

Saving Salvage

Sometimes it pays to consider old building materials before purchasing new. We caught up with Anne Nicklin, executive director at the Chicago-based Building Materials Reuse Association, which represents material suppliers in the U.S. and Canada that salvage and resell products, to talk about the current state of the industry.

Where in the U.S. is the market for building-material salvage and reuse the strongest?
There's a reuse market anywhere people are building. We've seen strong growth in the Chicago area, which has a demolition-debris ordinance requiring [residential] buildings of a certain size to divert 5 percent of waste material [by weight] to reuse. Seattle has a well-established marketplace and preferential permitting for deconstruction, is pursuing a zero-waste ordinance, and has high waste-tipping fees. Detroit's resurgence has closely aligned with its deconstruction and reuse markets, especially with regards to the deconstruction of its building backlog. The deconstruction and reuse operations that began in New Orleans as relief efforts following Hurricane Katrina have now become a mature market for affordable reused materials.

Reuse isn't a new phenomenon, but it seems to be gaining traction recently. Why?
It's a hugely old phenomenon. Recently, we've seen changes in city policies, including the way landfills will accept and charge for materials. On the East Coast, where you have more of a space limitation, you're seeing some landfills just not accept certain waste; in the Pacific Northwest, the lumber mills aren't accepting wood the way that they used to. Many traditional [waste] outlets have changed and suddenly we have more [waste] materials to deal with. And in the past five years, people have really loved the look of salvage.

What about deconstruction?
Deconstruction is more of a method than a goal. The goal is salvage. If you can do that with demolition, wonderful. I just want to see the materials saved. Deconstruction was standard practice 100 years ago, but the advent of crushing machines made for a much faster way to get rid of a building. We're starting to see a resurgence in deconstruction. It creates jobs and it can be less disruptive than demolition to a community.

Is today's building stock suited for salvage and reuse?
Architects are planting next year's waste. Buildings from the mid-1970s and onwards were framed and built very differently from those prior. For an entire era of buildings, all we're going to get out of them are building materials like chipboard, hollow-core doors, vinyl windows, glass with a low-E coating, spray-foam insulation, and materials covered with construction adhesive.

Does that mean there will be a limited supply of salvageable material in the future?
We will always find a way to salvage. Building materials is a trickle-down economy. Granite countertops, for

HALLIE BUSTA

RA **This interview has been edited and condensed. To learn more about material salvage and reuse, visit bit.ly/savingsalvage.**

example, may not always be the high-end option but there will always be a way for somebody to use the material—as long as we don't chop it into a million tiny pieces and bury it.

What should the architecture community know about building-material salvage and reuse?
Architects are becoming more curious about how to design for reuse. We get a lot of questions about selection—for example, how to pick out doors and store them for a few years. I encourage people to think about the process the same way they think about stone. You can specify a stone finish and then, often, when you're ready for it in construction, you can pick out your piece of stone from what's available. I don't think architects realize how much they can reuse on their own sites. On most sites there's a building that came down and still has a lot of [functional] materials—plywood, joists, glulam, stud walls, commercial steel—that are incredibly expensive to buy but are undervalued in the reuse market. —HALLIE BUSTA

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PHOTOGRAPHY: DAVID CLEVELAND

Chicago Ex Novo

Seeking a more permissive idea of urbanism.

Giles Smith, Mathew Leung, and Paloma Strelitz (left to right) are principals with Assemble, a London-based design collective founded in 2010 that comprises 14 members today. The group's work is varied, from installations to furniture to its "live projects," such as transforming derelict buildings or leading research trips to document how children interact with nature. The principals of Assemble are committed to variation, too. "There isn't a rule or methodic way of developing projects that we've always followed," Smith says. "We begin projects from scratch."

As told to William Richards

Our contribution to the Chicago Biennial is a film documenting the Baltic Street Adventure Playground and its context in Glasgow. We think that architects have a lot to learn from play and good environments for play, and Chicago will be a great opportunity to find a new audience.

An adventure playground is a place that's dense in variety—full of material, physical challenge, and change. It's a place that permits children to learn and grow in an environment that is permissive and secure. Contemporary cities, on the other hand, are commodified, tightly regulated, and increasingly uniform.

Cities could be more like adventure playgrounds. In the playground, children are given agency over its change, and for us this is an essential part of being in the city. As [the geographer] David Harvey has said, our right to the city is "a right to change ourselves by changing the city." Our projects reflect this idea.

The principal challenge as we grow and develop will be ensuring that our particular form of practice—as well as meaningful public engagement, an economy of means, and material experimentation—are maintained as we take on larger and potentially more formal projects. How do you continue to generate meaningful engagement with the construction process on a large and complex formal building site? And how can hands-on testing and prototyping in our humble workshop be used as a tool to help design a £3 million [$4.6 million] project? Far from being concerns, these questions represent exciting challenges that we look forward to tackling. AIA

→ Assemble is one of more than 70 participants in the Chicago Architecture Biennial, sponsored in part by the AIA. Learn more at *chicagoarchitecturebiennial.org*.

AIADesign

Beyond Light and Air

Big-picture, long-term thinking, along with simulation tools, has changed the way we look at fenestration.

