Award-Winning Coverage of Sustainable Construction, Products and Lifestyles

GREEN BUILDER®

September/October 2018 / www.greenbuildermedia.com

EFFICIENCY MATTERS

Despite uncertainties about the future, our annual Building Science issue finds the industry forging ahead with higher-performance homes and products.

BUILT FOR EFFICIENCY

DuPont™ Tyvek® Building Envelope Solutions

Keep the weather out. And the comfort in.

Build added durability, weather protection and energy efficiency into every home. DuPont™ Tyvek® weather barriers provide superior air and water holdout while allowing the building to breathe. When Tyvek® weather barriers are installed with DuPont™ Flashing Systems, you provide further protection against damaging and costly leaks from outside elements. That means greater confidence for you and lasting value for your customers.

weatherization.tyvek.com

CONTRACTOR REWARDS.COM

FOR GREATER GOOD™

EFFICIENT, MONEY-SAVING

PRODIGY

THE RHEEM® *PRESTIGE*® HYBRID ELECTRIC WATER HEATER is the smartest, quietest and most efficient water heater available–paying for itself in less than 3 years.

Earth-Friendly Efficiency – Lets homeowners shower, do the dishes and wash the laundry all while producing fewer greenhouse gases

Impressive Savings – Saves homeowners $4,750 over 10 years[1]

Industry's Smartest – Provides water leak detection[2], protective alerts and maintenance notifications via mobile app

Whisper Quiet – Operates so quietly, no one will notice it's on

Rheem.com/HybridSolutions

ELIGIBLE FOR NATIONAL UTILITY REBATES

AVAILABLE IN 50, 65 AND 80 GALLONS

PRO REMODELER TOP 100 PRODUCTS

works with nest

ENERGY STAR

EcoNet®

[1]*Based on comparison of the 50-gallon Hybrid Electric model against the estimated annual operating cost of a standard electric water heater of like capacity manufactured prior to 2015 under NAECA II which is likely being replaced. Savings over 10 years and will be slightly lower for 65- and 80-gallon models.* [2]*Built in leak detection alerts of a water leak so you can take action to prevent home damage.*

Rheem®

The new degree of comfort.®

EDITOR'S NOTE
The Inside Scoop

By Matt Power
Editor-in-Chief

Science Isn't Perfect, But It Beats Regret

A SHORT TIME AGO, Hurricane Florence bore down on North Carolina. Coincidentally, the North Carolina Home Builders Association's conference had just started—but builders left the conference early to prepare their job sites and businesses for the deluge.

A Bloomberg report cited Metrostudy data that indicates builders in the Raleigh-Durham region have about 7,500 new homes in their inventory, approximately 600 of which are under construction in coastal Wilmington.

Flash back six years: The same builder association helped bankroll conservative state Rep. Pat McElraft, who put forward a bill rejecting predictions about the state's vulnerability to massive flooding and damage—made more dire by climate change.

Gov. Bev Perdue, a Democrat, let the legislation quietly become law by doing nothing. Bad policymaking is not always partisan.

Mountains of data were shoved under the dunes. In the years since, thousands of new homes have been built in the same vulnerable locations, using the same old inadequate building science. Resilience be damned.

Let's assume, for the sake of argument, that the tiny minority view of climate change deniers is right, and that monster storms like Florence are just part of a natural cycle of nature's fury.

Does it make sense, even given this premise, to build to the bare minimum of wind and flood compliance? Does it make sense to lobby against standards that would increase the strength and resilience of coastal homes?

These are questions that thousands of upset homeowners may be asking after the fact, as storms such as Florence lay waste to their investments.

The worst injustice of these losses is that they don't have to happen. The latest building science of disaster-proofing homes rests on decades of post-mortem analysis of storm effects. Florida is a prime example, with its new, much stricter building codes. The last couple of major hurricanes have done almost no damage to homes built to the new code.

Raising an existing home from a foundation onto piers can cost $30,000 to $100,000. Instead, building "above code" on piers with new construction can cost considerably less. But builders need to get on board with the urgency of preparing homes for the worst. Science shows that the storms of the future will not follow predictable patterns. So-called "1,000-year" storm events, with sea level surging far above current flood maps, may be the new normal.

If you were building a home for yourself on the outer banks of North Carolina, wouldn't you apply the best building science available to make sure the home would survive all but the worst storm events? As construction professionals, your clients trust you. Do them and the industry at large a favor, and take a proactive role with regard to building science. Make your homes tougher, more efficient and more resilient than the climate change skeptics think they need to be. I guarantee you that when the flood waters subside, and the home you built is the only one standing on the beach, you'll have more business than you can handle—while your competitors battle lawsuits from devastated former clients. GB

Disaster déjà vu? After Hurricane Matthew slammed into North Carolina in September 2016—causing $4.8 billion in damage to the state—more than 80,000 homeowners were left picking up the pieces of their wrecked dwellings.

Green Builder® Media presents

SUSTAINABILITY Symposium 2019

THE DESERT SHALL BLOOM:
SOLUTIONS FOR A VERDANT PLANET

February 18, 2019
9:00 am – 5:30 pm

Artemus W. Ham Concert Hall
University of Nevada Las Vegas
Las Vegas, Nevada

A sincere thank you to our generous sponsors and partners for helping to make the Symposium possible!

Green Builder Media is delighted to announce the Sustainability Symposium 2019: The Desert Shall Bloom. For anyone who cares about green building, sustainable innovation, and climate action, this is truly a can't miss event.

Brimming with vision and ingenuity, the agenda features global leaders including:

- A welcome message from **Jeff Bridges**, Academy-Award winning actor and climate activist (yes, 'The Dude'!)
- **General Wesley Clark (ret.)**, four-star general, former Army Chief of Staff, Presidential advisor, and fervent climate action advocate
- **Bill Walton**, NBA All-Star icon and passionate sustainability enthusiast
- **Susan Kucera**, award-winning Director, Cinematographer, and Producer of eco-films including "Breath of Life" and "Living in the Future's Past" (co-produced with Jeff Bridges)
- **Gwen Migita**, Social Impact & Inclusion Vice President and Chief Sustainability Officer, Caesars Entertainment
- **Ron Jones**, Founder/President Green Builder Media and industry provocateur

NEW THIS YEAR! Green Builder Media will celebrate our annual Home of the Year Award winners, and our expanded Sustainability Award winners, at a festive dinner on February 17 at 6:00 p.m. at the exclusive Mr. Chow in Caesars Palace. Our renowned awards program recognizes the industry's most authentic, advanced, beautiful, sustainable projects and the professionals who design and construct them.

Space is strictly limited and by reservation only, so reserve your seat today! General admission for the Sustainability Symposium is $350. Register before October 1, 2018 using the Code EarlyBird and you'll receive a $100 discount. Tickets for the Sustainability Awards gala are $150.

To register for the Sustainability Symposium 2019: The Desert Shall Bloom, go to www.greenbuildermedia.com/desert-shall-bloom-2019

To enter a project into Green Builder Media's Sustainability Awards, go to www.greenbuildermedia.com/11th-home-of-the-year-call-for-entries

Net Zero the New Norm by 2030?

A declaration by mayors worldwide sets 2030 target date for new buildings, 2050 for old.

SEVEN U.S. MAYORS and 12 more worldwide have pledged to work toward making all new buildings net zero by 2030, in an effort to cut overall greenhouse gas emissions. The leaders of Copenhagen, Johannesburg, London, Los Angeles, Montreal, New York City, Newburyport, Mass., Paris, Portland, San Francisco, San Jose, Santa Monica, Stockholm, Sydney, Tokyo, Toronto, Tshwane, Vancouver and Washington, D.C., also pledged to ensure all buildings in the cities, old or new, will meet net-zero carbon standards by 2050.

The Net Zero Carbon Buildings Declaration (**https://bit.ly/2BJ818H**), signed by all 19 mayors, calls for creation of a roadmap to reaching net-zero status, development of a suite of supporting incentives and programs, and release of an annual progress report.

Furthermore, 13 cities, including Copenhagen, Johannesburg, Montreal, Newburyport, Paris, Portland, San Jose, Santa Monica, Stockholm, Sydney, Toronto, Tshwane and Vancouver are committed to owning, occupying and developing only assets that are net-zero carbon by 2030.

Buildings in urban areas are one of the largest sources of greenhouse gas emissions, and typically account for more than half of a total city's emissions on average, according to climate change leadership group C40 Cities. In London, Los Angeles and Paris, buildings account for more than 70 percent of the cities' overall emissions. And, half a million people die prematurely each year due to outdoor air pollution caused by energy used in buildings, the organization notes.

CREDIT: DAVID PHAN/FLICKR

Brighter days ahead? San Francisco is one of 19 cities committed to requiring all new buildings to be net zero by 2030. The mandate would extend to all buildings by 2050.

"Combating climate change is a moral necessity, an environmental imperative and an economic opportunity," Los Angeles Mayor Eric Garcetti says. "By pledging to reduce the carbon footprint of our buildings, cities are moving us another step closer to the goals of the Paris Agreement—and the promise of lower emissions, less pollution and more renewable energy innovation."

It will not be a simple effort, according to C40 Cities. City governments do not have direct control over all buildings within their boundaries. They will need to work with state and regional governments and the private sector to make things happen, the group notes. **GB**

Coastal States Are Getting a Sinking Feeling

Global warming-related flooding has dropped property values by $14.1B since 2005.

CLIMATE CHANGE-INDUCED SEA LEVEL RISE has resulted in $14.1 billion in lost home values in eight East Coast states, according to research by Brooklyn, N.Y.-based nonprofit First Street Foundation (FSF).

FSF's two reports released in July and August reveal loss of $3.08 per square foot of living area for waterfront properties impacted by tidal flooding and $3.71 per square foot of living area for land near roads subject to tidal flooding, from 2005 to 2017.

The combined research covers New York, New Jersey, Connecticut, Florida, Georgia, Virginia, North Carolina and South Carolina.

"We all knew that flooding issues were getting worse from sea level rise, but the home value loss associated with it is truly staggering," FSF Executive Director Matthew Eby says. "The time to act is now."

The states impacted the most were Florida, where 384,548 homes have lost $5.42 billion in value, and New Jersey, where 112,583 homes have lost $4.5 billion in value, according to the data.

CREDIT: BALDEAGLEBLUFF/FLICKR

Sinking fortunes. Once, this house on Holland Island, Md., was one of dozens that were oceanside. But over the past century, a rising ocean level buried the island—taking the other homes with it.

First Street Foundation has integrated the data into its Flood IQ (**https://floodiq.com/**) flood risk tool, which enables property owners to check their individual property value loss and the total loss for their city. **GB**

Rising Sun

Community solar is making green power an option for anyone with an electric bill.

CONSUMER AND BUSINESS demand for solar power is growing faster than ever. Demand by persons and companies that normally can't get it is expected to grow even faster.

According to a new study by GTM Research, community solar—systems that are shared by multiple residences or businesses, with the bill split between them—has grown by 53 percent since 2013, more than twice the 26 percent rate of all solar systems.

Community solar is becoming popular because it allows families that normally lack access to traditional systems—such as those whose homes do not have roofs or with technical limitations—to have the same benefits of green power as other homeowners, according to the study, *The Vision for Community Solar: A Roadmap for 2030.*

CREDIT: GTM RESEARCH

Bringing the heat. Demand for solar energy has become so strong, households unable to install traditional units are turning to community systems to meet their needs—which translates to busier times for installers.

That's great news for up to 74 million homeowners and businesses. "Community solar gives all 151 million electricity customers in the U.S. an opportunity to directly participate in solar," the study notes. "Community solar gives all customers the ability to choose local clean electricity that can support local economic development, resiliency and healthier communities." **GB**

CREDIT: PAVEMENT PRESERVATION & RECYCLING ALLIANCE

Paving tools. The new RoadResource.org website incorporates tools, calculators, technical information and advice to help roadway managers and other project managers make the wisest decisions when working with pavement.

Road Recycling Hub

PPRA's new website offers free info on roadway preservation and recycling.

IN AN EFFORT to promote successful, sustainable use of asphalt pavement during construction, the Pavement Preservation and Recycling Alliance (PPRA) has launched RoadResource.org (https://roadresource.org/), a digital hub offering more than 500 pages of accurate information about pavement preservation, recycling and optimized network management.

According to AEMA President Mark Ishee, the site compiles relevant information with a standardized technical menu on 18 pavement preservation, recycling and emulsion treatments, alongside useful network comparison calculators. The site allows users to learn and explore freely, applying concepts and strategies to their own pavements and networks, and provides a chance to see firsthand how progressive network approaches can impact taxpayers, pavement conditions and the bottom line.

"We wanted to give users the benefit of sitting down with experts in the industry," says Scott Bergkamp, a representative with the International Slurry Surfacing Association (ISSA), a primary contributor to the site. "It's as if we're driving the roads with you, pointing out what we see and what we know to be helpful."

PPRA leadership plans to roll out additional communication initiatives, including newsletters to agencies, educational webinars, and informative printed and digital materials to serve as an educational and functional hub for roadway managers across North America, according to Ishee. **GB**

Cornell Tech Takes Top Honors With ‘The House’

LEED’s Home Award winners includes industry leaders, innovators and ‘power builders.’

BY MARY SCHROTT

CORNELL UNIVERSITY’S THE HOUSE at Cornell Tech in Roosevelt Island, New York City, has been named as the U.S. Green Building Council (USGBC)’s 2017 LEED Home Awards Project of the Year, the association announced.

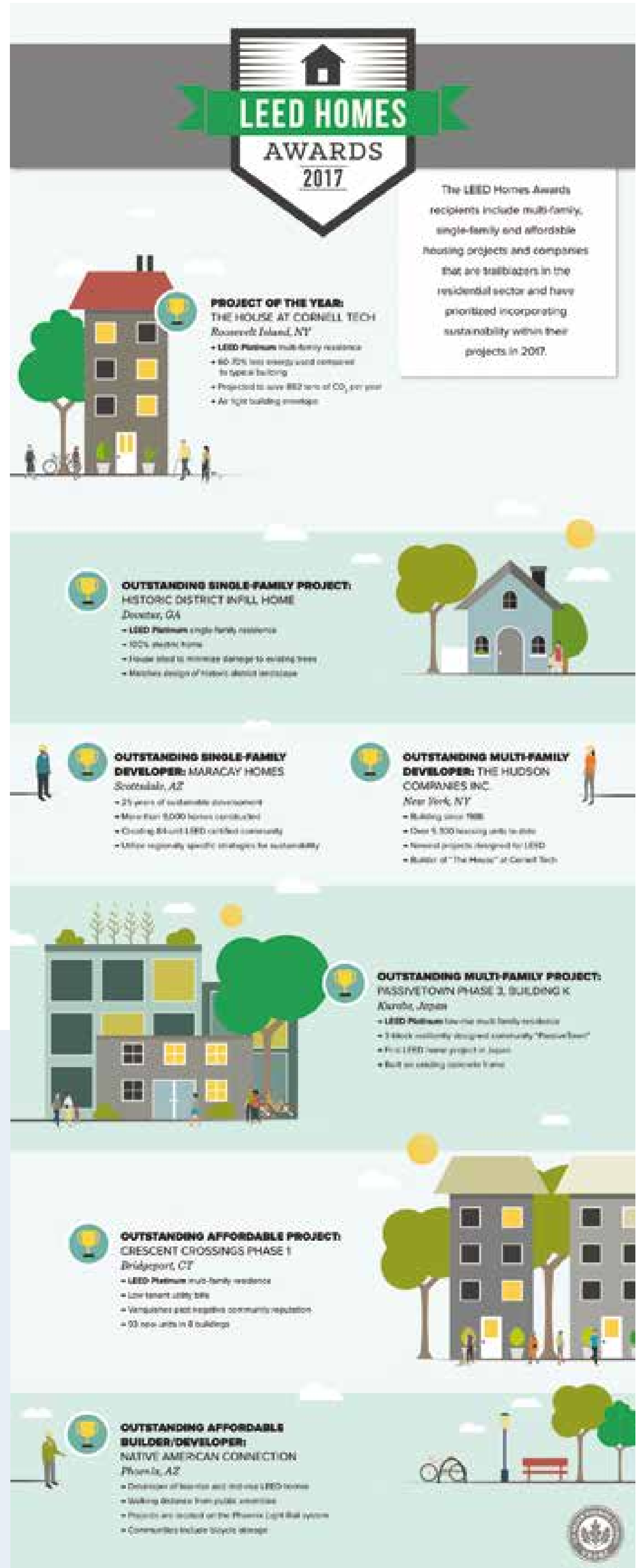
LEED’s annual competition recognizes innovative projects, architects, developers and homebuilders leading the residential green building market, according to USGBC President and CEO Mahesh Ramanujam. “We believe that every building, especially homes, should be green,” he says. “The LEED Homes Awards showcase the most inspired and efficient practices in the residential green building movement. These leaders show what it means to create a home that balances aesthetic appeal with real human and environmental needs.”

Winners in the competition’s seven major categories include multi-family, single-family and affordable housing projects, and companies that utilized innovative and effective sustainability methods in residential spaces in 2017, Ramanujam notes.

The grand winner, nicknamed “The House,” is a LEED Platinum-certified apartment building occupied by Cornell Tech students, staff and faculty. It is also the world’s first residential high-rise built to Passive House standards, according to Handell Architects, the project’s designer. The 26-story structure uses 60-70 percent less energy than that of a similarly sized typical building. The House is also projected to save 882 tons of CO_2 per year, about the same as planting 5,300 trees.

Other companies involved in the project included Cornell University, The Hudson Companies, Steven Winter Associates, Buro Happold, Vidaris and Monadnock Construction. A complete list of winners is at **www.usgbc.org**. **GB**

Mary Schrott is USGBC’s media and communications associate.



Standing tall. Energy-saving and carbon emissions-absorbing construction elements helped The House at Cornell Tech win USGBC’s 2017 LEED Home Awards Project of the Year competition.