By Kim A. O'Connell

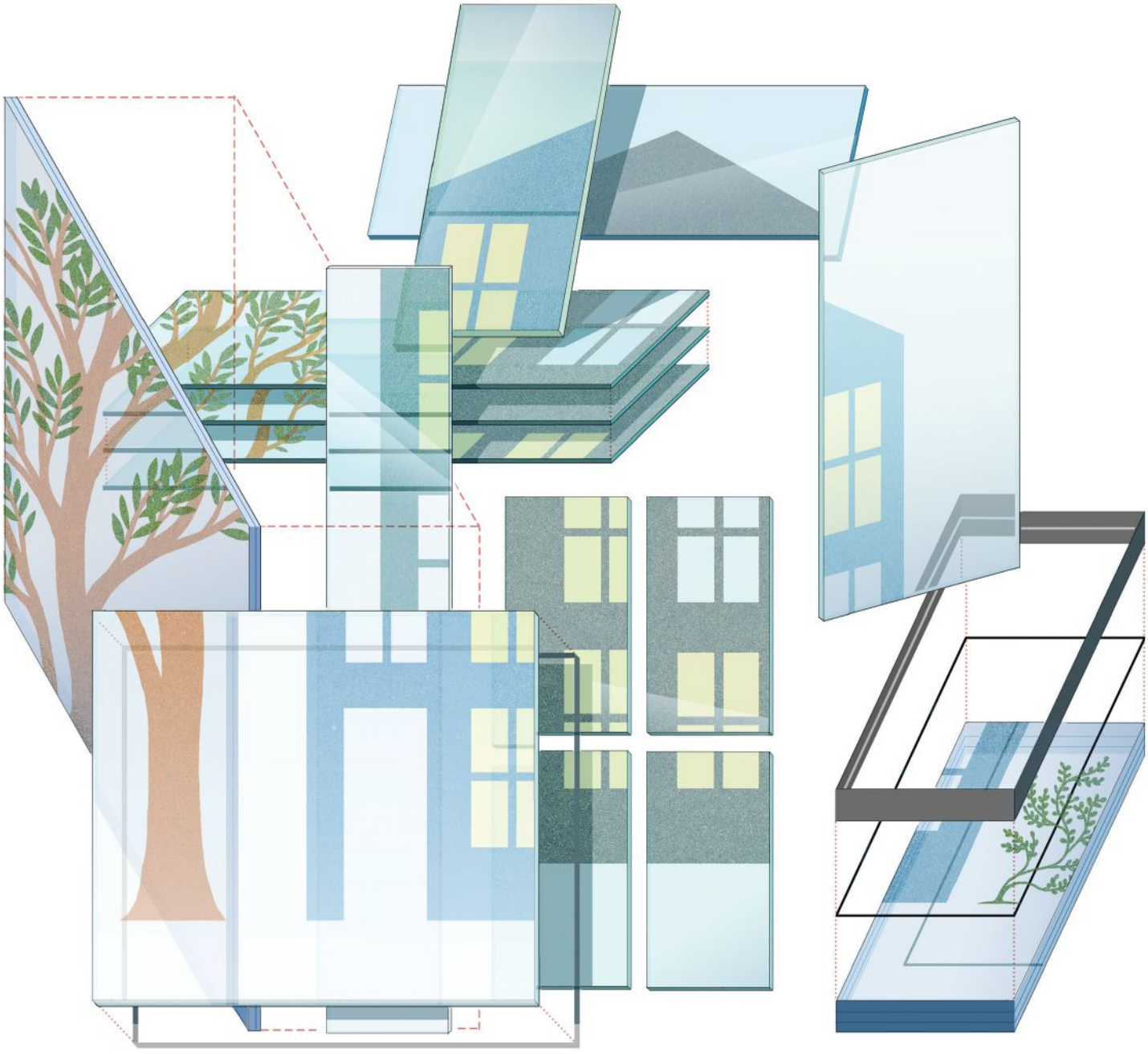

ILLUSTRATION: MICHAEL KIRKHAM

In his classic treatises on architecture, 16th-century architect Andrea Palladio recommended that windows and doors be placed with the utmost attention to proportion and symmetry—"that the void may be over the void, and the solid upon the solid," which, he said, "affords both beauty and cool air in summer, besides other conveniences." Beauty, light, and air have always been the main objectives of fenestration—until now.

As the building community has embraced a more integrated and holistic approach to sustainability, a similarly sophisticated systems-based approach to fenestration has evolved, with building envelope and glazing technology becoming ever more energy efficient and dynamic. Windows are increasingly thought of as "transparent intelligent façades," tasked with preventing heat loss, providing adequate daylighting, and contributing to higher overall energy efficiency or even net-zero energy buildings. Architects must now weigh a host of variables when specifying windows and doors—including glazing type, orientation, climate data, shading devices, HVAC systems, operability, and more—that would have made Palladio's head spin.

Researchers, manufacturers, and architects are now engaged in important dialogues about how to make this process more integrated and user-friendly. Kerry Haglund, executive director of the Efficient Windows Collaborative and a former senior fellow at the Center for Sustainable Building Research (CSBR) at the University of Minnesota, is one such researcher, having presented at the annual BEST (Building Enclosure Science & Technology) Conference and elsewhere on the topic of fenestration. She says that architecture is moving into a new era, repudiating outdated approaches and "relatively short-term thinking" based on low costs or quick energy paybacks. When it comes to windows, she encourages architects to think more about long-term performance (read: 30 years) and to look well beyond aesthetics.

"Today, high-performance fenestration has to be designed to be integrated with the HVAC and the lighting systems to take full advantage of daylighting and occupant comfort strategies," Haglund says. "These strategies need to be considered early in the design process, because they are not only part of the design and orientation of the façade but are also part of the design of the internal mechanical systems that provide appropriate ventilation, artificial light, and comfort to the building occupants."

According to Haglund, a general design path for residential window specification might look like this: determining the window's orientation, then daylighting controls (none versus dimming), then window area (window-to-floor ratio), then shading conditions (internal shades versus external or automated shading devices), and then, finally, window type. For the last one, the possibilities are seemingly endless, ranging from multiple layers of clear glazing to those with climate-specific low-E coatings on single or multiple panes of glass.

Stephen Selkowitz, a senior adviser in the Building Technology and Urban Systems division at the Lawrence Berkeley National Laboratory (LBNL), recognizes that the considerations have made things more complicated for architects, but that there are ways forward. He urges architects, contractors, and homeowners to literally push the envelope—to demand more from windows so that they make a house more functional, efficient, and comfortable, and perhaps even energy-producing, through photovoltaics. (He presented a paper on this subject at the BEST Conference in Kansas City, Mo., earlier this year.)

"For a building in a mild climate with small windows where the goal is to just meet the code, the solutions are relatively easy," he says. "However, if an owner wants a highly glazed, net-zero solution in a moderate or harsh climate—and one that delivers comfort as well as net-zero energy performance—then that's a real challenge not easily met by teams today. It requires a motivated owner and an integrated design approach that focuses on performance goals from Day One and wants to address occupant needs and practices in concert with the building design."

For example, the amount of fresh air required in a building is generally determined by the expected peak occupancy rate and a fixed schedule. Yet we now have precise lighting controls that can detect occupancy on a much more granular level, even down to the desk or workstation of an office, for instance. This data can be shared with the HVAC system to determine ventilation requirements that are much more energy efficient and responsive to actual occupancy.

Selkowitz points to the New York Times Building near Times Square in New York City, for which LBNL was engaged to help design, evaluate, and specify an integrated solution with energy-efficient lighting and controls, automated shading systems, and an underfloor air-distribution system in what is essentially an all-glass building. In a 2013 report five years after occupancy, LBNL found the building had experienced 56 percent lighting energy savings, 24 percent total energy savings, and up to a 25 percent reduction in summer peak demand over a similar code-compliant building. Perhaps most importantly, occupants were generally satisfied with working conditions there and the operation of the "smart shading and lighting" solutions.

Technology and simulation become essential to these kinds of success stories. LBNL has developed two simulation software tools, RESFEN for residential applications and COMFEN for commercial ones, which give decision-makers useful information on the impact of various design variables, including U-factor/R-value, solar heat gain or shading coefficients, and context conditions. The Efficient Windows Collaborative, a joint effort between the Alliance to Save Energy and the CSBR, has developed two easy-to-use online tools for windows: A residential Window Selection Tool (efficientwindows.org) that is geared toward homeowners, and the Façade Design Tool (commercialwindows.org), structured more for the designer or architect.

Simulation tools have already made an impact on built work. For SERA Architects in Portland, Ore., the firm's residential work is typically urban multifamily housing ranging from 60 to more than 200 units. Because of many shared internal walls, fenestration in the exterior must be optimized, according to the firm's Sustainability Resources Group

AIADesign

CONTINUED

manager, Mark Perepelitza, AIA. "We balance the needs for daylight and views with heat loss and gain," he says. "For some projects we check scenarios in energy modeling tools, including COMFEN, to compare window and glazing configurations. The R-value of the fenestration assembly has a significant impact on winter heat loss."

Designers must strike a balance between managing solar heat gain without compromising transparency. "One option is to select different glazing based on solar orientation," Perepelitza says, "but for elevations oriented toward the south, horizontal shading is a great option because it can block high-angle summer sun while allowing low-angle winter sun."

Perepelitza points to the firm's Burnside 26 project, a four-story wood-framed residential building that opened in Portland last year. The building uses low-E glass coatings that were specifically selected based on solar orientation; but because the color difference is so subtle, Perepelitza says, the different glazing had no adverse impact aesthetically. "An integrated design process allows us to optimize energy, health, and comfort with visually compelling buildings," he says. "We have a good handle on the fundamentals—but there are still plenty of challenges and opportunities to push for even better performance."

At LBNL, Selkowitz's team is now convening a consortium of businesses around the new Active Integrated Perimeter Building Systems project. The team is tasked with creating an infrastructure for fenestration in which hardware and software are all seamlessly configured and operate efficiently to meet energy and comfort goals under all use and climate conditions. It's an ambitious goal, but one that Selkowitz is confident the team can achieve. "There is a lot of skepticism that these high-tech approaches can reliably work in buildings," he says, "and, realistically today, often they don't. Simply put, if we have the engineering infrastructure to create and deliver driverless cars, why can't we reliably deliver a building that manages shades, lights, and HVAC to achieve low-energy goals and keep occupants comfortable?" AIA

AIAPerspective

PHOTOGRAPHY: CARL BOWER

Driving the Debate

How we live and how we get around.

At first glance, transportation and residential design seem unrelated. One is about mobility and the other (unless you live in a truly mobile home or on a houseboat) is about rootedness. Yet how we get around determines how we put down roots and affects our outlook on the notions of community and connectedness. In this way, architects have a lot to talk about with highway engineers, planners, and elected officials—things such as advocating for land use policies that make the best use of human and material resources to help foster vibrant, healthy, and resilient communities.

The relevance of our profession to this issue is not new: Think of Pierre Charles L'Enfant, whose master plan for the then-new city of Washington, D.C., was shaped by how best to move people and goods into and around the capital. Something similar happened halfway around the world a century earlier in Jaipur, India, where Jai Singh II consulted architects to design his observatories and Jaipur's plan.

Fast forward to the 20th century. The automobile has shaped our world just as much as princes and architects have and, for the last century, it has been peerless in helping citizens realize their version of the American dream—freedom and a piece of land on which to build one's own house. Cars are also expressions of financial freedom. The cost of ownership is relatively inexpensive and there are a lot of ways that you can buy one or finance one. Today, Millennials are rethinking what freedom means. New car sales for the 18- to 34-year-old set have declined as urbanization has increased and the sharing economy of Uber, Lyft, and others has expanded. There is a shift in attitudes about how we lead our lives, from notions of community and neighborhood to the definition of family. This opens up the possibility of new ways to think about community and mobility.