USGBC also announced its “LEED Homes Power Builders,” those developers and builders that “have exhibited an outstanding commitment to LEED and the green building movement within the residential sector.” Developers and builders must have LEED-certified 90 percent of their homes per unit count built in 2017. Homes at any LEED certification level were eligible for consideration:

- Construction Rocket Inc.
- JHM
- Habitat for Humanity of Kent County
- The Dinerstein Companies
- Metro West Housing Solutions
- Forest City Realty Trust
- MHI Dallas
- Gerding Edlen
- Koral & Gobuty Development
- Frankel Building Group
- AMLI Residential
- C&C Development
- Alliance Residential
- Carmel Partners
- Native American Connections
- The Community Builders
- Thrive Home Builders
- Active West

GREEN BUILDER®

Volume 13, Issue 6
September/October 2018
Published by Green Builder® Media

GREEN BUILDER MAGAZINE
EDITORIAL OFFICES
PO Box 97
Lake City, CO 81235
303-246-8890
www.greenbuildermedia.com

GREEN BUILDER MEDIA LEADERSHIP
Sara Gutterman CEO
sara.gutterman@greenbuildermedia.com
303-246-8890

Ron Jones President
ron.jones@greenbuildermedia.com

Cati O'Keefe
Chief Development Officer / Editorial Director
cati.okeefe@greenbuildermedia.com
513-532-0185

ADVERTISING SALES
Craig M. Coale Publisher
craig.coale@greenbuildermedia.com
512-344-9754

Scott Cunningham Southeast
scott.cunningham@greenbuildermedia.com
678-576-1487
AL, AR, FL, GA, NC and SC

John Clemens West Coast
john.clemens@greenbuildermedia.com
951-404-7000
AZ, CA, NV, OR and WA

AUTOMOTIVE ADVERTISING SALES
Dawn Rivard
dawn@focusmm.net
586-214-0635

EDITORIAL
Matt Power Editor-in-Chief
matt.power@greenbuildermedia.com
207-619-2713

Alan Naditz Managing Editor
alan.naditz@greenbuildermedia.com
916-681-2057

O'Brien Design Art Direction
john.obrien@greenbuildermedia.com
207-865-9908

Therese Workman Copy Editor
info@greenbuildermedia.com

Melissa Smith Web Editor / Cognition Project Manager
melissa.smith@greenbuildermedia.com

PRODUCTION
Mary Kestner Production Manager
mary.kestner@greenbuildermedia.com

CIRCULATION
Mary Kestner
mary.kestner@greenbuildermedia.com

GENERAL INFORMATION
admin@greenbuildermedia.com
360-376-4702

FINANCE
Dan DeGolier Chief Financial Officer
dan.degolier@greenbuildermedia.com
303-503-1000

Hannah Judson Controller
hannah.judson@greenbuildermedia.com
970-397-5483

Problems with your subscription?
For assistance, please contact Mary Kestner, Project Coordinator
mary.kestner@greenbuildermedia.com

Subscription Information
Subscribe to *Green Builder* magazine and receive valuable information about how to increase your bottom line, differentiate your business and change the world. At $39.95, it's an easy return on your investment. Just go to www.greenbuildermedia.com and click on "subscribe." To unsubscribe or change your address, email your name, company and address to: mary.kestner@greenbuildermedia.com.

Green Builder has reduced its environmental impact through Zerofootprint Offsets www.zerofootprintoffsets.com. Almost all of the natural resources used to produce *Green Builder* will be returned to the environment by planting trees and restoring watersheds. Also, greenhouse emissions will be mitigated through carbon offsetting. (Printed on recycled paper.)

zerofootprint ENERGY

NEW! SUBSCRIBE TO OUR NEWSLETTERS
www.greenbuildermedia.com/enewsletter-subscribe

@greenbuildermag
@visionhousegbm

www.instagram.com/greenbuildermedia

facebook.com/GreenBuilderMedia

pinterest.com/greenbuilder

ISSN 1559-4971

www.greenbuildermedia.com/subscribetogreenbuilder
Click above to subscribe to *Green Builder* magazine today!

www.greenbuildermedia.com/about-green-builder-media
Click above to learn more about Green Builder® Media.

MISSION STATEMENT: "Our mission is to effect meaningful, positive change for a better world. As advocates for sustainability, we provide mind-expanding information that catalyzes and inspires commitment to sustainable living."

TABLE OF CONTENTS

FEATURES

DEPARTMENTS

HERE'S A SAMPLE OF WHAT'S INSIDE

"The latest building science of disaster-proofing homes rests on decades of post-mortem analysis of storm effects [...] builders need to get on board with the urgency of preparing homes for the worst."

(Page 02)

ON THE COVER

EFFICIENCY MATTERS

Visit us at www.greenbuildermedia.com
for up-to-date news analysis, case studies, new green projects, code and reg updates, thought-provoking blogs, cutting-edge products and much more.

CREDIT: BESTGREENSGREENISTOCK

Annual Building Science Report 2019

EFFICIENCY MATTERS

CONTENT BY THE U.S. DEPARTMENT OF ENERGY, EDITED BY GREEN BUILDER STAFF

This year's housing innovations from the U.S. Department of Energy preserve the art of sustainable living.

A FEW YEARS AGO, as the number of subdivisions in a Northern California community began to explode, a long-time homeowner snidely remarked that he didn't see why everyone was so eager to move into a new home. "After all," he grumbled, "they're just another pile of wood and nails."

The U.S. Department of Energy would disagree. The cutting-edge housing brought forth this year by DOE is all about saving—as in saving energy, resources, time, money and lifestyles. One home is designed to withstand a forest fire. Another comes through the efforts of military veterans who are trained in green building. A third's airtight nature is guaranteed to help cut a homeowner's electric costs. And so on.

In addition, all projects showcased here are winners of DOE's annual Zero Energy Ready Home (ZERH) 2017 Housing Innovation Awards. The ZERH program requires builders to meet a host of high-performance requirements. These include certification to Energy Star Certified Homes Version 3.0, the U.S. Environmental Protection Agency's Indoor airPLUS, the insulation mandates of the 2012 International Energy Conservation Code, and the hot water distribution totals set by EPA's WaterSense program.

The homes must also have solar electric panels installed or have the conduit and electrical panel space in place for future installation of solar panels. And, every home is performance tested by a third-party home energy rater to verify that the requirements have been met.

Such homes, according to DOE Building Technologies Office Chief Architect Sam Rashkin, are "designed to provide a whole new level of homeowner experience" through lower living and maintenance costs, healthier environments and greater durability.

That's a lot to accomplish with "just another pile of wood and nails." But then—as you'll see on the following pages—a lot has happened to that pile, and a lot has taken place because of it. There's even more to come.

Flame guard. As a safeguard against wildfires, Alliance Green Builders crafted a home that includes stucco and concrete walls, stone and tile ground covering, metal roofing and high-impact windows.

COURTESY OF ALLIANCE GREEN BUILDERS

A Real Fire Fighter

Casa Aquila defies wildfires with resilient systems.

BY GREEN BUILDER STAFF

THE ELEGANT SINGLE-STORY stucco-and-glass house atop a hill above Ramona, Calif.'s San Pasqual Valley may not look very castle-like, but the home was built with a host of features that make it a veritable fortress against wildfires, the common enemy of Southern California homeowners.

When the Witch Creek fire took their previous home in 2007, along with 1,000 other homes in the neighborhood, the owners were determined that one day they would build a home that could resist the fires, and have the energy and water self-sufficiency to hold out through the multi-day power outages that often accompany wildfire season in the Southern California hills.

"Casa Aguila" includes fire- and power outage-resistant features such as stucco and concrete walls, stone and tile ground covering, metal roofing and posts, high-impact windows, energy-efficient construction, on-site wind and solar power generation and storage, and on-site water collection and recycling systems. For energy efficiency, Alliance Green Builders certified the home to the U.S. Department of Energy's Zero Energy Ready Home (ZERH) criteria (see page 15).

This uber-efficient home also achieved a LEED platinum certification from the U.S. Green Building Council and was the first home in San Diego County to be certified by the Passive House Institute U.S. In its pursuit of water and energy self-sufficiency, the project team received the county's first on-site wastewater treatment permit. They also designed a rainwater collection system to supply all indoor water uses. With the solar PV tracking system, solar thermal water heating, 45-foot wind turbine and battery storage, the homeowners are well on their way to achieving grid independence.

START WITH THE SHELL

Even with large solar capacity, energy self-sufficiency would be hard to achieve without first constructing a very energy-efficient shell. For this, the builder turned to the DOE ZERH program.

The builders exceeded code insulation requirements with double

Weather stabilizer. A bio-based phase-changing material lines the walls and ceiling to help even out day-night temperature swings.

COURTESY OF ALLIANCE GREEN BUILDERS

walls consisting of a 2-by-6 exterior wall and a 2-by-4 interior wall, set 7 inches apart to form a 16-inch cavity stuffed with R-57 of dense-packed cellulose. The inner walls and ceilings are covered with a bio-based phase-changing material that helps stabilize temperatures inside the home. The phase-change material consists of sheets of plastic containing pockets of a nontoxic gel with a defined melting point; the material cools the room as the wax melts, and warms the room as the wax re-solidifies. The sheeting is hidden behind a volatile organic compound (VOC)-absorbing drywall that lines the walls and ceilings. The outer wall is sheathed with ⅜-inch OSB that is coated with a liquid-applied waterproofing and air barrier product, which takes the place of housewrap to cover the walls and window and door openings with a seamless layer of protection. The walls are clad with traditional three-coat stucco applied over metal lath and one layer of stucco wrap. The home's wood framing is treated with fire- and termite-resistant borate.

WORKING A WAY INSIDE

The windows, which are set deep into the 16-inch-thick walls, are a key to the home's fire defense system. It turns out that exterior wood is not the chief source of ignition for house fire damage during wildfires in Southern California. Rather, most fires start inside from

embers blown through broken windows. The Santa Ana winds that cross California during wildfire season can get whipped up by the fires to such high velocities that they can pick up rocks and pelt windows with enough force to shatter glass. To protect against this

COURTESY OF ALLIANCE GREEN BUILDERS

One with the sun. Casa Aguila performs far better than net zero, thanks to a super-efficient building shell, a wind turbine, three sun-tracking solar photovoltaic arrays and solar thermal water heating.

threat, Alliance installed triple-glazed, tempered glass windows with an outer pane of impact-resistant laminated glass. The R-5 insulated windows also provide year-round energy efficiency with coatings to reduce heat transfer.

The roof consists of 2-by-8 rafters topped with ½-inch OSB coated that is coated with the liquid-applied waterproofing membrane that also covers the wall sheathing to form a continuous air and water barrier. This is topped with 6-inch-thick structural insulated panels (SIPs) that have a polyurethane core with a higher melting point than most foams. The SIPs are covered with a roofing underlayment and a standing-seam gray metal roof with a solar reflective index of 52 to help resist solar heat gain. Netting is attached to the underside of the roof rafters, and the space is filled with blown cellulose. Below that is a 2-inch gap and then 2-by-6 ceiling rafters that are covered with the phase-change material and drywall. The gap provides more space for insulation above the recessed can lights.

The home's slab-on-grade foundation is wrapped in 1 inch of expanded polystyrene (EPS) insulating foam. Embedded in the concrete is plastic piping for the home's radiant heating and cooling system.

FORWARD-THINKING TEMPERATURE CONTROL

The home actually has several heating and cooling systems. Most of the hot water for the radiant floor heat is provided by nine 4-by-10 (360 square feet) solar thermal collectors mounted on the roof. An air-to-water heat pump provides backup water heating and water cooling. Additional water cooling, should it be needed for extremely high summer temperatures, is available via a ducted fan coil system (with cold water from the air-to-water heat pump). Per the owners' request, a third system was installed consisting of a minimally ducted mini-split heat pump with fan coils to provide back-up heating and cooling to the bedrooms. This redundancy may seem excessive for a passive house, but according to builder Jeff Adams, "the system has been designed for a climate that could be dramatically different in 100 years or more."

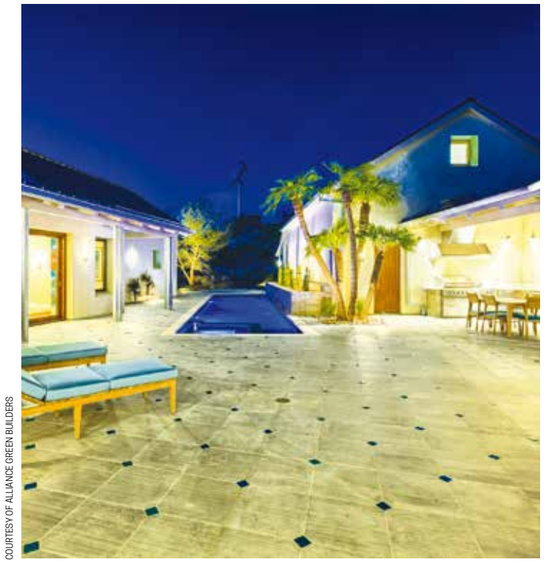
The solar thermal system is also the primary source for the home's potable hot water. The air-to-water heat pump and an 80-gallon heat pump water heater provide backup domestic hot water. The hot water distribution system was designed to cut water loss to 1 cup before hot water reaches any bath or kitchen fixture.

The hilltop home is self-sufficient for water. Five 10,000-gallon tanks collect rainwater from the roof to supply 100 percent of the family's indoor water use. Four more 10,000-gallon tanks collect stormwater from the site, and one additional 10,000 gallon tank collects graywater (from the shower, baths, sinks and washing machine). This stormwater and graywater is filtered and used for irrigation and fire suppression. A separate system collects blackwater from toilets and kitchen sinks in a septic tank; from there, it is aerated and filtered, and the clean water is pumped into another 1,000-gallon holding tank for drip irrigation.

The homeowners requested an electric production system that can allow the home to eventually go off grid. Three large dual-axis solar trackers were installed on a leveled area south of and below the home. Each tracker holds 474 square feet of photovoltaic panels, for a total capacity of 21 kW. The panels can rotate in multiple directions;

COURTESY OF ALLIANCE GREEN BUILDERS

Aqua Aguila. Solar thermal panels provide hot water for the pool, spa, domestic hot water and radiant floor heat.



COURTESY OF ALLIANCE GREEN BUILDERS

Excessive warmth warriors. A summer kitchen on the patio helps keep heat and humidity out of the home, as do solar-reflectant metal roofing, SIP roof panels, deep overhangs and triple-pane Passive House-certified windows.

sensors direct them to the brightest point in the sky, even on cloudy days. They can generate power for more than 12 hours per day and are expected to produce about 44,000 kWh per year.

In addition, a 45-foot-tall helical 3.2-kW wind turbine was installed on the hill just above the home, to take advantage of what is considered one of the best wind-generation sites in San Diego County. The wind turbine is expected to produce 5,000 kWh per year of power.

The home now operates off of 20 12-volt solar batteries, but is grid-tied to use the grid for backup power. When more battery storage is added, the home will be able to be completely energy self-sufficient.

RATED FOR LOW EDR

Like all DOE ZERHs, the house was evaluated by an energy rater. California uses the California Energy Design Rating (EDR) rather than the national Home Energy Rating System (HERS) score, for verification to the state's Title 24 energy code. This home scored a very low 43 EDR without the renewable energy systems included. With the solar and wind resource included, the home achieved a remarkably low EDR of -92.

The home's performance testing included blower door testing, which revealed an extremely tight building envelope with only 0.32 air changes per hour at 50 pascals pressure difference (ACH 50), nearly twice as tight as the 0.6 ACH 50 required by Passive House. To bring fresh air into the home without significant energy loss, Alliance installed a heat recovery ventilator (HRV). The HRV draws in fresh outside air through a filter and ducts the air to bedrooms and living spaces, while exhaust ducts pull air from the kitchen and bathrooms. The incoming and outgoing air ducts cross in a heat exchanger, which transfers heat from the warmer stream to the cooler stream, helping to warm incoming air in the winter and cool incoming air in the summer. Alliance tested a new model of HRV from Italy that also allows for some humidity control.

With the filtered ventilation system, and other features like low-VOC finishes or good moisture management, the home met the clean air requirements of the EPA's Indoor airPLUS.

The homeowners are happy to share the lessons of their home with others. Alliance Green Builders partners Jeff Adams and Rich Williams, founders of the San Diego chapter of Passive House U.S., have used the home for numerous tours and consider sharing lessons learned the "icing on the cake" for this project. "Designing arguably the most energy- and water-efficient home in San Diego [...] is incredibly rewarding," Adams says. **GB**

KEY FEATURES

DOE Zero Energy Ready Home Path: Performance.

Walls: Staggered 2-by-4s, 12-inch o.c. on 2-by-6 plates, 2-stud corners, ladder blocking at wall intersections, right-sized insulated headers, window and door framing aligned with 12-inch o.c. wall studs, R-25 dense-packed cellulose, 0.5-inch coated OSB sheathing, air-sealed housewrap, fiber cement. Window and door openings get flexible flashing and beveled sills.

Roof: Coated OSB sheathing, 13-inch raised heel trusses, 24-inch overhangs, 30-pound felt, ice-and-water shield at eaves. Energy Star light asphalt shingles.

Attic: Vented: all top plates foamed, 16-inch R-60 blown cellulose, few penetrations.

Foundation: Basement only 4 feet deep for daylight, insulated on exterior with 3-inch rigid XPS, 2-inch XPS beneath slab, drain mat over exterior insulation.

Windows: Vinyl-frame triple-pane, low-E, U=0.22-0.18, SHGC=0.24.

Air Sealing: 0.98 ACH 50.

Ventilation: Air-cycler-controlled fresh air intake balanced to timered exhaust fans.

HVAC: 96 percent AFUE gas furnace, 14 SEER AC. Ducts un-insulated, in conditioned space.

Hot Water: Tankless gas EF 97.

Lighting: 95 percent LED.

Appliances: Energy Star dishwasher, clothes washer.

Renewables: 2.8-kW PV.

Water Conservation: 100 percent WaterSense fixtures.

Energy Management System: None.

Other: No-/low-VOC primer, paint, cabinets, flooring. Pre-wired for electric car charger.

Sustainability showcase. Amaris Homes' Afton Model in Afton, Minn., utilizes numerous energy-saving exterior elements, such as insulated sheathing, and interior products such as an ice-and-water shield under the roof.

COURTESY OF AMARIS HOMES

A Net-Zero Initiative

Amaris Homes goes right to work saving energy and cutting waste with its Afton, Minn., project.

BY GREEN BUILDER STAFF

FEW BUILDERS ARE BOLD ENOUGH to offer even a one-year guarantee on their homes. Raymond Pruban of Amaris Homes offered a 10-year guarantee on his model home in Afton, Minn., promising that it would be a net-zero-energy performer, producing as much energy as its occupants used each year, for a decade.

What inspired such confidence? Pruban had made a commitment to certify all of his homes to the strict performance criteria of the U.S. Department of Energy's Zero Energy Ready Home (ZERH) program and, since making that promise in 2013, the custom home builder had already certified 11 homes through the program.

Amaris Homes met all DOE program criteria (see page 15) and included a 12.1-kW solar system on the model's roof. The home had calculated energy savings of $4,500/year compared to a home built to the state code (the 2012 IECC) and achieved a Home Energy Rating System (HERS) score of 9. Even without the PV, the home would score a HERS 39, far below the 80 to 100 HERS score of typical new homes.

The energy savings show: Despite a hard winter, the home's February 2017 bill revealed a credit of $110.38. Homeowners can also use the surplus to power an electric car with the charging station in the garage.

WHAT'S ON THE OUTSIDE COUNTS

The high-performance home started with a highly efficient shell. The concrete foundation slab was wrapped in rigid foam with R-10 under the slab and R-15 hugging the slab edges.

The exterior walls are constructed with 2-by-6 studs set 24 inches on center and aligned with the 24-inch on-center floor and roof trusses. On the exterior, the walls are sheathed with 7⁄16-inch OSB, then covered with a 1-inch layer (R-5.5) of rigid foam, which dramatically reduces thermal bridging, or the transfer of heat through the studs. The wall cavities were filled with R-21 of high-density spray foam,

Power-miser appliances. The home's high-efficiency Energy Star-rated refrigerator, dishwasher and exhaust fans, and low-flow fixtures contribute to electricity and water savings.

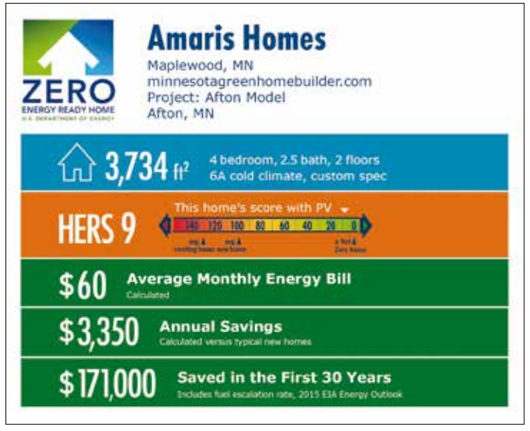
COURTESY OF AMARIS HOMES

which combines with the exterior rigid foam for a total wall insulation value of R-26. This wall assembly eliminates condensation potential in the wall cavity in Minnesota's cold climate (zone 6). Headers over doors and windows were constructed with a single ply of wood, rather than layers of solid wood, to allow space for closed-cell spray foam insulation.

The exterior insulated sheathing is topped with housewrap that is taped at the seams and overlapped to provide a continuous weather-resistive barrier and drainage plane under the board-and-batten engineered wood and stone siding. All wood-to-wood seams in the walls and around windows and doors and the wood-to-concrete joints along the base of the walls are sealed with thick beads of caulk or adhesive to reduce air infiltration and seal out pests, dust and exterior allergens.

LOSING THE LEAKS

Attics can be a major source of air leaks. The gaps around light fixtures, flues, heating ducts, vents, and between sheetrock and wall top plates can add up to one large hole. Amaris sealed all of these leaks at once by covering the entire ceiling deck with two inches of spray foam. They covered this with 12 inches of blown cellulose to increase the insulation value to R-65.5. The



vaulted ceiling over the great room was insulated with R-49 of closed-cell spray foam. Before installing the spray foam, Amaris installed full-length air chutes (or baffles) along the underside of the roof to maintain a ventilation path in each truss bay from

COURTESY OF AMARIS HOMES

Tools of temperature control. A high-efficiency gas boiler provides hot water for the zoned radiant floor system as well as for faucets and showers. A high-efficiency heat pump provides zoned cooling.

the soffit vents to the continuous ridge vent. The vaulted ceiling was spray foamed when the wall cavities were foamed, before the ceiling drywall was installed. Shorter air chutes were also installed at the eaves above the flat ceilings to provide a path for ventilation air and a "back stop" to keep insulation out of the soffit vents. The baffle-top plate juncture was sealed with spray foam when the rest of ceiling was foamed after the ceiling drywall was installed.

The roof decking was covered with ice-and-water shield to 36 inches above the vertical wall line, then topped with 15-lb asphalt-impregnated felt underlayment. All valleys were flashed with metal. Metal roof edging was installed at all exposed roof decking. Step flashing and kick-out flashing were installed at any house-wall intersections. The roof was topped with architectural asphalt shingles. Three-foot overhangs at the eaves provide shade and rain and snow protection for the walls and windows.

The windows are double paned and vinyl framed with low-emissivity coatings and an insulating argon fill between the panes. They have a better-than-code insulating value of U-0.22 and a low solar heat gain coefficient (SHGC) of 0.21 to allow for more beneficial solar heat gain in this cold climate location.

The extensive use of spray foam helped to create a tight house. Blower door testing, required in the DOE ZERH program, confirmed that the house had a whole-house air leakage rate of 1.1 air changes per hour at 50 pascals (ACH 50).

AIRING THINGS OUT

To bring fresh air into the home, Amaris installed an energy recovery ventilator (ERV). The 80-cfm, 76-watt HRV brings in fresh air through an outside air intake that is ducted to the return side of the central air handler for the furnace. At the same time, the ERV exhausts stale air that is pulled from returns in each room of the home. The air ducts cross in a heat exchanger where heat is transferred from the warmer duct to the cooler duct, warming the incoming air in winter and cooling the incoming air in summer. The incoming air also passes through a high-filtration MERV 16 filter capable of removing particles as small as pollen, mold, dust, auto fumes, bacteria and smoke. The bathrooms have local ventilation with Energy Star-rated motion sensor-controlled exhaust fans. Amaris specifies low-VOC paints, stains and adhesives to help keep contaminants out of the house.

The home is equipped with a highly efficient natural gas boiler (annual fuel utilization efficiency [AFUE] of 0.95) which supplies hot water for the in-floor hydronic heating and for domestic hot water. Cooling is provided by a two-stage air-source heat pump and distributed by an air handler with a variable-speed DC motor. The heat pump has a cooling efficiency (seasonal energy efficiency ratio (SEER) of 16.0 and a heating efficiency (heating season performance factor) of 9.8. All HVAC ductwork is rigid metal ducting that is sealed with an interior spray sealant. The ducts

COURTESY OF AMARIS HOMES

Illumination. All of the Alton home's lighting needs are met by LED fixtures.

COURTESY OF AMARIS HOMES

Built for a lifetime. To ensure longer value to a homeowner, the builder added several aging-in-place features, such as wider doors and hallways, and zero-step entryways.

are located within the insulated, conditioned space of the home, as required by DOE ZERH. A mechanical room over the centrally located entry of the H-shaped home serves as the center point for four heating and cooling zones in the home's left and right wings.

While these energy-saving features are a financial plus for any homeowner, residents will find many other benefits thanks to the ZERH requirements and Amaris's thoughtful design. The home meets all clean air and moisture management mandates of the EPA's Indoor airPLUS program (a DOE ZERH requirement). This equates to lower indoor humidity, better filtration and ventilation, and fewer contaminants in the home. Pruban also added several aging-in-place features, like wider doors and hallways, zero-step entryways and a zero-step master shower.

Because Minnesota experiences severe storms and even occasional tornadoes, Pruban took pains to strengthen the building envelope. Amaris uses let-in bracing and installs metal strapping every 48 inches along the exterior walls to secure roof, wall and floor framing to the foundations. Structural sheathing fasteners are attached every 3 inches along the edges of the sheets and every 6 inches in the field. The 3 inches of closed-cell spray foam used to insulate the exterior walls has been shown in testing to provide at least 200 percent additional shear (lateral) strength. Amaris also uses upgraded hold-downs and reinforced garage doors.

IN THE LIMELIGHT

The DOE homes have caught the attention of local media, and Amaris has been the subject of newspaper, magazine and web articles, and radio and TV news stories. The Afton home was featured in two Parade of Home events and received more than 2,000 visitors, with some coming from as far as 200 miles away.

"Establishing these higher standards in our specifications has attracted sub-contractors who are intrigued by the idea of building something different and better," says Pruban. "This has enabled us to take on higher dollar value projects with confidence." Pruban notes that the company's warranty costs have also gone down since the switch to high-performance construction. GB

KEY FEATURES

DOE Zero Energy Ready Home Path: Performance

Walls: 2-by-6 24 inch o.c., R-21 closed-cell spray foam plus R-5.5 rigid foam over 7/16-inch plywood for R-26 total; housewrap, engineered wood siding.

Roof: Ice-and-water shield 36 inches past wall line; 15# felt; metal valley, edge and step flashing; kick-out flashing; 3-foot overhangs at eaves; continuous ridge vent; vents and baffles in each truss bay; architectural asphalt shingles.

Attic: Vented, raised-heel trusses; 2-inch closed-cell foam on ceiling deck for interior barrier plus 12-inch blown cellulose for R-65.5 total. R-49 closed-cell spray foam in vaulted ceilings.

Foundation: Slab-on-grade, R-10 rigid exterior foam, R-10 rigid foam under slab.

Windows: Double-pane, low-E, argon-filled, vinyl-framed, U=0.22; SHGC=0.21.

Air Sealing: 1.10 ACH 50.

Ventilation: ERV, motion-controlled exhaust fans. MERV 16 filter.

HVAC: 0.95 AFUE gas boiler for in-floor radiant heat; 9.8 HSPF/16 SEER air-source heat pump with spray-sealed metal ducts in three zones.

Hot Water: Gas boiler; super-insulated in-direct storage tank; recirc pump.

Lighting: 100 percent LED.

Appliances: Energy Star refrigerator, dishwasher and three exhaust fans.

Solar: 12.1-kW PV.

Water Conservation: EPA WaterSense fixtures. Rainwater harvesting.

Energy Management System: Smartphone PV tracking; thermostat and lighting controls.

Other: One 240-volt quick charge electric car charging station in the garage. Low-VOC finishes. Wheelchair accessible; wider hallways and doors; zero-barrier shower. Metal ties roof to foundation.

Ready for zero. Greenhill Contracting's homes are all built to the Department of Energy's Zero Energy Ready Home program standards, which include requirements for air, water, insulation and solar energy.

COURTESY OF GREENHILL CONTRACTING

Example of Efficiency

For Greenhill Contracting, building zero-energy-capable homes are an everyday thing.

BY GREEN BUILDER STAFF

NEARLY 10 YEARS AGO, homeowners of one of the nation's first zero-energy homes, built in the Green Acres community in New Paltz, N.Y., posed the question, "Why isn't every home built this way?"

While many are still pondering that question, builder Anthony Aebi of Greenhill Contracting in Esopus, N.Y., is doing his part to make sure more homes *are* built that way.

Aebi built his first zero-energy home by accident in 2007, when his search for a better building material led to insulated concrete forms (IFCs). When an energy rater tested the home's performance, he told Aebi he had just built the first zero-energy home in the Northeastern United States. Aebi soon signed on with the U.S. Department of Energy's Zero Energy Ready Home (ZERH) program and committed to building all of his homes to DOE's criteria (see page 15). Now 10 years later, Aebi has certified 25 homes through the ZERH program (and nine homes through its predecessor, the DOE Builders Challenge). Aebi routinely achieves Home Energy Rating System (HERS) scores of under 10 with photovoltaics, or under 40 when the renewable energy is not counted in the scoring. Most typical new homes built to code would score about 80 to 100.

The 3,912-square-foot home Aebi built on an empty lot in an existing development in Gardiner, N.Y., scored a HERS 33 without PV, or HERS 2 when PV is included. Homeowners can expect to save nearly $5,500 per year in energy costs compared to a similar-sized home built to the state's energy code.

GREEN BUILDING MASTER

Aebi is more than willing to share the secrets of his success with others in the homebuilding community. He has spoken at state and regional conferences, including the regional ACI (now Home Performance Coalition) conference, the New York State Green Building Conference and the Energy and Environmental Building Alliance (EEBA) conference. He's also met with representatives of

COURTESY OF GREENHILL CONTRACTING

Rain guard. A thick waterproofing paste is applied around window and door openings to provide a seamless layer of protection against rain intrusion.

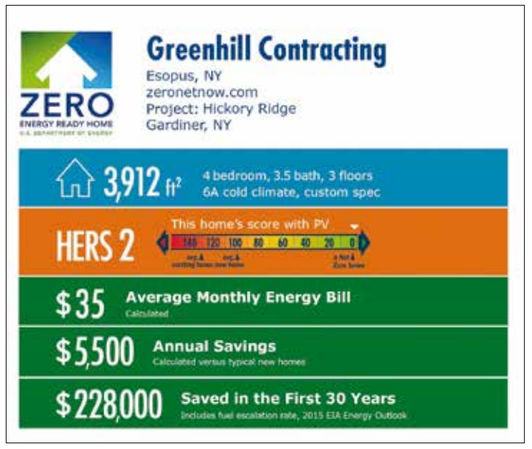
the New York State Energy Research and Development Authority (NYSERDA) and provided instruction to builders through their sponsorship. More than 10 articles by or about Aebi have appeared in trade publications. Greenhill hosted a series of open house events and several zero-energy educational tours in 2017 for building professionals, code officials, students and homebuyers.

For the past several years Aebi has provided tours for students from the engineering department of nearby West Point Military Academy. Aebi is currently working with West Point students who are preparing to participate in the DOE's Race to Zero Student Design Competition.

Aebi has also added articles and videos to his website to help homebuyers understand what goes into a zero-energy home. He's increased his presence on social media platforms like Facebook and Twitter.

Greenhill Contracting has worked with a real estate agent to put together information packets for prospective buyers that include brochures (from DOE ZERH and EPA's Indoor airPLUS), testimonials, case studies and a cost-benefits calculator. Greenhill has provided training in its energy efficiency features for sales agents who actively promote their homes through online databases, open houses and outdoor signage.

Aebi recognizes the value of homeowners as spokespersons for their energy-efficient construction. "Many of our new homeowners were referred by current homeowners of Greenhill zero-energy homes," he says.



COURTESY OF GREENHILL CONTRACTING

Working parts. A highly efficient GE *GeoSpring* water heater helps homeowners receive a credit on their monthly utility bill.

To educate homeowners and keep them informed, Greenhill provides each of them with an individualized homeowners' manual providing details on the features of their home. The company now offers annual spring and fall service checks to ensure systems are operating properly and filtration features are well maintained.

ALL ABOUT BARRIERS

All of Greenhill's homes are constructed with ICFs, which not only provide energy efficiency advantages, but are also rated to withstand hurricane-force winds and earthquakes.

The homes start with the super-insulating properties of ICFs, which are hollow foam blocks that stack like *Legos* to form a hollow wall that is reinforced with steel rebar and then filled with concrete. The concrete hardens, and the foam sides remain in place to form a solid wall with continuous rigid insulation on the inside and exterior. Aebi starts the ICF walls below grade where they serve as the foundation stem walls, providing R-22 of slab-edge insulation for the basement floor slab. The slab is poured over 4.3 inches (R-27) of closed-cell spray foam, which is sprayed directly onto a clean gravel base. The ICF blocks also serve as the basement and above-grade walls extending all the way up to the roof line of the two-story homes.

The ICF blocks are sealed at the seams to provide a continuous air barrier. They also serve as the drainage plane on the exterior side of the walls so no housewrap is needed. To protect the framing where windows or doors will be installed, an elastomeric waterproofing compound is applied with a caulk gun and putty knife to provide a seamless, jointless flashing layer around the openings. Vinyl siding is used for the exterior cladding.

Aebi constructs a sealed, unvented attic that is insulated on the underside of the roof deck with two types of spray foam. He sprays 11 inches of open-cell spray foam against the roof decking (R-4.45/inch) then covers this with 2 inches of closed-cell spray foam insulation (R-7.4/inch) to completely fill the roof rafter cavities and encase the rafters, providing R-64 worth of insulation and creating a thermal break to keep heat from transferring to the outside. Above the roof deck, a self-adhered bitumen membrane is installed at the roof edges and valleys, and the roof is covered with enhanced-performance shingles that have a 130-MPH wind-speed rating and a lifetime warranty.

High-performance triple-paned windows complete the thermal envelope of this snug, draft-free home.

The remarkably airtight home showed blower door whole-house air leakage results of only 0.12 air changes per hour at 50 pascals pressure difference. That level of airtightness (which is typical of Aebi's homes) is far below the 3

COURTESY OF GREENHILL CONTRACTING

Sustainably 'LED'. One-hundred-percent LED lighting keeps energy costs low for homeowners—and makes the house easy on the eyes at night.

COURTESY OF GREENHILL CONTRACTING

Insulated secret. Greenhill's homes are wrapped in closed-cell foam insulation, from under the slab to the underside of the roof deck and roof rafters—but you'd never know it from the outside.

ACH 50 required by the 2012 International Energy Conservation Code and even well below the 0.60 ACH 50 required in the Passive House Institute U.S. (PHIUS) standard.

BRINGING IT BACK FOR MORE

To provide fresh air for the homes, Aebi installed an energy recovery ventilator (ERV). The ERV runs 24/7 at low speed to exhaust air from the bathrooms, kitchen, laundry and attic. The bathroom exhaust registers are also equipped with occupant-controlled boost settings, and the kitchen range has a dedicated, occupant-controlled 100-cfm range hood fan. Fresh air is brought into the home from an air duct that brings the outside air through the ERV, which has a MERV 13 filter on it.

The ERV also contains an exhaust duct, which pulls stale air out of the house. Both ducts pass through a heat exchanger that transfers heat and humidity from the warmer air to the cooler air, thus "recovering" warmth to heat up incoming air in the winter and cool incoming air in the summer. The incoming fresh air is then ducted to the return side of the air handler, where it is again filtered via a set of electro-static and media air filters rated at MERV 13 to help ensure clean air for the airtight home.