Architects whose focus is residential design can play a key role in designing homes for this emerging constituency. What's called for, however, is more than a focus on four walls and a roof. How will you live outside those walls? How will you connect with your friends? That's design thinking applied to movement. That's an issue for architects. AIA

Elizabeth Chu Richter, FAIA, 2015 AIA President

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2015 SOLAR DECATHLON

INTRODUCTION BY NATE BERG
TEAM DETAILS BY SELIN ASHABOGLU
RENDERINGS COURTESY U.S. DEPARTMENT OF ENERGY SOLAR DECATHLON

By the mid-'90s, Richard King was starting to get frustrated. A physicist in the solar program at the U.S. Department of Energy, he'd been working to develop high-performance and highly reliable photovoltaic panels to provide solar energy. But despite the improvements made to the technology over the preceding decade, people were still reluctant to put them on their roofs. Solar panels weren't catching on.

"People didn't really know how to do it. Builders were kind of clueless back then," King says. "What I saw was a need for architects to come in and just design beautiful houses that the public would want."

That idea led King to create the Solar Decathlon, a collegiate competition to design and build energy-efficient houses, which is now in its seventh iteration. The dozens of homes built and exhibited as part of the competition since 2002 have shown how solar energy and environmental sustainability can be integrated into good design. The architecture students who are designing and building these houses are, in a sense, helping to make the case for solar energy.

But this is not just another student competition. The Solar Decathlon is also, effectively, an architectural testing ground where new ideas, technologies, and materials are put on display. Over the two-year timeline given to each chapter of the competition, these novel technologies and design approaches are vetted for their efficiency and applicability in real-world built projects. For the student architects working on the competition, it is an invaluable experience. For working architects seeing the results, it's a hands-on guide to the latest best practices in sustainable design.

The village of homes that is set up for the final stage of the 2015 Solar Decathlon is a showcase of innovative ideas and designs. The 14 teams in the 2015 competition (three others dropped out at various points during the two-year cycle) have implemented a wide variety of innovative technologies and approaches to sustainable building, including passive heating, cooling, and lighting; low-cost CNC-routed

plywood structural components; aquaponics and rainwater harvesting; temperature-control apps; climate-responsive designs that can adapt to changing conditions; and, of course, innovative approaches to integrating photovoltaic panels. Each of these technologies and approaches will be on full display at the village in Irvine, Calif., when the competition opens to the public on Oct. 8, offering a unique opportunity to see all of the latest cutting-edge developments in sustainable design in one place. "These are all things architects should be aware of," King says.

Practicing architects should also take advantage of what is essentially free research and development conducted by the competing teams. King likens the competition to the scientific method, in which new technologies, appliances, and ideas are designed, tested, and revised until the best solution emerges. Of course, not all of the tested ideas are successful. "Some of it is very experimental, and some of it has proven that it doesn't work so well," he says. "That's a learning process for the university students, but it's also a learning process for everybody." Even if some elements aren't quite ready to scale up to widespread industry adoption, many of the ideas proven on the competition grounds can easily be integrated into the professional work of an architecture practice.

"There's usually something out of the ordinary that will be inspiring for practicing architects. They can see [that] here's a different way to do really anything, from thermal mass to a little design twist," says Sandy Stannard, an architecture professor at California Polytechnic State University, San Luis Obispo and a faculty adviser for the school's 2015 Solar Decathlon team. She says the competition offers practitioners a chance to see experimental ideas put into action. "It invites a degree of creativity that isn't always an option for practicing architects who may have other restrictions" like limited time, small budgets, and itchy clients.

Seeing these more radical ideas being implemented is not only proof to practicing architects that far-out ideas can work, "it keeps us from getting complacent," says Amy Gardner, an associate professor of architecture at the University of Maryland who's been involved with the Solar Decathlon since its second iteration in 2005, and who led her university's team to win the competition with its WaterShed house in 2011. (Turn to page 56 to learn what has happened to the Watershed house since its 2005 victory.)

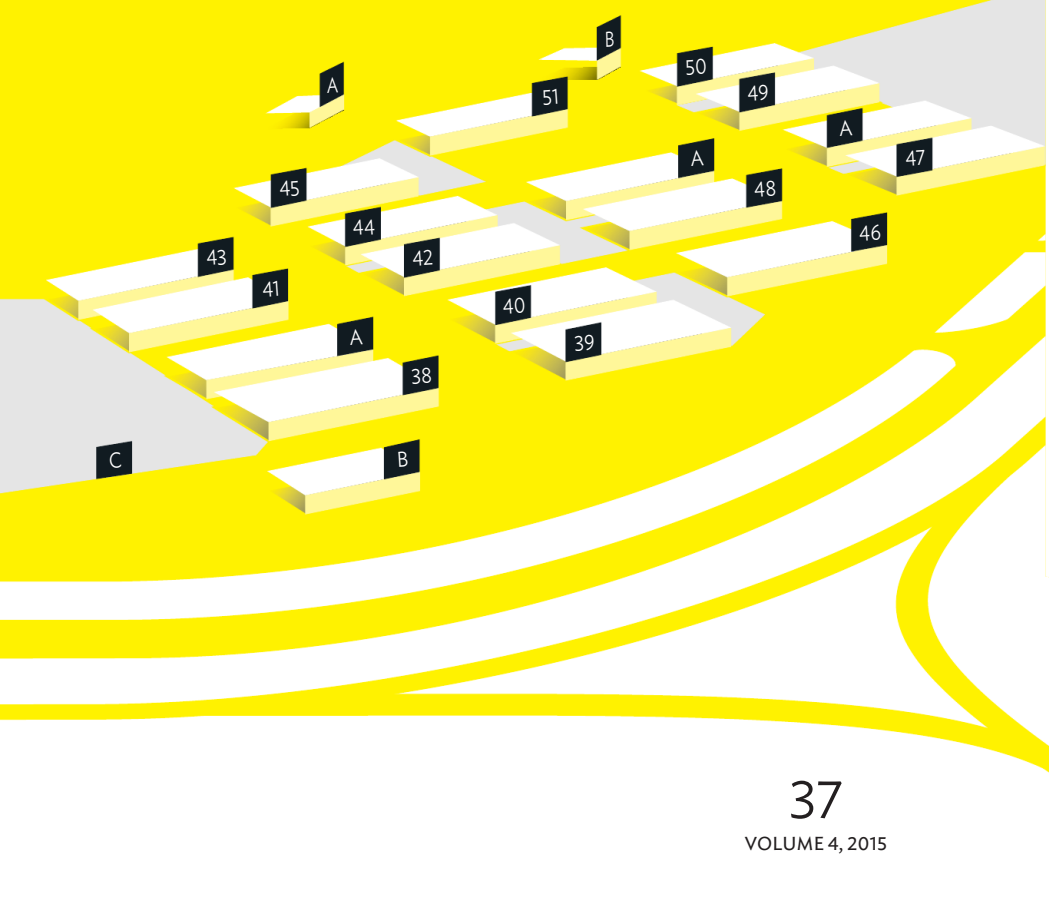
Gardner argues that working architects have a lot to learn both from the finished houses and also from the interdisciplinary nature of the competition, which requires architecture, engineering, planning, and business management to work very closely throughout the entire process. "You can't get the project done unless you act in a holistic way. And I think that it's kind of axiomatic that architects have to practice like that," she says. "My first reason for being interested in the competition was that I thought this was the way to change the way buildings are designed and built, using the tools available at the time. But the main goal was not so much a house as it was changing the profession."

With 1,500 to 2,000 students participating in each biennial competition, that change may be coming from the ground up. King argues that each competition creates a new generation of young architects that have a deep, baked-in knowledge of sustainable design that will heavily influence the work they do. "The competition is developing a new cadre of leaders that really understand," he says. "And they're out there in the working world now."

As they go from student competitors to working architects, these emerging professionals will help to continue the push towards more sustainable design in architecture. But they'll also need their more experienced colleagues to be equally literate in the language of sustainability if any of these ideas are to find their way into built projects. To keep up with the growing demand for energy-efficient, environmentally conscious, forward-thinking buildings, practicing architects have to be constantly learning about advancements in sustainable design. For that, the Solar Decathlon is a hands-on crash course.

RA **For complete coverage of each project in this year's competition, go to bit.ly/2015SolarDecathlon.**

2015 Solar Decathlon Competition Map



38 ShelteR³

39 Reflect Home

40 NexusHaus

41 DURAhome

42 Indigo Pine

43 INhouse

44 Nest Home

45 SURE House

46 Aggie Sol Home

47 EASI House

48 Casa Del Sol

49 GRoW Home

50 STILE House

51 ALF House

Not pictured because these teams dropped out before the final competition:

52 Y-House
Solar Living House
Harmony House

A Exhibitor Pavilions

B Information

C No Public Access

ShelteR^3

CROWDER COLLEGE
DRURY UNIVERSITY

ShelteR^3 is intended to provide a home for a family to recover in the wake of damage caused by a tornado. As such, the team emphasizes the three R's in its design: Resistance, Response, and Recovery. The modular home is wind resistant, easy to transport to areas in need, and adaptable to transition from temporary shelter to long-term habitation.

Sustainable Systems: Lexan polycarbonate layers; SIP roof with photovoltaic panels mounted flat

Wind Reinforcement: The SIP roof is anchored to the foundation of the house via steel threaded rods, minimizing the risk of damage caused by high winds.

Project Size: 997 square feet

Reflect Home

Sustainable Systems: Ductless, mini-split HVAC system; graywater capturing system; rooftop- and pergola-mounted photovoltaic panels

Indoor/Outdoor Living: Large shaded decks off of the living room and bedroom encourage outdoor living. Operable glass walls connect these spaces to the interior, increasing the square footage during nice weather.

Project Size: 996 square feet

CALIFORNIA STATE UNIVERSITY, SACRAMENTO

Reflect Home seeks to redefine the American starter home by realizing a net-zero energy house that is comfortable to live in and attainable for first-time home buyers. An open floor plan and offset levels allow for flexible living spaces, and clerestory windows shaded by overhangs let plenty of natural light into the wood-clad house with minimal heat gain.

NexusHaus

UNIVERSITY OF TEXAS AT AUSTIN
TECHNISCHE UNIVERSITÄT MÜNCHEN

NexusHaus tackles the need for affordable housing in Austin, Texas, with this inexpensive, modular, carbon-neutral home. One of the team's focuses was on water conservation, and they aim to build the first house in the city to collect rainwater from its roof and canopy and utilize it as potable water—some of which can then be recycled again by the house's graywater system.

Sustainable Systems: Integrated thermal energy and rainwater storage system; 6-kilowatt roof-mounted photovoltaic system

Making the Most of Water: Graywater collected from the shower, sinks, and laundry machine will be reused to irrigate the landscape around the house.