The home is heated and cooled with a highly efficient air-source heat pump rated to have a coefficient of performance (COP) of 3.62 and an energy efficiency ratio (EER) of 12. The air handler is located in the conditioned basement, and all of the sealed metal ducts are located within the conditioned space of the home. The heat pump has a modulating condenser and variable-speed ECM blower.

Hot water is provided by an air-source heat pump water heater with a 50-gallon tank and an energy factor of 3.4.

OTHER ENERGY-SAVING ASPECTS

Additional energy savings come from 100 percent LED lighting and Energy Star-rated appliances. Low-flow plumbing fixtures reduce water and water-heating demand. Drought-tolerant turf and native plants were planted to eliminate the need for landscape irrigation systems.

Aebi noted that the ICF house is energy efficient and disaster resistant. With the footing-to-roofline steel reinforcement, the ICF exterior walls are resistant to earthquakes, tornadoes and hurricanes. Hurricane clips and closed-cell spray foam in the attic reduce the potential for roof uplift during high winds. The ICFs are fire, moisture and bug resistant. The home's highly insulated enclosure reduces the impacts of power outages. Pipes are less likely to freeze, and interior temperatures can be maintained for days.

After 34 homes, the custom and production builder is beginning to make zero-energy-ready home construction look easy. In fact, for Aebi the most challenging part isn't technical difficulties with the construction. It's "convincing everyone that building high-performance homes is easy, and the right thing to do for us all." GB

KEY FEATURES

DOE Zero Energy Ready Home Path: Performance.

Walls: R-22 ICF, vinyl siding, liquid-applied door and window flashing.

Roof: Asphalt shingles, peel-and-stick membrane at edges and valleys.

Attic: R-64 vaulted ceilings, insulated, unvented roof with 11-inch open-cell plus 2-inch closed-cell spray foam.

Foundation: ICF below-grade foundation walls for R-22 at slab edge, R-27 closed-cell spray foam under slab.

Windows: Triple-pane, U=0.20, SHGC=0.23, argon-filled, vinyl-framed.

Air Sealing: 0.12 ACH 50.

Ventilation: ERV continuous 20 cfm in baths and 43 cfm in kitchen with boost speeds and timers; MERV 13 and electrostatic filters.

HVAC: Air-source heat pump, 3.62 COP, 12.0 EER, all ducts inside.

Hot Water: Air-source heat pump water heater, 50-gal., 3.4 EF.

Lighting: 100 percent LED.

Energy Star Appliances: Refrigerator, clothes washer, dishwasher, heat pump clothes dryer.

Solar: 10.26-kW PV.

Water Conservation: Low-flow fixtures; drought-tolerant plants.

Energy Management System: None.

Other: Disaster-resistant ICF construction with spray-foamed roof and hurricane clips; triple-pane windows; maintains indoor temperature thru multi-day power outages. No-VOC paints; 75 percent of construction debris recycled.

Twice as good. Thrive Home Builders' award-winning Courtyard townhomes include energy-saving aspects such as double-wall construction.

COURTESY OF THRIVE HOME BUILDERS

Regal Residences

Heavy insulation, top-notch air sealing and energy-miser appliances make Courtyard Rows a crowning achievement in multi-family living.

BY GREEN BUILDER STAFF

THRIVE HOME BUILDERS COULD REST ON ITS LAURELS. After all, the Denver-based company has won grand awards for housing innovation from the U.S. Department of Energy four years in a row. Thrive has built more DOE Zero Energy Ready-certified homes than any other builder in Colorado and has the second-highest number of homes certified nationally, with 280 as of August 2017.

Gene Myers, the owner and CEO of Thrive Home Builders, was awarded the Denver-area Home Builders Association 2016 Builder of the Year Award. Thrive was the first "solar standard" builder in Colorado and the first production home builder to include DOE Zero Energy Ready Home (ZERH) certification as a standard feature for an entire series of houses.

With the Courtyard Rows townhomes at RidgeGate, in the Denver suburb of Lone Tree, Thrive becomes the first builder in Colorado to offer net-zero-energy construction in a townhome community. This includes placing solar voltaic panels on all 86 of the project's homes. All units will be equipped with at least 2.44 kW of PV panels; an upgrade to 6.2 kW is available. "Denver's suburbs have never seen anything like this before," says Thrive Home Builders Vice President of Operations Bill Rectanus.

Designing a multi-family product with sufficient roof space for a meaningful system is a major design challenge, according to Rectanus. "With RidgeGate's large, monolithic roof plane design and a site plan that enabled strong solar access, Thrive was able to reach 6.2-kW PV arrays on this residence at Courtyard Rows, which is virtually unheard of in multi-family construction," he says.

With the upper-end solar panels, Courtyard Rows achieves an impressive Home Energy Rating System (HERS) score of about 8, or net-zero-energy performance. Fortunate homeowners are likely to pay no more than service charges on their utility bills. Even without PV, each two-story, 2,780-square-foot townhome would achieve a

Sightseer. Energy Star-labeled windows provide daylighting while their low-emissivity coatings help prevent heat loss and unwanted solar heat gain.

COURTESY OF THRIVE HOME BUILDERS

calculated HERS score of 41, while typical new homes built to code would score about 80 to 100.

A FIRST FOR THRIVE HOMES

RidgeGate is Thrive's first townhome development to use double-wall construction. The double walls consist of two 2-by-4 walls set 2.5 inches apart to create a 9.5-inch wall cavity that is filled with blown fiberglass insulation. The studs are set at 24 inches on center and staggered so the inner wall studs and outer wall studs don't align. Advanced framing details were used including open two-stud corners, right-sized headers over windows and doors on non-load-bearing walls, and open-framed interior-exterior wall intersections. All of these steps reduced the amount of lumber used while maximizing the space for insulation, resulting in a total R-value for the exterior walls of 40.7.

Thrive used framing wood that was locally harvested and locally milled from standing dead trees that had been killed by a beetle infestation in the mountains of Colorado. Thrive's crews carefully applied closed-cell foam sealant around electrical boxes, wall penetrations, and at the joint between the bottom wall plates and the floor. They also used a sprayer-applied sealant to form a gasket along all top plates before installing the drywall, which served as the wall's air barrier. The half-inch OSB exterior sheathing was

covered with a textured housewrap, which provided a weather-resistant barrier and drainage plane under the fiber cement and synthetic stone siding.

COURTESY OF THRIVE HOME BUILDERS

Warming things up. Highly efficient heat pumps backed up by a gas furnace, and tankless gas water heaters with smart recirculation loops keep areas like the bathrooms as warm as homeowners want them to be.

To protect the roofs through Denver's hard winters and daily temperature extremes, the crews installed self-adhering ice-and-water shield extending from the roof edge up at least 24 inches past the wall line and at all valleys. All roof edges are protected with a metal drip edge. The deck is covered with a waterproof underlayment and 30-year asphalt shingles. RidgeGate's vented attics are insulated with R-50 blown fiberglass insulation. Truss heel heights are raised to 14 inches to maximize the insulation depths to the outside edge of the top plate. Crews used sprayer-applied sealant to air seal all top plate-attic ceiling junctions. "This reduces air infiltration at one of the homes' most leak-prone areas," Rectanus says. Thrive installed airtight can lights and sealed them to the drywall with caulk.

The party walls in townhomes can be challenging to air seal. However, the RidgeGate townhomes were tested for whole-house airtightness and easily met the code-required air-leakage limit of < 7 air changes per hour at 50 pascals (ACH 50). The units tested at 4.35 ACH 50.

Basement walls were insulated with R-15 fiberglass batts in the finished walls. Under the basement slab, the home is separated from the soil by 4 inches of clean gravel and a vapor barrier, which helps to keep radon gas from entering the homes. The soils on the site presented a high risk of expansion after construction. To mitigate that risk, the site was over-excavated by as much as 30 feet, and the excavated material was replaced with soil at optimal moisture and compaction, which reduced the risk of soil expansion at a lower cost than a friction pier foundation. Groundwater was encountered during the excavation process; after dewatering, an underdrain system was installed to mitigate future groundwater issues. Retaining walls were installed throughout the sloped site, and a detailed grading plan was engineered to accommodate positive drainage away from the home foundations.

The homes are equipped with highly efficient heat pumps having an HSPF of 9.0 and a SEER of 15.5. Back-up heating is provided by a gas furnace with a 97.4 AFUE (annual fuel utilization efficiency). The HVAC system and metal supply and return ducts are sealed with mastic and located within the home's conditioned space. The homes use Energy Star-rated exhaust fans set for continuous ventilation. High-efficiency (EF 0.97) tankless gas water heaters with "smart" recirculation loops provide endless hot water without the wait.

COURTESY OF THRIVE HOME BUILDERS

Standards-setter. Thrive built this 2,780-square-foot townhome in Lone Tree, Colo., to the high-performance requirements of the U.S. Department of Energy's Zero Energy Ready Home Program.

COURTESY OF THRIVE HOME BUILDERS

'Star' light, 'Star' bright. Energy Star-certified windows and appliances, combined with efficient lighting, boost the home's energy savings.

Energy Star windows, appliances and efficient lighting further energy savings. Each home is equipped with an internet-based system to track the home's solar energy production and electric consumption.

NOTHING BEATS FORWARD THINKING

Rectanus credits Thrive's commitment to DOE ZERH certification with helping to position the company as a forward-thinking, conscientious builder. This helped to secure Thrive's selection as the builder for RidgeGate from a field of much larger competitors, according to Rectanus. In addition, Thrive's success at RidgeGate (47 of the 57 units were sold before the model was completed) gained it an opportunity to acquire a parcel across the street to construct an additional 29 units.

While Thrive could just stay the course, the company has charted a path forward. In 2017 Thrive created an internal Quality Assurance department to develop continuous improvement across all of its departments, including construction, purchasing, architecture, warranty and vendor-partner relations. The QA department has implemented an inspection software called *FTQ360*, worked with project managers to develop new quality inspection checklists, established a process for internal audits of the inspections, worked with other departments to review warranty issues, and established new training programs for staff, vendors and trades.

Thrive also reviews its construction processes continuously with weekly visits to all construction sites. A QA consultant does annual spot checks to benchmark progress on quality and safety initiatives. In addition, as a DOE ZERH builder, Thrive Home Builders has every one of its homes performance tested by a third-party home energy rater. "The ultimate objective is to deliver the highest level of excellence for our customers through exceptional performance by every member of Thrive Home Builders," says Rectanus. **GB**

KEY FEATURES

DOE Zero Energy Ready Home Path: Performance.

Walls: Double walls, 2-by-4 24-inch o.c. advance framed, staggered studs, 9.5-inch, R-41 blown fiberglass. Sprayer-applied sealant; 1/2-inch OSB; corrugated housewrap; fiber cement and stone siding.

Roof: Ice-and-water shield; waterproof underlayment; metal drip edge; 30-year asphalt shingles.

Attic: Vented attic; R-50 blown fiberglass; 14-inch raised heel trusses; sealed top plates.

Foundation: Basements with R-19 blanket insulation on interior of unfinished walls; R-15 in cavity of finished walls; 4-inch gravel and vapor barrier under slab.

Windows: Energy Star double-pane, argon-filled, vinyl-framed; U=0.21, SHGC=0.28.

Air Sealing: 4.35 ACH 50.

Ventilation: Continuous exhaust fans.

HVAC: Central air-source heat pump HSPF 9.0, SEER 15.5, plus 97.4 AFUE backup gas furnace. Ducts in conditioned space.

Hot Water: 0.97 EF tankless gas water heater.

Lighting: 100 percent CFL.

Appliances: Energy Star refrigerator, dishwasher, exhaust fans.

Solar: 6.2-kW solar PV.

Water Conservation: WaterSense fixtures, "smart" hot water recirc; drought-tolerant plants, drip irrigation.

Energy Management System: Internet monitoring of PV production and energy use.

Other: EPA Indoor airPLUS; low-VOC paints; low-formaldehyde wood products. Shear walls; reinforced framing and roof. Excavation to 30-foot depth to replace high-expansion soils. Active radon ventilation system. Ducts cleaned.

A veterans' affair. The Beacon House in Huntington Station, N.Y., is a highly sustainable home built by veterans for veterans, featuring energy-saving weatherization, renewably sourced power and smart appliances.

COURTESY OF UNITED WAY OF LONG ISLAND

A United Effort

The United Veterans Beacon House is a green home and career-maker.

BY GREEN BUILDER STAFF

"EVERYONE DESERVES TO LIVE in a healthy home." This has become the operating slogan for United Way of Long Island Housing Development Corporation, a nonprofit organization that builds homes for local governments and several of the 126 agencies funded under the United Way of Long Island (UW-LI) umbrella. To fulfill this "healthy housing for all" vision, United Way began constructing homes to meet the guidelines of the U.S. Department of Energy Zero Energy Ready Home (ZEHR) program in 2014 and has certified five homes so far, including the United Veterans Beacon House, a 3,719-square-foot, two-story home in Huntington Station, N.Y.

In 2015, UW-LI committed to building all of its homes to DOE's ZERH program. It currently has eight homes under construction. "High-performance homes are by design healthier and more comfortable, and provide a better living experience," says UW-LI Senior Vice President of Housing and Green Initiatives Rick Wertheim.

In the long run, they're also less expensive. Wertheim notes that operational costs are becoming more of a driving force in the agency's decision-making process than upfront construction costs, especially in light of the high utility costs on Long Island. "Nonprofit housing agencies are very worried about escalating energy costs," says Wertheim. "It costs less for nonprofits to own a ZERH than a just-to-code home."

As a result, Wertheim has used the Beacon House project as a model to showcase healthy home and zero-energy features for other nonprofit developers under United Way's umbrella.

FOR VETERANS, BY VETERANS

One unique aspect of this home is that it is built by veterans for veterans. The residents, who moved in June 2017, are veterans with various types of disabilities. The builders who constructed the home included veterans enrolled in UW-LI's "VetsBuild" program, a six-week course to learn the principles of building science, energy retrofit and weatherization, as well as green- and high-performance

Not a block-buster. In the basement, seams are taped in the above-grade, heat-blocking insulation so that the rigid foam also serves as an air and water barrier.

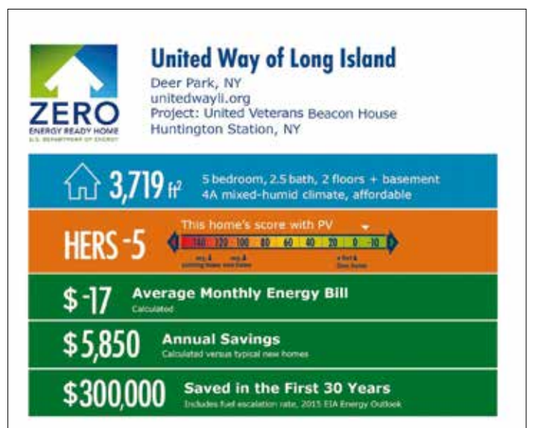
COURTESY OF UNITED WAY OF LONG ISLAND

homebuilding. "We are very proud of the homes we build, but are even more proud of the training these vets get so they can enter the high-performance homebuilding industry as a skilled workforce," Wertheim says.

The Housing Development Corporation (HDC), which Wertheim directs, also operates YouthBuild, Green Job Corps, Weatherization Boot Camp and Green Construction programs that train dozens of individuals each year, preparing them for skilled jobs in the construction industry. Homes like the United Veterans Beacon House serve as instructional projects for its training programs, as well as low-cost housing for United Way partner agencies.

The HDC conducts classroom and immersive training in its 5,000-square-foot E3 (Energy Efficiency Education) SmartBuild Center, which is co-sponsored by the New York State Energy Research and Development Authority (NYSERDA). The Center has the region's only "House of Pressure Lab House," which gives students hands-on training in air sealing, insulation, waterproofing, building diagnostics and mechanical systems. The center also serves as a BPI (Building Performance Institute) training and testing center.

The student builders helped put together a very high-performing home, which achieved a Home Energy Rating System (HERS) score



of -5. Monthly energy costs should average about negative $17. The home is expected to save $2,050 in energy costs per year compared to a home built to the local code, which is the already-rigorous 2015 International Energy Conservation Code.

COURTESY OF UNITED WAY OF LONG ISLAND

Pipe dreams. A wall-hung boiler feeds a super-insulated, 120-gallon storage tank that can meet up to 85 percent of the home's hot water needs.

A big part of the savings stems from the home's solar energy products, which include an 8.5-kW photovoltaic electric generation system and an evacuated tube hot water heating system. The systems helped the home achieve the net-zero-energy performance, but even without them, Beacon's other energy efficiency features helped it achieve a HERS of 31, far lower than the HERS 80 to 100 of typical new homes.

BENEFITS OF BEING FRAMED

The 3,719-square-foot, five-bedroom, two-and- a-half-bath, two-story home features 2-by-6 walls that are constructed using advanced framing techniques, such as spacing the studs at 24 inches on center rather than 16 inches on center, using two-stud corners rather than three- or four-stud corners, minimizing studs around windows, and using open rather than solid wood headers over doors and windows. These steps reduce lumber, leaving more space in wall cavities for insulation.

As for insulation, the 5-½-inch-deep wall cavity was dense-packed with cellulose for an R-19.8 insulation value. The studs were covered with half-inch coated OSB sheathing, which was topped with two layers of ¾-inch rigid foam. The seams were staggered and taped so that the rigid foam could serve as an air barrier and weather-resistant barrier, replacing housewrap. Furring strips were installed over the foam to provide a ventilation gap under the vinyl siding; they also allowed the rigid foam to serve as a drainage plane. The insulation types combined to provide a total wall value of R-30. The poured concrete basement walls were insulated along the interior with 2.5 inches of polyisocyanurate rigid foam (R-15.5 total). The exterior was covered down to the footing with a fiber protection board. An elastomeric membrane protects the fiber board and provides a capillary break on top of the footing.

While not adhering strictly to the Insurance Institute for Business & Home Safety (IBHS) Fortified Homes protocol, the home incorporates severe-weather-resistant details. Examples include a code-plus roof nailing schedule, 120-MPH windows, moisture-resistant below-grade materials, and impact-resistant siding.