Project Size: 784 square feet

DURAhome

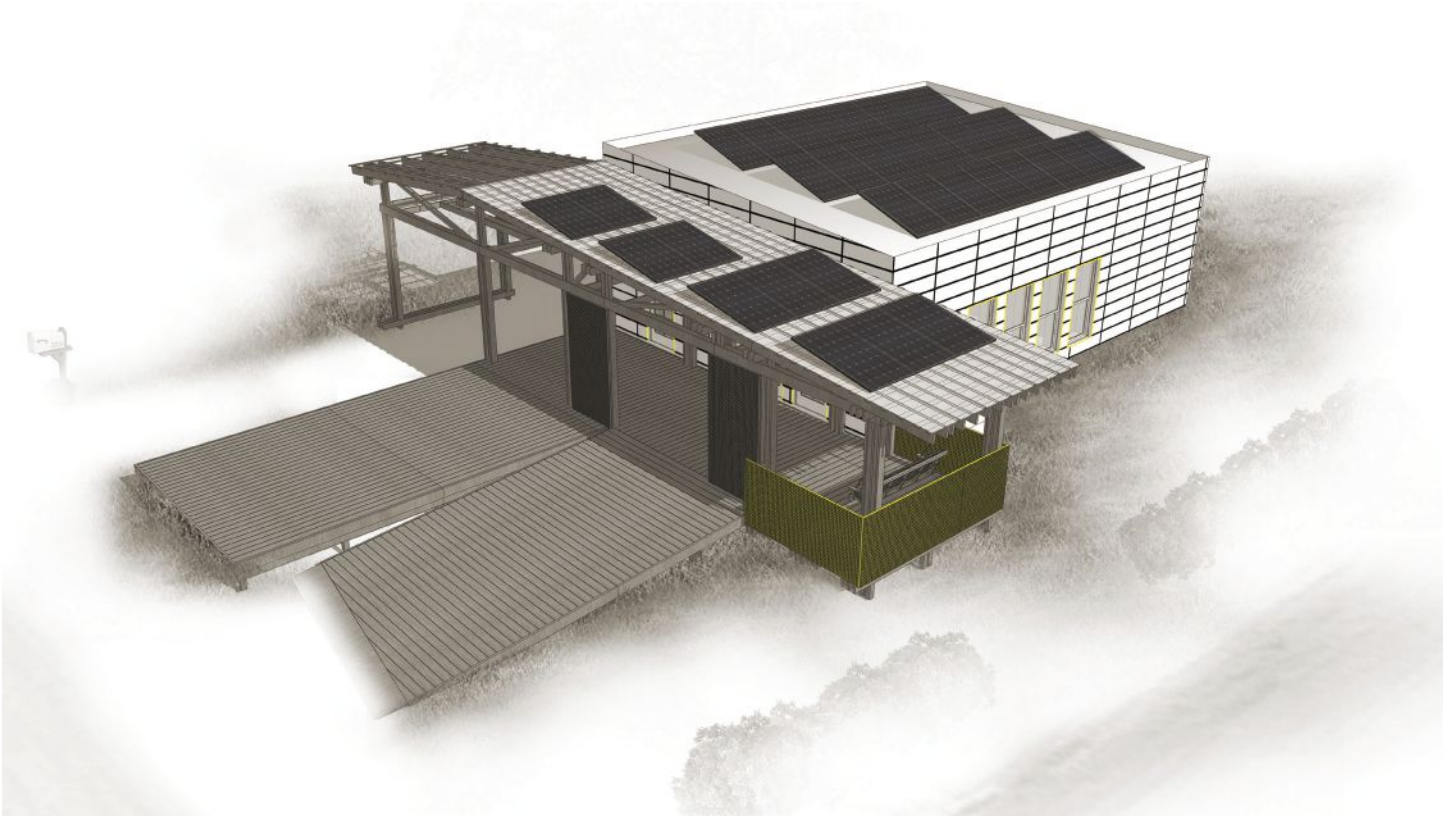
Sustainable Systems: 6.5-kilowatt photovoltaic array; graywater system; energy recovery ventilator

Passively Efficient: Passive House design principals reduce energy consumption throughout the house.

Project Size: 897 square feet

NEW YORK CITY COLLEGE OF TECHNOLOGY

The DURAhome is designed to be resilient against floods, high-force winds, and earthquakes. The house's efficient photovoltaic panels power the home, while its modular structure makes it capable of adapting to both a changing climate as well as making it suitable for a fast-growing city environment.



Indigo Pine

CLEMSON UNIVERSITY

Indigo Pine is a low-environmental-impact, cost-effective house designed for southern families. Its gabled ceilings (underneath the flat roof) and front porch were inspired by traditional southern architecture, but the house certainly takes advantage of modern energy efficiency and sustainable technology such as photovoltaic panels.

Sustainable Systems: Photovoltaic panels rated at 17% efficiency; a hybrid solar electric water heater; R-30 thermal resistance

Simplified Construction: A Sim[PLY] structural framing system cut out of 4′ x 8′ plywood sheets eliminates the need for on-site measuring, making construction more efficient.

Project Size: 1,000 square feet

INhouse

Sustainable Systems: Constructed wetlands system; bifacial solar panels; phase-change material duct

Energy Monitoring: Residents are able to receive real-time feedback on energy use throughout the house.

Project Size: 1,000 square feet

CALIFORNIA POLYTECHNIC STATE UNIVERSITY, SAN LUIS OBISPO

INhouse melds together a classic California design aesthetic with features that are interactive, integrated, and intuitive, and then couples those with an emphasis on water preservation. The home easily transitions from indoors to out, thereby maximizing the living space.

Nest Home

MISSOURI UNIVERSITY OF SCIENCE AND TECHNOLOGY

True to its name, this home was inspired by how birds construct their nests: by reusing materials. The structure of the house is made up of three steel shipping containers, insulation is provided by denim batting made out of old jeans, and the house's exterior skin is constructed out of used shipping pallets collected from the local community.

Sustainable Systems: Home automation system; 24 solar panels; graywater reclamation system

Green Thumb: Three types of hydroponic gardens can be found in the Nest Home—vertical wall, tower, and shade.

Project Size: 986 square feet

SURE House

Sustainable Systems: Plywood and glass-fiber composite sheathing; bi-folding storm shutters; building-integrated photovoltaic panels; resilient charging hub

Multipurpose Shutters: When folded up, the storm shutters act as a shading system and angle the solar panels towards optimal sun exposure.

Project Size: 1,000 square feet

STEVENS INSTITUTE OF TECHNOLOGY

Designed for coastal regions, the SURE House is solar-powered yet well equipped to withstand powerful storms. The house uses an innovative composite sheathing that wraps the house up to the designated FEMA Base Flood Elevation level and has bi-folding storm shutters that protect it from hurricane-force winds.

Aggie Sol Home

UNIVERSITY OF CALIFORNIA, DAVIS

The Aggie Sol Home was designed with West Coast agricultural workers in mind. This affordable, solar-powered, net-zero energy house's butterfly-sloped roof makes collecting rainwater simpler and divides the structure into three specific zones—two that are climate controlled, and one that is not, allowing for passive cooling and heating depending on the season.

Sustainable Systems: Tubular skylights; heat recovery system; in-line "balloon" framing

Easier Water Collection: The butterfly roof is sloped inwards, creating a single valley in which rainwater can be collected and drained.

Project Size: 995 square feet

EASI House

Sustainable Systems: Twenty-panel, 5-kilowatt solar array; Enphase Energy microinverters; Menck Windows energy-saving windows that use tilt-and-turn technology

Ample Space: Resource Furniture's space-saving furniture, such as fold-away beds, help make the house more spacious.

Project Size: 680 square feet

WESTERN NEW ENGLAND UNIVERSITY
UNIVERSIDAD TECNOLÓGICA DE PANAMÁ
UNIVERSIDAD TECNOLÓGICA CENTROAMERICANA

Sporting a name that stands for Efficient, Affordable, Solar Innovation, the EASI House is a modular, net-zero energy, solar-powered structure. The building maximizes its energy efficiency using automatic sensors and controls from Big Ass Solutions installed within the house.

Casa Del Sol

UNIVERSITY OF CALIFORNIA, IRVINE
CHAPMAN UNIVERSITY
IRVINE VALLEY COLLEGE
SADDLEBACK COLLEGE

This net-zero energy house was inspired by the drought-resistant California poppy flower and uses graywater irrigation, rainwater collection, and xeri-scaping in order to prevent the use of excess water. Its open layout not only accommodates a growing family, but also makes use of a passive solar design by regulating the heating, cooling, and lighting of the home using elements such as strategically positioned shading devices and natural ventilation.

Sustainable Systems: LibRe Lumencache lighting system; Envision geothermal hydronic heat pump; sub wet bulb evaporative chiller

Print Your Own Fixtures: The house has a 3D printer that uses biodegradable thermoplastic filaments to easily create fixtures for the home.

Project Size: 972 square feet

GRoW Home

Sustainable Systems: Twenty-four photovoltaic panels; Energy Star–qualified appliances; energy recovery ventilator

By the Numbers: The photovoltaic panels have a rated efficiency of 17.2%.

Project Size: 770 square feet

UNIVERSITY AT BUFFALO, THE STATE UNIVERSITY OF NEW YORK

The GRoW Home aims to be a self-sufficient house with a 320-square-foot greenhouse/solarium—aptly called the GRoWlarium—capable of producing food for its occupants year round. The building also uses photovoltaic panels and a solar hot-water heating system for further energy efficiency.

STILE House

WEST VIRGINIA UNIVERSITY
UNIVERSITY OF ROMA TOR VERGATA

STILE House, which stands for Sustainable Technology Integrated in a Learning Experience, has a modern aesthetic and is designed to function on solar power controlled remotely from the user's smartphone app made by Z-Wave technology. Photovoltaic panels line the Roman-inspired arch that covers the house, while a solar chimney passively regulates the indoor temperature.

Sustainable Systems: Monocrystalline photovoltaic panels; Z-Wave technology; solar chimney

Multifunctional Canopy: The Roman arch serves as shading, a passage for residents, and supports the solar panels.

Project Size: 880 square feet

ALF House

Sustainable Systems: Carrier energy recovery ventilator; photovoltaic panels that use monocrystalline panel technology; lighting dimmers from Lutron

Sun Catcher: A southern-facing, sloped roof creates an optimal angle for the photovoltaic panels to capture sunlight.

Project Size: 900 square feet

ALFRED STATE COLLEGE
ALFRED UNIVERSITY

The ALF House is a modular, net-zero energy home designed for a middle-class family of four. It's adaptability creates a favorable environment for various solar and renewable energy applications such as photovoltaic panels, and the house has a green wall that absorbs sunlight and rainwater.

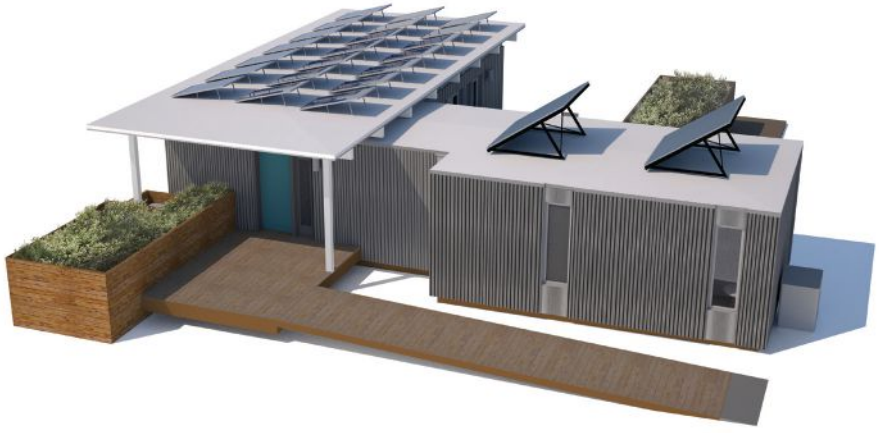
Here are the designs for three teams that were initially part of the Solar Decathlon program, but withdrew before the final competition in Irvine, Calif.

Y-House

YALE UNIVERSITY

This 750-square-foot house was designed to have a modular structure for adaptability, a communal garden to maximize social space, and natural ventilation to cool the living spaces.