The engineered roof and floor trusses are strong and straight and can be made using less lumber and less waste than standard lumber. The attic trusses have raised heels to allow room for a full 14 inches (R-50) of loose-fill blown cellulose at the eaves and across the attic floor plane. The attic was vented with a continuous ridge vent and soffit vents. Baffles were installed at each soffit vent to prevent wind washing and to direct venting air up along the underside of the roof deck. The vaulted ceiling was insulated with open-cell spray foam and had a one-inch airspace at the underside of the roof sheathing. All of the top plates, plumbing penetrations and rough electrical ceiling boxes were air sealed with one-part foam. The attic hatch was gasketed and insulated with two inches of polyiso rigid foam board. Ice-and-water shield was installed at the roof's rakes and valleys as well as at the dripline and under the solar panels. The 8.5-kW PV and solar thermal panels were mounted in an ABS plastic tray installed on the large, optimally angled, south-facing side of the asymmetrical roof. This tray is not

COURTESY OF UNITED WAY OF LONG ISLAND

On the slanted side. Beacon House's asymmetrical, optimally angled roof provides plenty of space for roof-mounted solar panels for electric generation and hot water.

COURTESY OF UNITED WAY OF LONG ISLAND

Air force. An elaborate ERV works in conjunction with the home's boiler, fan coil and AC to provide whole-house ventilation and humidity control.

installed over the roofing shingles but instead takes the place of them. The PV panels don't need to be removed if the shingles are replaced at some point during the life of the solar panels.

MAKING IT WORK WITH AUTOMATION AND APPLIANCES

The home's heating system consists of a 95 AFUE wall-hung boiler that supplies hot water to a hydrocoil in the central air handler. Conditioned air is distributed through small-diameter high-velocity ducts, which are located within the conditioned space of the home. Air conditioning is provided by a 13 SEER air conditioning unit. The air handler is zoned to condition the first and second floor independently. There is a central return with jumper ducts into the bedrooms for pressure balancing. The wall-hung boiler also feeds a super-insulated storage tank for domestic hot water. This 120-gallon double-coil storage tank is also filled from the evacuated-tube roof-mounted solar thermal panels, which are expected to meet 85 percent of the home's hot water needs.

Vinyl-framed double-pane windows were installed that have invisible low-emissivity coatings and an argon gas fill to slow heat transfer. The windows have an insulation value of U=0.17 and a solar heat gain coefficient (SHGC) of 0.20.

A home automation system controls all of the mechanical devices—the boiler, fan coil, AC and ERV—for whole-house ventilation and humidity control. The internet-accessed system tracks energy use and indoor air quality, and provides alerts for mechanical issues and maintenance reminders. Supply and return duct sensors monitor temperature changes and provide remote diagnostic functionality. Occupancy and vacancy sensors control lights.

The home is situated on a corner lot on the community's main road. It replaces an abandoned home in a revitalization zone in the older downtown part of this otherwise upscale community. The home's exterior design incorporates many traditional colonial features typical of the village, with one twist—an asymmetrical roof with a large south-facing side to capture maximum southern exposure for the solar panels. The design incorporated moisture-resistant details like pan flashing at windows and doors, a drainage plane under the siding, non-paper-faced gyp board, and surface grading to divert runoff.

Xeriscaping minimizes maintenance and irrigation. Window placement and porches encourage cross ventilation. Large roof overhangs provide protection and shading. Sustainable materials and low-VOC finishes were used. Best of all, from United Way's perspective, is that the home will provide veterans with comfortable, healthy housing and zero power bills for years to come. **GB**

KEY FEATURES

DOE Zero Energy Ready Home Path: Performance.

Walls: Advanced framed 2-by-6 24-inch o.c. stud wall with 5.5-inch R-19.8 dense-packed cellulose plus two 3/4-inch sheets of R-10 foam insulation for total R-30. Coated taped OSB, PVC siding.

Roof: 5/8-inch plywood decking; ice-and-water shield at valleys, drip line and roof edges, 30# felt, architectural fiberglass shingles.

Attic: Vented attic, raised-heel trusses, 14-inch R-50 blown cellulose in flat ceiling; open-cell spray foam in vaulted ceiling.

Foundation: Basement, poured concrete with 2.5-inch R-12.5 polyiso on interior. Exterior covered with elastomeric waterproofing membrane plus fiber protection board to footing.

Windows: Vinyl-framed, double-pane, low-E, argon-filled windows, U=0.17, SHGC=0.20.

Air Sealing: 2.06 ACH 50.

Ventilation: ERV, MERV 13 filter.

HVAC: Hydrocoil split-air system attached to 95 AFUE wall-hung gas-fired boiler, 13 SEER AC.

Hot Water: Solar thermal water heating; wall-hung boiler for backup.

Lighting: 100 percent LED, occupancy and vacancy sensors.

Appliances: Energy Star refrigerator, dishwasher and clothes washer.

Solar: 8.5-kW PV.

Water Conservation: WaterSense fixtures; central manifold distribution. Drip irrigation.

Energy Management System: Internet-controlled HVAC; tracks energy use, temp, humidity, maintenance.

Other: Low-VOC finishes, formaldehyde-free furnishings. Extra fasteners, 120-MPH windows, impact-resistant siding.

A place to 'Dwell.' Dwell Development's Genesee Park custom home in Seattle is a winner in the Department of Energy's Zero Energy Ready Home (ZERH) Housing Innovation Awards. The project was also one of *Green Builder*'s Homes of the Year last March.

First Look

Here are the homes up for top honors at DOE's 2018 Housing Innovation Awards.

BY GREEN BUILDER STAFF

FOR FIVE YEARS, the U.S. Department of Energy's annual Zero Energy Ready Home (ZERH) Housing Innovation Awards have honored the very best projects that are headed to net zero. The awards also recognize forward-thinking builders who are delivering a better experience to American homebuyers.

This year's awards ceremony will be held during the EEBA High Performance Home Summit [**http://summit.eeba.org**] in San Diego, Oct. 16-18. Winners have been selected for each of five categories, and one Grand Winner will be announced from each one.

Here are the categorical winners:

INNOVATION IN AFFORDABLE HOMES

- Habitat for Humanity South Sarasota County, Venice, Fla.
- Habitat for Humanity of Catawba Valley, Hickory, N.C
- Kalamazoo Valley Habitat for Humanity, Kalamazoo, Mich.
- United Way of Long Island, Deer Park, N.Y.
- Thrive Home Builders, Denver, Colo.
- Mandalay Homes, Prescott, Ariz.

INNOVATION IN CUSTOM HOMES (FOR SPECIFIC BUYER)

- High Performance Homes, Gettysburg, Pa.
- TC Legend Homes, Bellingham, Wash.
- Imery Group, Athens, Ga.
- Ferrier Custom Homes, Fort Worth, Texas
- Bellingham Bay Builders, Bellingham, Wash.

INNOVATION IN CUSTOM HOMES (BUILT ON SPECULATION)

- Addison Homes, Greer, S.C.
- BrightLeaf Homes, Hinsdale, Ill.
- C & B Custom Homes, Cottonwood, Ariz.
- Dwell Development, Seattle, Wash.
- Leading Force, Yakima, Wash.
- Meritage Homes, Orlando, Fla.
- Tim O'Brien Homes, Pewaukee, Wisc.

INNOVATION IN MULTIFAMILY HOMES

- Health-E Community Enterprises of Virginia, Williamsburg, Va.
- Garbett Construction, Salt Lake City, Utah
- Revive Properties and Philgreen Construction, Fort Collins, Colo.
- Off the Grid Design, San Rafael, Calif.

INNOVATION IN PRODUCTION HOMES

- Revive Properties and Philgreen Construction, Fort Collins, Colo.
- Thrive Home Builders, Denver, Colo.
- Mandalay Homes, Prescott, Ariz.
- Garbett Construction, Salt Lake City, Utah
- Insight Homes, Bridgeville, Del.

Learn more at DOE's Tour of Zero website: **https://bit.ly/2s36AIW**

GREEN BUILDER® MEDIA PRESENTS

THE ALIGN PROJECT BY Kasita

The Align Project: Align Your Finances

How can we design and build homes that work for people, instead of the other way around?

BY JULIET GRABLE

WHEN IT COMES TO BUYING, building and remodeling houses, we've been lulled into going for the lowest bid or the least cost per square foot. But anything cheap is bound to have long-term costs. Take plastic goods—most don't last, and they come with a steep price tag to the environment.

The same could be said for the materials and systems in our homes—pay me now, or pay me later.

"Looking at lowest upfront cost only is an antiquated approach that is no longer applicable and serves no one," says Sara Gutterman, Green Builder® Media CEO. "We have to start thinking about full cost, or lifecycle cost, to properly understand the value of our homes and buildings."

To be sure, green building programs such as LEED reward holistic thinking. But how can the industry start incentivizing long-term value—which arguably is better for all of us? The burgeoning field of resilient design may point the way.

Getting 'Aligned.' The Align Project demonstration house is currently under construction in Kasita's factory in Austin, Texas.

COURTESY OF KASITA

GREEN BUILDER® MEDIA PRESENTS

THE ALIGN PROJECT

BY Kasita

CREDIT: JAMES BREY/ISTOCK

Built for tough times. While no building is completely disaster-proof, resilient buildings are likely to suffer less damage, protecting occupants and their pocketbooks.

INVESTING IN RESILIENCE

Today's building codes are doing a pretty good job of protecting occupants in the face of hazards. But many building professionals, including such organizations as the American Institute of Architects, recognize that "building to code" isn't enough anymore.

"Given the increasing frequency and intensity of superstorms, wildfires, hurricanes, tornadoes, flooding and other natural events, investing in resilience has quickly shifted from a 'nice to have' to a 'must have,'" says Gutterman.

In short, resilience describes a building's ability to bounce back in the face of disasters. I like the definition put forth in the Whole Building Design Guide, which names "four Rs" that characterize resilient buildings and communities: robustness, resourcefulness, rapid recovery and redundancy.

In practical terms, this describes a building with a back-up plan—one that can take a battering and retain its vital functions. And one that may not just survive a disaster, but suffer minimal damage with minimal cost to its owner.

Resilient design creates positive feedback loops. For example, a home with a robust, energy-efficient envelope will help regulate interior temperatures and keep occupants comfortable, even if the power goes out. And, because these buildings demand less energy, they help ease the burden on the electric grid and contribute less to the emissions that cumulatively lead to more extreme and unpredictable climate events.

But there's more: Resilient buildings actually *create* value. According to a report from the Urban Land Institute, which compiles case studies of resilient buildings, such buildings can "benefit from better financing options, more competitive insurance rates, greater long-term savings on maintenance and higher overall value compared to more vulnerable properties."

In that case, what are we waiting for?

A ROBUST ENVELOPE

The Align Project demonstration house showcases resilience with its renewable energy system and storage battery, durable and energy-efficient construction, and energy- and water-saving features.

Architect Dason Whitsett designed the Kasita envelope after building science expert Joe Lstiburek's "perfect wall" system, which uses four control layers, ideally installed on the outside of the structure, to manage rain, water vapor, air and heat.

The envelope begins with a sturdy light-gauge steel frame. For the production model, parts are milled with a CNC machine, making for precise, tight framing. Noncombustible Roxul *COMFORTBATT* mineral wool insulation fills the stud cavities.

"There is some cavity insulation, but the majority of the thermal control layer is outside the drainage plane," says Whitsett, who teaches in the Sustainable Design Program at the University of Texas at Austin.

Though the details are slightly different for each, both The Align Project demonstration house and Kasita's production model utilize

COURTESY OF ROXUL

Solid comfort. Roxul *COMFORTBOARD* rigid insulation comes in four thicknesses between 1.25 inches and 3 inches.

a rainscreen assembly, which provides a capillary break and a path for liquid water to drain. In the demonstration home, DuPont *Tyvek CommercialWrap* is installed against OSB sheathing. This durable housewrap controls air flow and repels bulk water but allows water vapor to escape; it is also UV resistant for up to nine months. Three inches of Roxul *COMFORTBOARD* rigid mineral wool insulation are installed between the housewrap and cladding. This rigid insulation is also installed on the roof and under the foundation, creating a continuous thermal barrier that eliminates most thermal bridging.

COURTESY OF KASITA

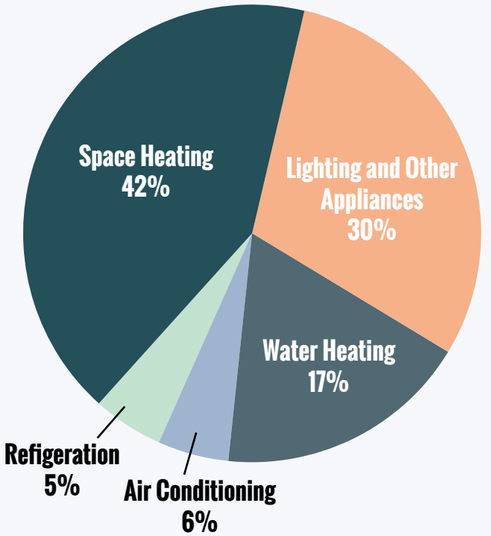
A perfect pine. Delta Millworks' sustainably sourced exterior cladding *Accoya* absorbs 80 percent less water than similar wood products.

Whitsett was excited for the opportunity to use *Accoya* from Delta Millworks as the exterior cladding. *Accoya* is sustainably sourced radiata pine that has been treated with acetylation. This non-toxic chemical process reduces the wood's water-absorbing capacity by 80 percent, improving its dimensional stability and making it much less vulnerable to insects, mold and rot. In addition, Delta Millworks treated the *Texas Barnwood* cladding with a surface charring process developed in Japan called *shou sugi ban*, which further protects the material from water intrusion—and results in a striking aesthetic.

The high-performance Andersen windows feature *SmartSun* [https://bit.ly/2CCLMNv] glass, which, with its high solar heat gain coefficient and high visual transmittance, is good at blocking heat and UV light, but still lets in plenty of light—ideal for the climates in Kasita's target markets.

"We designed for the most extreme conditions in all the locations

How Energy Is Used in Homes (2009)

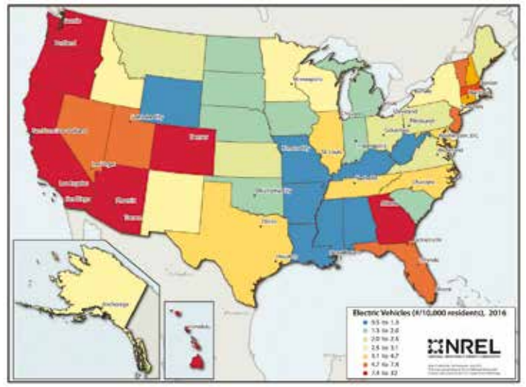


CREDIT: U.S. ENERGY INFORMATION ADMINISTRATION

**2009 is the most recent year for which data are available.*

SOURCE: U.S. ENERGY INFORMATION ADMINISTRATION, *RESIDENTIAL ENERGY CONSUMPTION SURVEY* (RECS) 2009

Power point. The Rheem mini-split system and hybrid water heater significantly cut down on the energy required for space heating and water heating—the two largest categories of energy use in most homes.



CREDIT: STATISTICA

Charging ahead. A combination of mandates and incentives has placed California among the leaders in electric vehicle sales and adoption.

The State of Federal Incentives

Solar PV systems

According to the Solar Energy Information Association (SEIA), the Solar Incentive Tax Credit has helped boost a 1,600 percent increase in solar installations since it was rolled out in 2006. Since then, the ITC has provided a 30 percent tax credit for residential and commercial solar PV systems. The Tax Cut and Jobs Act of 2017 extended the residential credit through 2021, with some caveats:

- Residential projects can enjoy 30 percent credit in 2018 and 2019.
- The ITC steps down to 26 percent for project that break ground in 2020 and 22 percent for those that start in 2021.
- The credit sunsets in 2022.

Residential battery storage systems

These systems do not qualify for the ITC unless they are charged exclusively by solar energy. The Energy Storage Tax Incentive and Deployment Act, introduced to Congress last year, would change the Internal Revenue Code to allow the ITC to apply to energy storage technologies. Several states, including **Maryland** and **California**, offer incentives for battery storage systems.

Electric vehicles

The federal tax incentive for EVs is being phased out. After this year, it will drop from $7,500 to $3,750, then in July 2019 it will halve again, to $1,875. However, many states offer their own incentives. The Toyota *Mirai*, for example, qualifies for a $5,000 rebate from the State of California and three years (or $15,000) of free fuel.

we build for," says Whitsett—up to climate zone 6; seismic design category E, which includes most of California; and wind speeds up to 150 miles per hour.

Complementing the robust construction, features inside the home meet the lowered demand as efficiently as possible. An Energy Star-qualified mini-split system from Rheem provides comfortable space heating and cooling, and the slim indoor cassette mounts on the ceiling or in a framed enclosure—a perfect fit for small spaces. The *Prestige* hybrid heat pump water heater, also from Rheem, boasts an efficiency of up to 3.75 UEF, nearly 300 percent higher than a standard electric tank-type heater.

R IS FOR RENEWABLE

As an investment, renewable energy is a no-brainer: Once deployed, it takes advantage of "free" solar and wind resources and can lower or even eliminate energy bills while reducing the environmental impact—including water demand—of conventional fossil fuel energy.

But renewable energy has always been a *long-term* investment, and the upfront cost continues to be a real barrier to entry for most people. Incentives such as the federal solar Investment Tax Credit (ITC) and alternatives such as solar leasing—and more recently, community solar—have helped paved the way for solar renaissance in recent years (see sidebar, at left), but it will take incentives paired with progressive policies to push renewables, including electric vehicles, fully into the mainstream.

COURTESY OF TABUCHI

The *Eco Intelligent Battery System* (*EIBS*) from Tabuchi is an all-in-one solution that includes a hybrid inverter and 7.4-kW lithium-ion storage battery. The DC-coupled battery can be charged without having to convert energy to alternating current (AC), making it more efficient. The ***EIBS*** uses software from Geli to manage energy and connect with other smart home devices.

COURTESY OF TOYOTA

The *Mirai* hydrogen fuel cell electric vehicle from Toyota combines hydrogen and oxygen to make electricity onboard. Water vapor is its only emission. It has an EPA estimated driving range of 312 miles and refuels in about five minutes. The small, lightweight fuel cell stack and hydrogen tanks are located under the floor of the vehicle, leaving plenty of room in the cabin for passengers.

California, the state with the highest deployment of solar, residential battery storage, and electric vehicles, is the test case.

To help meet the state's mandate that all new residential construction be net zero by 2020, the California Energy Commission passed a requirement that, starting in 2020, all new homes under three stories must include solar PV modules. Critics point to the added cost ($8,000 to $18,000, by one estimate) in what is already the nation's most expensive housing market, but proponents argue that the monthly savings will more than make up for it.

The state's Self Generation Incentive Program has also helped California see a spike in residential battery storage installations. According to the Energy Storage Association, 36 megawatt-hours of grid-connected residential energy storage systems were deployed in the first quarter of 2018—mostly in California and Hawaii.

These systems are still quite expensive, but changes in utility fee structures have incentivized them in some states. In particular, some utilities, California included, are changing from net metering to time-of-use metering, which charges lower rates during times of low demand.

Finally, California's Zero Emission Vehicle program, which requires automakers to earn a certain percentage of credits by selling EVs, has combined with generous rebates and a commitment to charging infrastructure to accelerate EV sales in the state. EVs could reach a market share of 10 percent by the end of 2018. Several other states have adopted the ZEV program.

Meanwhile, the efficiency of solar PV systems and EVs keeps improving, as companies vie for supremacy in a "technological arms race" which has seen such advances as passivated emitter rear contact (PERC) technology and improved batteries.

Align Project sponsor JinkoSolar offers several PERC products.

"We're always looking for ways to enhance the production of PERC cells," says Jeff Juger, director of business development at JinkoSolar. The company, which started out as a manufacturer of solar cells, is set to launch a new mono PERC module with cells that are 2 millimeters larger in each dimension, which translates into a greater power output across the entire module. JinkoSolar is also manufacturing "half-cut cells"—solar cells that are literally sliced in half—which lower the resistance between cells and results in greater power output for the whole module. GB

COURTESY OF JINKOSOLAR

Sun powered. The Align Project house features a complete renewable energy system with solar PV array from JinkoSolar, storage battery from Tabuchi, and electric vehicle from Toyota. The solar array on The Align Project house will feature JinkoSolar's ***Eagle 60*** mono PERC modules. PERC, or passivated emitter rear contact technology, improves the efficiency of cells by enabling unabsorbed light to pass back through the cell. The all-black modules have an efficiency rating of up to 17.72 percent.

Voting with your dollars

One of the best ways to make sure your dollars count is to invest in companies with strong commitments to sustainability and transparency. Here are just a few ways The Align Project sponsors are making a difference.

Toyota: In September 2015, Toyota announced its Environmental Challenge 2050, a series of challenges that seek to push the company beyond minimizing environmental impact to creating net positive change. The Challenge addresses four components: Carbon, Biodiversity, Materials and Water. Toyota vows to eliminate 90 percent of CO_2 emissions from new vehicles by 2050 by offering vehicles with alternative powertrains and working to expand infrastructure that supports electric and fuel cell vehicles.

Andersen Windows: This American company takes seriously its mission "to reduce energy consumption and emissions, lower utility costs, and improve personal health and well-being" through its window and door products. Andersen released the first Environmental Product Declaration (EPD) for a U.S. window manufacturer and has stated goals to reduce operational water and energy use and waste by 20 percent, per unit of product, by 2020.

JinkoSolar: The world's largest solar module manufacturer, JinkoSolar also produces solar cells and wafers, using its leadership position "to drive a global transition towards a cleaner and more sustainable way of energy generation." But the company is also dedicated to reducing emissions, water use and to conserving resources in its facilities around the world.

We will highlight additional sponsors in upcoming articles.

Lighting the Future

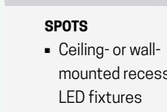
LOXONE, WHICH PROVIDES its comprehensive smart home platform for Kasita, also manufactures about 150 smart home products, including lighting fixtures, switches and accessories. The highly efficient LED fixtures can produce thousands of color combinations as well as warm white light, and the products also meet the standards of California's Title 24, which requires high-efficacy lights and dimmers or vacancy sensors in most rooms.

The system is flexible, too. Existing lighting circuits can be integrated into the system, and all lighting can all be controlled via the *Loxone Smart Home App* or with *Touch Pure*, a frameless switch that can be used to control lighting, music and blinds. Products can be installed using flexible plug-and-play wiring or wireless dimmer and switch options.

The Loxone system does not depend on internet connection, and its "cloud-free" products aren't subject to software updates or the shuttering of cloud services.

For example, "Many intelligent light bulbs become obsolete in five years," says Loxone CEO Florian Woess. "We want our solutions to last."

PHOTOS COURTESY OF LOXONE



Here are some of the highlights of the Loxone lighting portfolio:

SPOTS
- Ceiling- or wall-mounted recessed LED fixtures
- Full-spectrum color or warm white
- 100 percent dimmable

PENDULUM SLIM
- Elegant modern design
- Diffused color or focused warm white light

LED STRIP
- 300 RGBW LED chips
- Can be divided or extended
- Waterproof and splashproof options available

GREEN BUILDER® MEDIA PRESENTS

THE ALIGN PROJECT

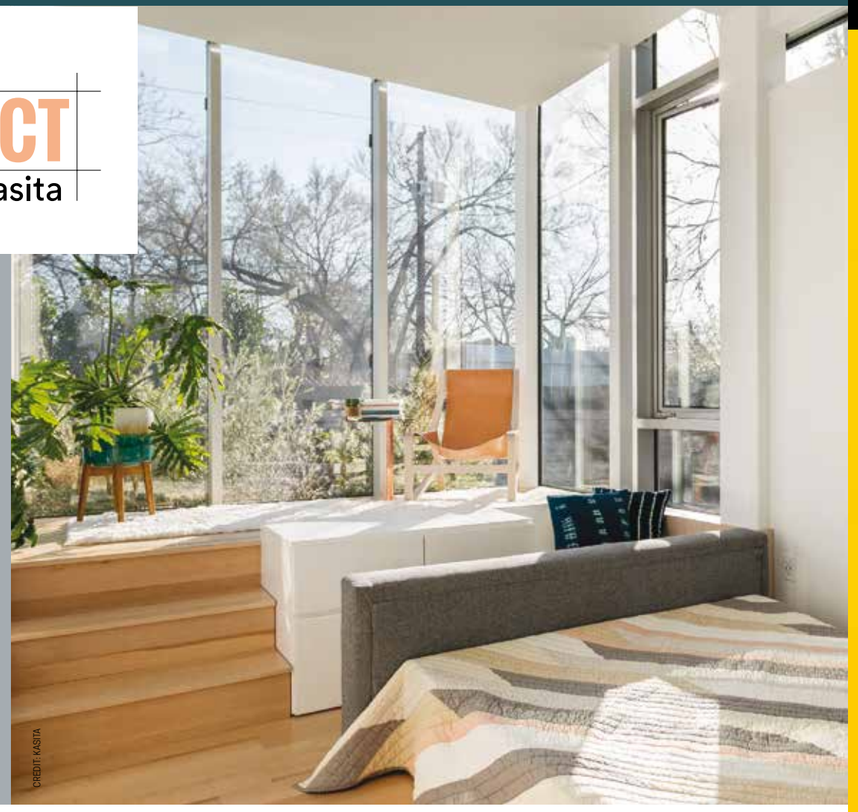
BY Kasita

Experience The Align Project

SOLAR POWER INTERNATIONAL:
September 24-27, 2018
Anaheim Convention Center,
Anaheim, CA

CONSUMER ELECTRONICS SHOW:
January 8-11, 2019
Las Vegas, NV

DESIGN & CONSTRUCTION WEEK:
February 19-21, 2019
Las Vegas, NV



CREDIT: KASITA

Can we chart a new course? The Align Project says YES.

Here's a peek at the facets of an aligned life we'll explore over the next year:

ALIGN Your Space: The 100 Percent House

Most of us use only 5 percent of the large homes we were told we needed. What if instead, we optimized our living spaces to create a home that's 100 percent useful? The *Kasita* house, with its precision-engineered design and modular construction, uses good design to optimize space and reflects how people actually use their homes.

ALIGN Your Finances: Investing in Resilience and Efficiency

Many of the choices we make about our homes sacrifice durability, resilience and efficiency for short-lived cost savings. When we put in a carpet that lasts five years instead of hardwood floor that lasts a century, we sabotage our future. To align our finances, we must focus on reducing predictable costs, not creating future sinkholes for our money.

ALIGN Your Technology: Mastering Our Machines

At what point do high-tech gadgets stop serving you and start sucking away your valuable time and life energy? How can we be seamlessly "connected" all the time without feeling watched and violated? We'll dig into research about where and how people are using technology, and explore which innovations are truly helping people improve the quality of their lives and which are merely trendy gizmos destined to be mothballed.

ALIGN Your Mobility: Destination Deconstruction

What if, when thinking about getting from point A to point B, we focused on the journey instead of the destination? This shift in focus could affect everything from the type of vehicle we drive to the type of neighborhood we choose to live in. Join us as we explore the topic of mobility from a human-centric perspective, considering the implications for everyone from city planners and car makers, to the users themselves.

ALIGN Your Future: Aging With Dignity

Devices and products are now available that monitor vital signs, improve access or mobility around the homes, and ensure safe and healthy spaces. Combine these with a compact, portable, flexible housing option like *Kasita* and you have the ultimate strategy for a home that changes with you.

UTILITIES, the essential power backbone of our country, are evolving rapidly to provide seamless, clean energy to a growing population. From increasing use of renewables to employing smart technology to embracing a new service-based model, utilities are pulling out all the stops to ensure the veracity of America's power grid.

THE RENEWABLES SHIFT

Today, the United States is increasingly integrating renewables into its energy grid, while reducing its reliance on coal. In 2016, renewables made up almost 15 percent of the country's electricity generation at utility-scale facilities, according to the Energy Information Administration. In addition, reliance on natural gas is on the rise, making up roughly 34 percent of the U.S.'s electricity generation in 2016.

The increase in natural gas can be attributed to its low cost and flexible generation capacities. The low prices have encouraged utilities to run plants more, leading natural gas to surpass coal as the top U.S. generating resource last year.

Consumers continue to be a driving force in the use of renewables. One example of this is through net metering, which allows people who generate their own electricity to buy and sell it to utilities. Net metering, which is often done through power generated by solar panels, incorporates renewables into the grid on a smaller scale.

However, according to James Jackson, a business development manager at Emerson Climate Technologies, practices like net metering are forcing utilities to re-evaluate their business models. "Renewables and energy efficiency are consumer driven, not programmatic, impacting how utilities see future business," Jackson explains. "They don't want to become a 'wires business'—meaning connecting A to B, and the grid just moves power no matter where it comes from. Utilities have done well selling electricity because of high demand. Now, microgrids, batteries and such infringe on their business model. They can't continue to raise rates."

As part of their re-evaluation of their business models, utilities are incorporating renewables into their grid through integrated resource plans, or IRPs, through which they have to look at every reasonable option for providing consumers with reliable and low-cost energy. "Customers, without knowing it, are consuming renewables because it's part of the IRP," Jackson points out.

SMART HOME TECH GROWS

As consumers become more interested in conserving energy to save money and help the planet, the number of smart-home devices has increased. These devices aim to help consumers lower the amount of energy used by providing them with more information and tools to better manage their energy consumption.

Through this technology, customers can receive more data and be able to choose a variety of technologies and services to support their individual needs. The growing popularity of devices such as Amazon's *Alexa* and Google *Home* are steadily shifting public attitudes toward smart-home devices.

As this trend grows, there will likely be more interactions between utilities and consumers through mobile, web and even social media.

A common example of this is the smart thermostat, which enables customers to monitor and control their home's temperature from their smartphone or tablet while reducing their energy bills. These devices can monitor temperature and humidity inside and outside the home, keep track of when people come and go, and create cooling and heating cycles that match. In addition, many of these smart thermostats allow users to create preset schedules, and mobile controls can help them save energy if, say, they go on vacation and forget to turn off their heat.

As part of a more service-focused model, utilities will need to provide alternative generation sources, equipment replacement, energy monitoring systems, data analytics and facilities management services. In addition, the growing use of apps and online tools expands relationships between customers and the people providing their utilities.

Emerson's *ComfortGuard Monitoring Service* aims to reduce energy consumption and save customers money, through a set of sensors monitored to one's air conditioning unit that provide up-to-date information on the health of an HVAC system.

Some smart thermostats include geofencing, which tracks a customer's location in order to decide how cool or warm to keep one's home. This is helpful for those who have busy or irregular schedules and can't always predict when they'll be home. Instead of having to creating a preset schedule, the thermostat is adjusted by the owner's smartphone. For example, when he drives into his community at night, the temperature will automatically adjust.

At Emerson, a *ComfortGuard Monitoring Service* aims to reduce energy consumption and save customers money through a set of sensors monitored to one's air conditioning unit. These sensors provide people with up-to-date information on the health of their HVAC system. If a problem is detected, *ComfortGuard* alerts Emerson's monitoring team, which will analyze the data and send an alert and a service technician. By keeping customers aware of possible maintenance issues, this system helps avoid larger problems before they happen and keeps HVAC systems running as efficiently as possible.

"It makes the AC communicate so performance or maintenance issues are caught," Jackson says. "The system monitors and sends alerts to contractors for repairs, and troubleshooting is preemptive. The system picks up the failure so contractors can be scheduled to fix or change filters."

In addition to residential customers, business customers are increasingly interested in managing their energy-use platforms. Sustainability has become a goal of companies pursuing energy efficiency, rather than just gaining a competitive advantage by the cheapest means possible. Many of the nation's largest corporations, such as Walmart, McDonald's and Google, have all set their own energy efficiency targets for 2020.

SERVICE-BASED MODEL

Until recently, utilities typically used a commodity-based model, which focused on cost-effective supply acquisition and overall bill reduction. However, as energy efficiency becomes more of a priority for consumers, utilities will have to adjust so that they can enable customers to reduce their energy consumption without having to raise the cost of energy—and still make a profit.

Those working to conserve energy will often require the kind of help utilities can provide. Going forward, utilities can take advantage of this opportunity to provide energy management services to all of their customer base. Many utilities currently offer expert energy management to their commercial customers in areas such as infrastructure, large-scale equipment and industrial platforms; however, most of these services have not yet been extended to residential and other small-scale customers.

As part of a more service-focused model, utilities will need to provide alternative generation sources, equipment replacement, energy monitoring systems, data analytics and facilities management services. In addition, the growing use of apps and online tools expands relationships between customers and the people providing their utilities.

One way some utilities are beginning to embrace a service-based model is through demand response, in which people can shift their electricity usage during peak periods, often in exchange for financial incentives. For utilities, this is a way to manage supply and demand. When everyone's air conditioners are running at the same time, and utilities are close to meeting capacity, they can use demand response to reduce the burden on the electrical grid.

"This used to be a way to get out of hot water; it's now a resource. If you're able to better control the grid, you can control power production," Jackson says. "They're looking for ways to round their dollars to lowest dollar in the budget by using connected thermostats and energy efficiency."

In addition to the national trends in how utilities are changing the way they do business, there are regional ones as well. Following are case studies of three of the nation's utility companies, highlighting how they are helping guide the nation's energy grid into a new era. **GB**

NV Energy

PowerShift by NV Energy—the right tools to save energy and money.

NV Energy offers a free smart thermostat program, which can save homeowners up to $100 on home energy per year. The handy app allows users to access their thermostat remotely.

"Our customers drive our daily operations and decision-making, because we're dedicated to partnering with them. Together, we're working to ensure a reliable and sustainable energy future for generations to come." – Cynthia Messina, NV Energy

NV ENERGY TAKES PRIDE in helping customers save energy and money while making their homes and businesses more comfortable. That is why it launched PowerShift—a one-stop shop for energy-efficiency products and service with the power tools to save.

For more than a century, NV Energy has served the state of Nevada. Today, the company delivers safe, reliable electricity to more than 1.2 million customers and a state tourist population of more than 43 million annually, and also provides natural gas to more than 165,000 citizens in the Reno-Sparks area.

With a 46,000-square-mile service territory that includes the Desert Southwest and Sierra Nevada mountain range, NV Energy cares deeply about the environment and the preservation of its beautiful home state.

In 2017, PowerShift customers saved nearly 249,338 megawatt-hours of electricity, enough to power more than 14,330 homes. "Our job is to provide excellent service and help our customers make their home or business more energy efficient," said Cynthia Messina, senior project manager, NV Energy. "That is why we are hard at work every day offering PowerShift tools that increase savings and contribute to the sustainability of our communities."

FREE SMART THERMOSTAT

State-of-the-art technology helps save up to $100 on home energy bills every year and takes the hassle out of temperature adjustments. Professionally installed, smart thermostats make it easy to set heating and cooling schedules, participate in community energy events scheduled June through September and remotely access the thermostat from the free mobile app or website. A $300 value, they are the smart way to save.

FREE IN-HOME AND ONLINE ENERGY ASSESSMENTS

PowerShift Energy Advisors make house calls when they visit a home to inspect lighting, insulation levels, seals around doors and windows and more. Customized assessments are a great way to learn about inexpensive ways to increase energy efficiency, save money and potentially receive free energy-saving products. Appointments are conveniently scheduled Monday through Saturday.

Powered by the latest technology, customers can also take a free online home energy assessment via MyAccount, the NV Energy account portal. Convenient and confidential, this interactive tool provides usage information, energy updates throughout the day, along with bill comparisons and customized tips to increase savings.

BUSINESSES SAVE WITH POWERSHIFT

Energy costs are controllable operating expenses for many businesses. PowerShift tools that support business energy management include smart thermostats, energy assessments and incentives. Here's what Donna Catalfamo, owner, Posare Salons, Las Vegas, had to say about her PowerShift tools:

"I love being able to check the smart thermostats in our salons 24/7 from the app on my phone. It helps me manage our energy use while keeping our customers and staff comfortable. I can also adjust the temperature in one of our salons from my phone, and that's really convenient. The app also notified me if the AC unit isn't working properly, and that's important because it helps with energy efficiency and maintenance."

ENVIRONMENTAL STEWARDSHIP

Between 2005 and 2015, Nevada tripled its in-state renewable production and reduced carbon emission in the electricity sector by 44 percent. Today, that means even more clean energy, with nearly 50 projects statewide. That is enough renewable energy to power more than a million homes at once.