Solar Living House



UNIVERSITY OF FLORIDA
NATIONAL UNIVERSITY OF SINGAPORE
SANTA FE COLLEGE

The team behind the Solar Living House used midcentury modern houses for their aesthetic and spatial inspiration, while updating the technological capabilities using systems for energy production and solar-powered dehumidification.

Harmony House

VANDERBILT UNIVERSITY
MIDDLE TENNESSEE STATE UNIVERSITY

The Harmony House was designed as a sustainable version of the traditional Tennessee "dogtrot" house, aimed at lower-income families in densely populated areas.

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WHERE ARE THEY NOW?

WaterShed

ROCKVILLE, MD.

Located at a utility company in Maryland, the Solar Decathlon 2011 winner is now a museum. Pepco Holdings, the parent of Maryland and D.C. utility company Pepco, acquired the University of Maryland's (UMD) winning entry, WaterShed, in 2012. (Pepco was also a sustainable partner in the competition.) In April 2014, the Pepco WaterShed Sustainability Center opened at the company's Rockville, Md., service center.

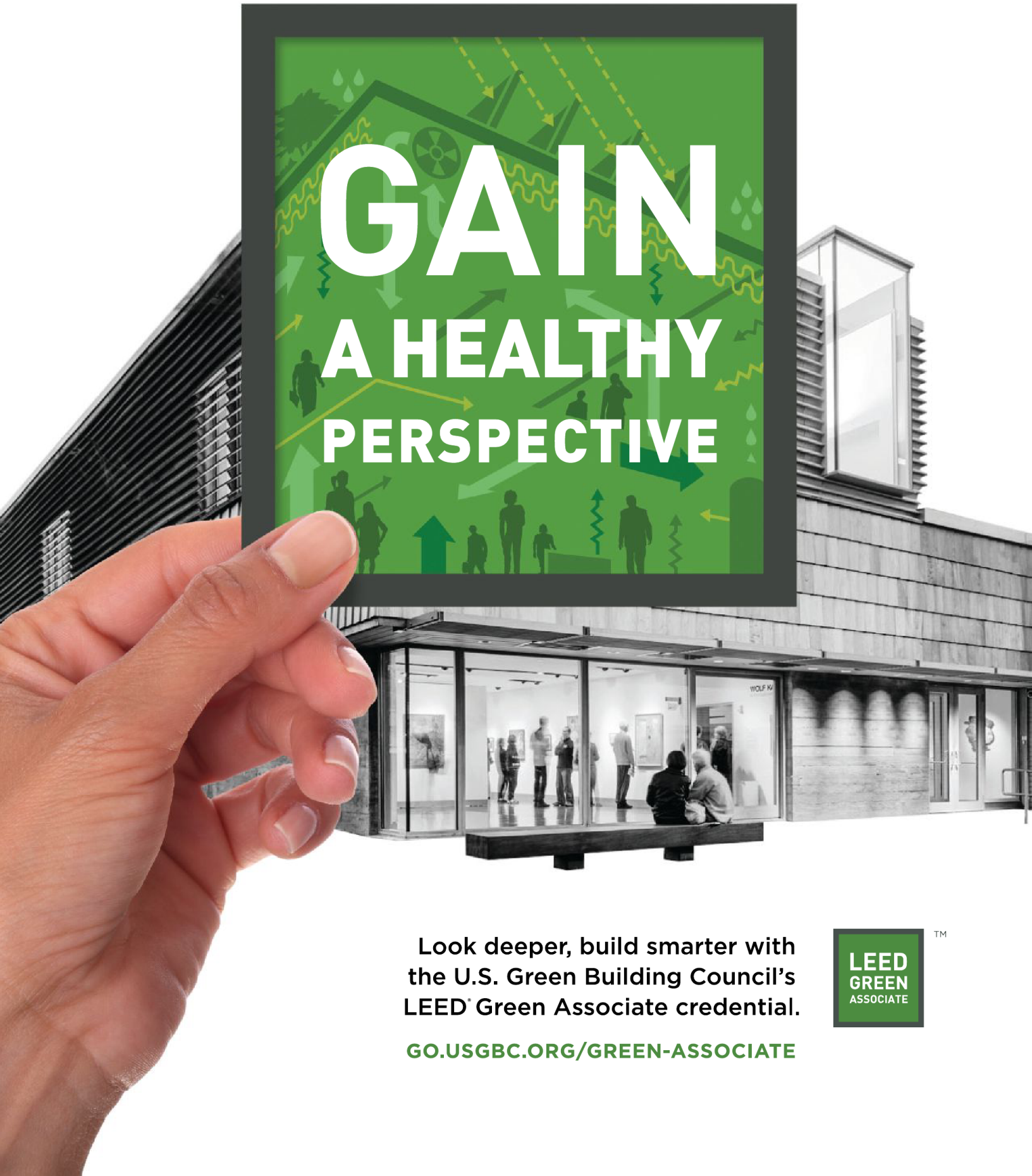
The Sustainability Center is designed to educate the public about energy-efficient technology and design. It contains two structures: the reconstructed WaterShed house and the Exploration Center, a purpose-built structure also designed by the UMD team. The latter contains technology demonstrations, including a residential microgrid powered by a set of on-site solar panels.

WaterShed is a 900-square-foot, three-room house with a wraparound deck that roughly doubles the living space. Forty-two solar panels mounted on the roof and pergola power the house as well as two electric vehicle charging stations. A green roof covers one side of the house, and wetlands on either side filter runoff.

One of UMD's student leaders, Scott Tjaden, proposed that Pepco expand the monitoring system (which tracks variables such as temperature, humidity, and runoff). "We're trying to see the actual performance," says Tjaden, now an environmental scientist and WaterShed's site manager, "and collect data with the systems we installed and get it back to the industry." —SARA JOHNSON

RA **More photos at residentialarchitect.com**

APRIL GREER



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