PowerShift tools help to lower energy costs, save homes and businesses money and help the environment. NV Energy is a leader in offering a variety of energy efficiency products and services that allow customers to monitor and understand their energy use. Because when you have the right tools, you have the power to save. PowerShift Energy Advisors are available 24/7 at 855-676-9373. GB

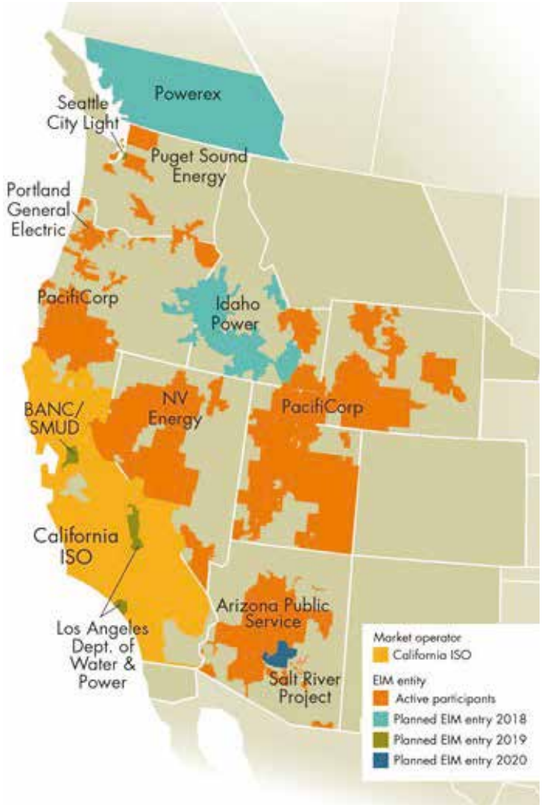
Visit NV Energy at **www.nvenergy.com/save-with-powershift.html.**

Las Vegas salon owner Donna Catalfamo loves the ability to check the thermostats in her salons to keep utility costs in check.

At NV Energy, PowerShift tools and the latest technology support a customer experience that delivers customized and convenient offerings. Learn more at www.nvenergy.com/powershift

PacifiCorp

From its innovative Energy Imbalance Market to green fleets, PacifiCorp helps California manage its massive grid.



PacifiCorp and the California Independent System Operator launched the Energy Imbalance Market (EIM) in 2014. The EIM uses a sophisticated system to automatically balance demand every five minutes with the lowest cost energy available across the combined grid. The EIM leverages the growing diversity of renewable resources, flexible backup resources and demand using advanced technology to keep energy supply affordable and reliable. The new market is attracting additional participants and has the benefit of increasing benefits for all customers as diversity increases.

Energy Imbalance Market. PacifiCorp aims to increase energy efficiency, utilize natural resources and save money by participating in the Energy Imbalance Market. The market was launched in 2014 by PacifiCorp and the California Independent System Operator. It uses a system that automatically balances demand every five minutes with whatever energy is available at the lowest cost across the combined grid.

Through the Energy Imbalance Market, PacifiCorp utilizes the growing diversity of renewable resources, flexible backup resources and demand to keep energy supply affordable and reliable. By allowing real-time visibility across and between grids, the Energy Imbalance Market measures supply and demand closer to when energy is consumed and strengthens grid reliability. Once the market systems identify changes in supply in demand, they automatically find the best resource to meet fluctuating demand.

Because the amount of energy produced by renewable sources like wind and solar is often weather dependent, more precise regional coordination has become more important. The Energy Imbalance Market improves the ability to manage the growing diversity of resources available, smoothing out power flows and effectively integrating renewables into the grid.

Ry Schwark, a spokesperson for PacifiCorp, notes that being able to use more renewables lowers overall costs: "Anytime I have to run a fossil fuel plant, there are real world costs associated with that. With renewable energy, once it's running you have no fuel costs. The incremental cost of that is zero, and you're willing to share that cheaply with neighbors. In an EIM, the renewables get used and traded first."

By taking advantage of a wider portfolio of resources PacifiCorp and other utilities connected to the market can reduce the quantity of reserves required at any one time to ensure electricity is available when it's needed.

Greening Our Fleet Initiative. PacifiCorp is actively pursuing new technologies to reduce fleet miles and related fuel consumption within the company. They've set a company-wide goal of reducing idling across their fleet by 10 percent and plan to accomplish it through an "idle-free" policy. By doing this, PacifiCorp will avoid emitting approximately 974 tons of CO_2 per year and reduce gasoline and diesel consumption by about 93,000 gallons annually.

The policy prohibits idling except when the trucks in their fleet are performing essential work that requires power from the engine. The fuel economy of each truck is monitored and reported to encourage more environmentally friendly driving habits.

PacifiCorp's growing use of automated meter reading, which enables the company to avoid periodic trips to each physical location to read a meter, has allowed them to remove 27 pickup trucks from their active fleet, resulting in a reduction of 324 tons of CO_2 emissions annually. Additionally, by replacing full-sized trucks in their automatic reading fleet with smaller, more efficient Ford *Escapes*, PacifiCorp is able to avoid the release of about three tons of greenhouse gases each year.

Finally, new 37-foot bucket trucks used by linemen reduce carbon dioxide emissions. The trucks, Altec-built *AT37Gs*, use plug-in hybrid electric technology to power boom operation, air conditioning and cabin heat without running the diesel engine. **GB**

GREEN TRUCK SOLUTION

PacifiCorp uses Altec-built *AT37G* bucket trucks. The trucks use Altec JEMS (Jobsite Energy Management System), which is an integrated plug-in system that uses stored electrical energy to power the aerial device, tools and exportable power, and provides cab comfort. The energy storage system is recharged by plugging into shore power or by the truck's internal combustion engine.

YouTube

Altec Green Fleet: Sustainable Solutions
https://youtu.be/p0PAprkP76g

THIS TECHNOLOGY:

- Eliminates idle time at the job site
- Reduces fuel consumption
- Lessens noise pollution
- Decreases carbon footprint and tailpipe emissions
- Minimizes impact on payload
- Offers reliable performance with automatic stationary recharge
- Reduces maintenance costs
- Complies with anti-idle legislation
- Is approved by the EPA

MidAmerican Energy

Part of the Midwest is served by this utility, which touts a 100 percent renewable vision.

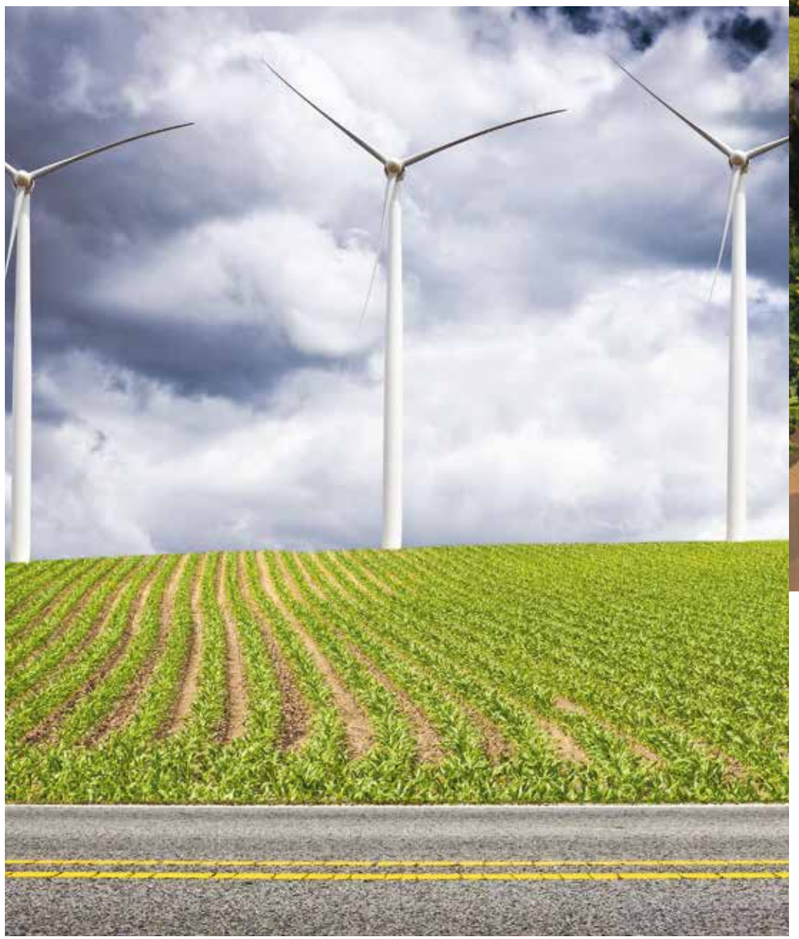
Private Generation. MidAmerican Energy, which serves a 10,600-square mile area in Iowa, Illinois, South Dakota and Nebraska, encourages energy efficiency through its commitment to customers who generate their own energy. MidAmerican provides energy to private generation customers when a private generation source isn't producing enough energy to meet their needs.

Private generation customers can also sell any excess energy they produce to MidAmerican Energy in a net metering program. Excess energy is sent through a customer's meter to the grid, and MidAmerican credits the customer. This both encourages users to produce their own energy and, in some cases, reduces MidAmerican's own need to generate.

100 percent Renewable Vision. In April 2016, MidAmerican announced a goal to eventually provide 100 percent renewable energy for its customers. In 2004, 70 percent of the company's generation came from coal, and it wasn't using wind energy at all. By the end of 2016, 48 percent of its generation capacity came from wind, and 31 percent came from coal.

A key component in accomplishing this vision is the Wind XI project, in which MidAmerican will invest $3.6 billion to install additional wind turbines in Iowa by the end of 2019. When this project is completed, the company's annual renewable energy generation is expected to reach a level equivalent to 89 percent of MidAmerican's Iowa customers' annual use.

In addition to its focus on generating more renewable energy, MidAmerican is preparing to support the integration of renewable energy into its power grid by investing in its transmission infrastructure and working to ensure it can carry the growing power load. **GB**



In April 2016, MidAmerican announced a goal to eventually provide 100 percent renewable energy for its customers. In 2004, 70 percent of the company's generation came from coal, and it wasn't using wind energy at all. By the end of 2016, 48 percent of its generation capacity came from wind, and 31 percent came from coal.

CREDIT: LAUNDROID

Folding away. Seven Dreamers' *Laundroid* (far right) takes the guesswork out of ironing and tucks away inside a wall until needed.

TWELVE WAYS TOWARD A 'SMART' FUTURE

If today's futuristic, Wi-Fi-enabled home devices seem familiar, it's because we've seen them in TV's past.

BY ALAN NADITZ

SHOW OF HANDS— how many of you grew up watching "The Jetsons?" That was television's first stab at broadcasting the lifestyle of the typical Nuclear Family, circa 2062. It also introduced people to some technological wizardry that today's homeowners are enthralled by. A flying car isn't quite here yet, and automation hasn't resulted in three-hour workdays. But there are numerous smart products that George, Jane, Judy, Elroy and Astro helped usher in or inspire during the past half century.

Here are 12 such products that are "must include" items in new homes and mandatory upgrades for existing housing.

CREDIT: WINK

Wi-Fi traffic control. Wink's *Hub 2* for home appliances and household activities acts just like its PC cousin, being able to communicate with and route multiple devices at once.

Home Automation: From Buttons to Vocals

JANE JETSON'S HARD DAY OF HOUSEWORK— accomplished with the help of a panel of buttons for everything—has given way to the do-it-all-by-voice products found throughout the home. Amazon's *Alexa*, the *Google Assistant* and Apple's *Siri* are household names now, being able to activate those lights, locks, thermostats and appliances with a few words. Expect more of the same in the years ahead, as the number of products controlled with vocal commands spreads.

Rolling along the all-purpose path is the Wink *Hub 2* [**https://bit.ly/2MftV3l**], capable of simultaneously controlling thermostats, security cameras, door locks, lighting systems, sensors, ceiling fans, garage door openers, window blinds, doorbells and more. Compatible with iPhones and Androids, *Hub 2* runs on Wi-Fi via 2.4 GHz or 5 GHz routers utilizing WPA-PSK, open security or WEP. It also works with Amazon's *Alexa* voice commands and has its own If This Then That (IFTTT) [**https://ifttt.com**] web channel. The product retails for about $200.

CREDIT: NORTEK SECURITY & CONTROL

Music major. Nortek Security & Control's *Elan G* home automation system can double as an entertainment center, thanks to its music service access.

Also capable of being a jack-of-all-trades is Nortek Security & Control's *Elan G 8.0* [**www.elanhomesystems.com**], a home automation system that manages security, climate, lights, garage doors, sprinkler systems and swimming pools, to name a few. All components are handled through a touchscreen interface that is easily shared on computer screens, televisions, tablets and mobile devices. *Elan G 8.0* also acts a home entertainment master, being linked to *Pandora, iHeartRadio, TuneIn, SiriusXM, Deezer, Tidal, Napster* and other music and video apps.

Household Controllers: Safety First

JUST ABOUT EVERY CARTOON has a moment when a character, trying to play plumber, gets water-blasted in the face by a leaking pipe. In the real world, leaks are no laughing matter, capable of causing thousands of dollars in damage. Trying to locate the shutoff valve—and often, just getting it to move to the off position—can be a chore. That's where LeakSmart's *LeakSmart Snap* and *LeakSmart Hub 3.0* [**https://leaksmart.com/**] come in. *Snap*, the valve control, easily installs on a water main and automatically calibrates the torque needed to turn off a home's water supply. Meanwhile, sensors placed near potential trouble areas throughout the home allow the hub to detect leaks when they start. The system then shuts off the valve and sends an alert via the *LeakSmart* app, SMS and email that a leak has occurred, and where it took place. The system also gives a heads-up when pipes are in danger of freezing, and includes a valve shut-off reminder for when an owner is away from home for an extended period. It will also function even if the power or internet go out. *LeakSmart* is compatible with Control4, Nest, *Google Assistant* and Amazon *Alexa*.

CREDIT: LEAKSMART

Water wise. LeakSmart's leak detection system searches for problem sites throughout the house, and makes it easy to shut the water main off when a leak is found.

Also in the home safety realm, First Alert has just unveiled *Onelink Safe & Sound* [**https://onelink.firstalert.com**], a device that pairs a smoke detector with a smart speaker. Thus far, models for *Alexa* and *Google Assistant* are on the table. In addition to the obvious smoke detection capability (and the ability to send alerts to your phone or tablet about the problem), *Safe & Sound* can play music via *Pandora, Amazon Music*, Bluetooth and eventually *Spotify*, as well as search the internet and perform other tasks offered by digital assistants. It is available for about $250.

CREDIT: FIRST ALERT

Sounds right. First Alert's *Onelink Safe & Sound* pairs a smoke detector with a smart speaker, making the unit a fire safety tool and audio communication device.

Environmental Control: At Your Fingertips

"HEY, IT'S COLD IN HERE—who turned off the sonic heat?" Nothing like hearing George Jetson complain about the outcome of not paying the electric bill—just like now. And that's not the only thing from the television future that's unchanged: Thermostats in fictional 2062 still needed a flick of the wrist to work.

Not true in today's real world, however. Honeywell's *Lyric T6 Pro* [**https://bit.ly/2Nok8Dz**] geofencing technology lets the thermostat adjust the temperature based on a homeowner's smartphone location. If, for example, the owner arrives home late from work or leaves the house for a few hours on the weekend, the *T6* will know and switch into savings mode, maximizing energy efficiency. The unit also lets an owner manage the home's temperature directly through smart phones, and works with nearly any HVAC system. The unit retails for about $120.

Also taking an approach not foreseen by the Jetsons clan is Johnson Controls' *GLAS* smart thermostat [**www.johnsoncontrols.com**]. The company reports that the product is the first to use a translucent OLED touchscreen display, monitor indoor and outdoor air quality, track energy savings and be controlled by voice. The latter feature is accomplished via its integration with Amazon *Alexa, Google Assistant* and *Microsoft Cortana. GLAS* retails for about $320.

The simply designed, Zigbee-connected *Zen Thermostat* from Zen Ecosystems [**https://bit.ly/2kzPZZ9**], paired with multiple service operator (MSO) smart home software, offers similar temperature control and energy saving benefits. It also, during high-demand periods, automatically adjusts temperature to reduce energy use and strain on the grid. *Zen Thermostat* sells for around $200.

Meanwhile, Lennox's *iComfort M30 Smart Thermostat* [**https://bit.ly/2x393qF**] includes a "Feels Like" temperature feature, similar to a weather report. The feature takes into account indoor and outdoor temperature, and humidity to make the home feel exactly like the homeowner wants it to. The "Perfect Temp" mode allows homeowners to set the ideal temperature, and the system automatically adjusts heating and cooling to maintain that level. *M30* retails for about $320.

CREDIT: HONEYWELL

CREDIT: ZEN ECOSYSTEMS

CREDIT: LENNOX

CREDIT: JOHNSON CONTROLS

Running a temperature. Smart thermostats such as Honeywell's *Lyric T6 Pro*, Zen Ecosystems' *Zen*, Lennox *iComfort M30* and Johnson Controls' *GLAS* are making indoor environmental control a breeze (when desired).

Security: All Eyes on the Door

THE TRANSPARENT, ONE-WAY FRONT DOORS seen in later Jetsons adventures—which give a clear view of a visitor without revealing the homeowner's presence—aren't quite here yet. But Nest's *Hello* video doorbell [**https://bit.ly/2p5PeMf**] brings us closer. The unit has a built-in HD video camera that streams to a phone or computer, enabling an owner to see who's ringing, even if they are nowhere near the house. A microphone and speaker allow two-way communication. Similar systems exist—such as those from Ring, August and SkyBell—but *Hello* one-ups competitors with the ability to scan faces and identify visitors from a database of friends or family. This capability requires a subscription to Nest's *Aware* database management service. Available for about $230 to $330, *Hello* is compatible with *Google Assistant* and *Alexa.*

CREDIT: NEST

***Hello* there.** Nest's *Hello* smart doorbell includes an HD video camera that streams to a phone or computer, enabling an owner to see visitors without being at home.

Unlike the Jetsons, who for some reason still had to deal with lost keys, anyone whose homes use standard deadbolts can open and close doors with their phone. August's *Smart Lock* [**https://august.com**] offers keyless entry to family, friends, housekeepers and others. The product's *DoorSense* technology also gives the homeowner the ability to tell if a door is closed *and* locked. Although the product works with the Nest system, Logitech's *Harmony*, Comcast's *Xfinity Home* and Apple's *Siri*, it's not compatible with every lock, and it currently only runs through iPhones. *Smart Lock* retails for about $230.

CREDIT: AUGUST

Under lock and (no) key. August's *Smart Lock* system provides keyless access to the house, and eliminates worry over whether a door was locked before leaving home.

CREDIT: LG

Fully stocked. Among other things, LG's *Smart InstaView ThinQ* refrigerator allows an owner to check contents through a smartphone, draft interactive messages and prepare recipes.

Appliances: Hands-Off Is What's Going On

REMEMBER THE JETSONS' CAR that folded into a suitcase? Sorry, but parking spaces are still needed when you go to shop. But there's now a machine in the works that can fold shirts on demand. The *Laundroid* from Seven Dreamers [**https://bit.ly/2AVjFbM**] debuted at CES in 2017 and appeared in upgraded form at this year's show. The Wi-Fi-driven product—jointly developed by Panasonic and Daiwa House—scans each article of clothing, then uses a catalogue of 256,000 images to determine the best way it should be handled, held up and folded by mechanical arms. Speed isn't its forte, as it takes five to 10 minutes to fold a T-shirt. And at a price tag of $16,000, it's not likely to be a household standard yet. But the days of accidentally burning a shirt through hand-held ironing are numbered.

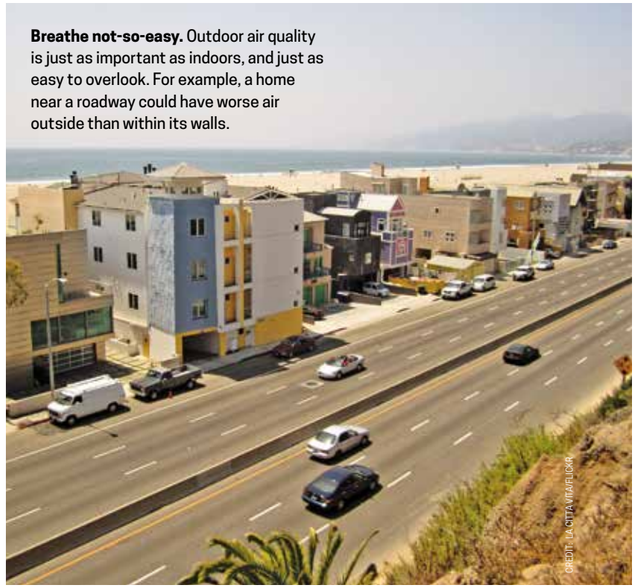
The Jetsons had more fun with food—real stuff, not vitamins—with the family finding ways to overeat, consume super cookies, even feed a kleptomaniacal lug nut to the family maid and robot, Rosie. One thing they didn't have was a smart refrigerator. LG's *Smart InstaView ThinQ* [**www.lg.com/us/lg-thinq**] features a large touchscreen on the front and a camera on the inside that allows an owner to check a smartphone for food needed while they are at the grocery store. The touchscreen also serves as an interactive bulletin board for messaging, and the unit stores recipes and reads them meals are prepared. *InstaView* runs on Amazon's *Alexa* for various digital assistant duties, and enables use of Amazon *Prime* to place orders items such as groceries. It can even request an Uber ride if needed. GB

Breathing Room

Knowing about air quality is an important part of green building.

BY TERRY BEAUBOIS

This is the sixth in a series of articles about the increasing interest in—and necessity for—smart homes, villages, cities and communities globally, and how they relate to green building in the U.S.



Breathe not-so-easy. Outdoor air quality is just as important as indoors, and just as easy to overlook. For example, a home near a roadway could have worse air outside than within its walls.

CREDIT: LA CITTA VITA/FLICKR

AS AN ARCHITECT, I've always been aware of air management in buildings. This includes heating, ventilating and air conditioning (HVAC). It also includes humidity, fresh air ventilation and air quality. Some of my recent experiences have significantly increased my awareness of how critical this issue is becoming for every building.

In many ways, air handling seemed to be a more-technical aspect of architecture, as opposed to other more visible and aesthetic aspects of design. Because many of the leading indicators of problems in air quality are not visible and have no odor, measurements and testing will become an increasingly significant factor in addressing these issues completely and effectively during design, construction and post-construction. This is definitely a case of "what we don't know and can't see, CAN hurt us."

A recent survey of 16,000 U.S. homeowners and builders by Hayward Healthy Home revealed that many people don't know exactly what the path of air is their house is and whether this is affecting their health. People have assumed that all materials, finishes and furniture used in their home don't degrade air quality. They also may assume that natural and mechanical ventilation in their house will address air quality. We need to increase the awareness and knowledge of air quality problems and solutions, so that we are designing and building healthy homes and buildings.

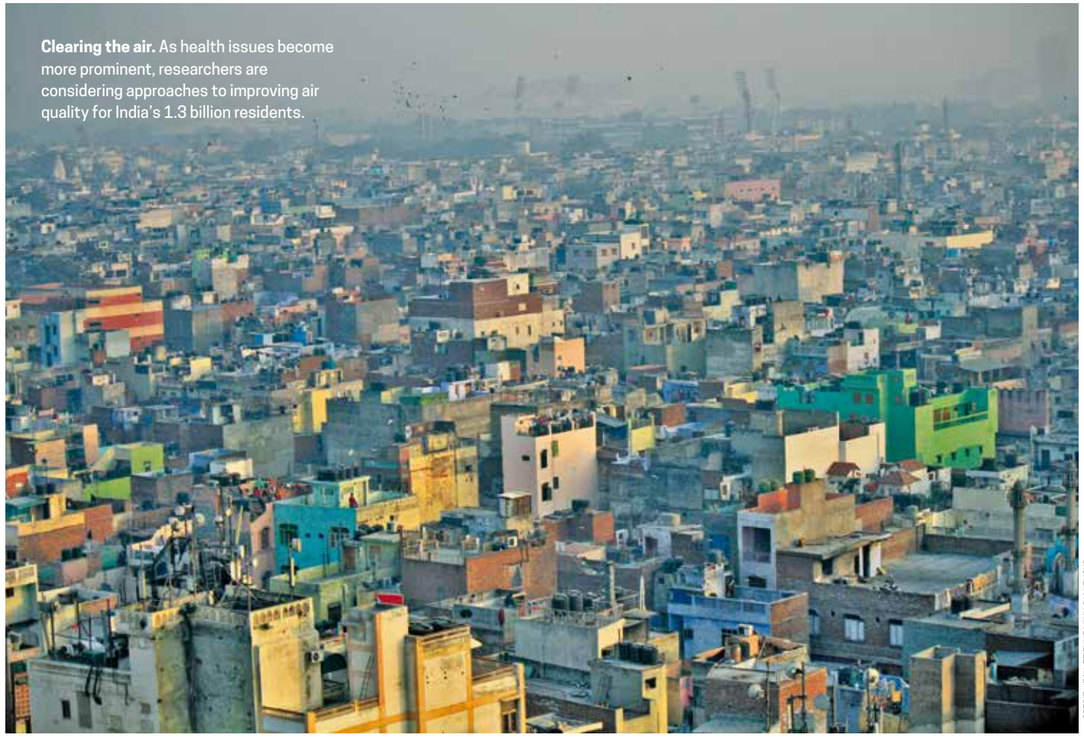
Air supply and quality are crucial, as I learned through my experiences at NASA and the Montana ecoSMART House Project, detailed in previous *Green Builder* articles. I have learned more since.

VILLAGES IN INDIA

In 2015, I became involved in University of California at Berkeley's Smart Villages program headed by Professor Solomon Darwin. He led a six-week tour of India and then subsequent trips in 2016 and 2017. While not focused on air quality specifically, our work and interaction with people in the villages revealed that serious health issues were arising from the cooking stove fumes in village homes and the pollution of outdoor air by brick kilns and other industrial facilities. For us to make significant contributions in this area, there are many social, economic, political and practical considerations. I will be attending this year's India Conference update in September. Combined with my involvement as a team member in Stanford's Ideal Villages program, there are beginning to be approaches to improving air quality-related health for the 1.3 billion people in India (70 percent live in villages).

SLUM HOUSING IN DHAKA, BANGLADESH

Earlier this year, I accompanied members of the Stanford Medical School's Bangladesh Ventilation Research Study to Dhaka. This project further alerted me to the seriousness of air quality issues in buildings. The Stanford Medical School's Bangladesh Ventilation Research Study led by Steve Luby, MD, investigates the slum housing of Dhaka, where the residents have some of the highest incidents of pulmonary disease (lung cancer) affecting both children and adults. I was privileged to be a team member on a visit to Dhaka to see firsthand the conditions being studied. I participated in the design of windows, doors and vents to improve the natural ventilation in the buildings. I will continue to include information through *Green Builder* on the work and findings of this team. Some team members are currently back in Dhaka doing air quality testing.



Clearing the air. As health issues become more prominent, researchers are considering approaches to improving air quality for India's 1.3 billion residents.

CREDIT: JEAN-ETIENNE MINH-DUY/FLICKR

OTHER FINDINGS ON EARTH AND IN SPACE

Solar radiation's effect on humans is similar to the Earth's radiation (in the form of radon). We know to ventilate buildings well in locations where radon is present, but we hadn't really correlated it to solar radiation, nor did I completely understand what radon was and how it worked. Moon base, Mars base, space station astronauts, and even long-range commercial airline crews are or will be exposed to high levels of solar radiation. Coordinating research in buildings with the extensive research being done by NASA will accelerate and advance our knowledge for increasing health for humans in buildings on earth.

The World Health Organization (WHO) in Geneva, Switzerland, recently ranked radon as the second-leading cause of lung cancer globally and will be publishing an update to its work in this area soon.

BACK IN THE U.S.A.

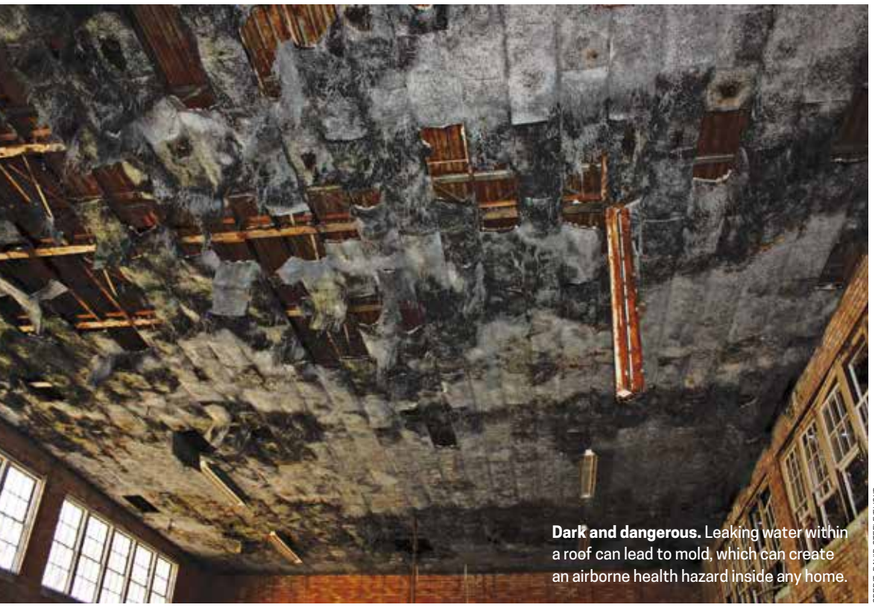
Every time I travel abroad, I learn something about the U.S. While we were studying slum housing and air quality effects on the residents, I returned to the U.S. to learn that many areas in the country have similar problems—not limited to impoverished areas. Areas with million-dollar homes can experience air quality issues that create significant health problems, sending the occupants to their doctors, often with no conclusion as to what is the cause of their illnesses. This can even happen to people living in recently built homes. The solution is knowledge and properly addressing the problems with good design and construction methods and measuring the results.

MOISTURE CAN BE A SERIOUS PROBLEM

A number of years ago, I helped my dear friend Doug Engelbart (his name may be familiar—he invented the computer mouse) through his own poor air quality experience. One day he commented on being dizzy all of the time. I asked if we could go to his house, so I could look around. I found a giant water stain on the ceiling of his dining room from an ongoing roof leak, with signs of black mold forming. I recommended getting a qualified specialist to carefully remove the ceiling material and the mold, and then have the ceiling repaired. Soon after the completion of the work and with help from his physician, Engelbart felt better. Every building and house has the potential to become a health hazard, even through the simplest of issues—like a nail-sized hole in the roof that allows water to leak into the building. The presence of mold in a house can increase allergic reactions and in itself can cause many serious illnesses, such as Ménière's disease.

The Hayward Healthy Home program and Hayward SCORE were developed in response to one family's experience with their home.

SMART CITIES



CREDIT: DAVID STEELE/FLICKR

Dark and dangerous. Leaking water within a roof can lead to mold, which can create an airborne health hazard inside any home.

CREDIT: FAMILY SAFETY PRODUCTS

Quiet assassin. Radon gas is a less-recognized threat to household air quality, but it could be a nightmare for space-faring colonists when combined with solar radiation.

leading research in 3D printing of buildings (and other construction elements); moisture and moisture-related building and air quality issues; radiation/radon issues; and air quality/human healthy buildings issues. I will be detailing my efforts with CERL and the Army Corps of Engineers in future articles.

THE REALITY OF CLEAN AIR

I think that many of us assumed and may still assume that the outside air that we breathe is clean, and that our inside air is not contributing to health problems. I suggest that we check to make sure. Studies are showing that we can't see or smell some of the most dangerous elements in our air. The building industry can benefit from reconsidering our role in creating houses and buildings that benefit from our knowledge about fresh air, clean air and air quality, and to verify that our buildings are, in fact, healthy buildings. We need to know how to detect and measure problems and be able to show that we have mitigated any known problems during the creation of a house or building.

In other countries like Bangladesh and India, there may be asphalt plants or brick kilns in or near inhabited areas that hinder outside air quality and make it not the "fresh air" one would hope for. Also, however, in the U.S. any house located near a freeway may have outside air quality that is not healthy. Measuring and knowing outside and indoor air quality will take the guesswork out of the environmental effects on our health.

Successful green building can address air quality on each of our projects, for the sake of the effects on human health in our buildings. We can begin to understand more completely and address this for the sake of all of our businesses and clients.

For existing homes and buildings, products that measure air quality are becoming available. I will detail more about the new devices and companies focused on this issue in a future article.

Good air quality in the houses and buildings that we design and build doesn't happen by accident. We can succeed in this area by knowing what to do. It is an area that will be taking on even more importance in the very near future. **GB**

THE EPA

The EPA (Environmental Protection Agency) is also involved. Under the Clean Air Act (CAA), the EPA sets limits on certain air pollutants in the United States. The CAA also gives EPA the authority to limit emissions of air pollutants coming from sources like chemical plants, utilities and steel mills. Individual states or tribes may have stronger air pollution laws, but they may not have weaker pollution limits than those set by EPA. The EPA recently categorized radon as the second-leading cause of lung cancer as well.

CONSTRUCTION ENGINEERING RESEARCH LAB (CERL)

I also recently reconnected with Construction Engineering Research Lab (CERL) as a building industry resource. CERL is currently

Terry Beaubois is an architect in Palo Alto, Calif. He is CEO of Building Knowledge Systems (BKS) LLC, and an adjunct lecturer at Stanford University.

AD INDEX

COMING NEXT ISSUE

GREEN BUILDER®

Right-Sized Revolution

Green Builder's first *Tiny House Tactical Guide* provides building tips, products, code updates and more that can be applied to anyone's vision of living smaller.

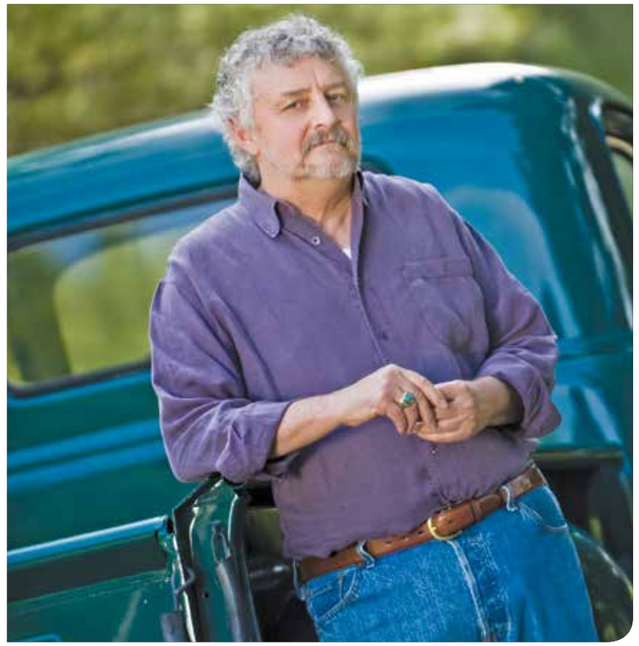
CREDIT: TINY HOUSE COMMUNITY

FROM THE TAILGATE

New Offerings for the Sustainable Minded

By Ron Jones

Built for the Future



WHEN WE DROPPED THE TAILGATES and broke out the various lunch containers one day recently, I seized the opportunity to gather some insight from some of the most legitimate sources in the industry: guys on the job.

At the upcoming EEBA High Performance Home Summit, scheduled for Oct. 16-18 in San Diego, I have the privilege of providing a breakfast presentation on the final day. I have been asked to talk about the future of the building industry, a topic I regularly give a fair amount of thought to. Not only is this an interesting subject, and an obvious source of concern, but it's also one that does not suffer from any shortage of opinions.

I have been seeking input from a wide range of folks connected to the industry, from product manufacturers, suppliers, marketers, and folks in the media, to builders, specialty contractors and building officials. While I've found a wide range of perceptions out there, there is a common thread in the vast majority of the responses I've received. Namely, the industry is poised for significant and inescapable changes going forward.

My jobsite lunch companions were all pretty seasoned workers. Their histories of experience range from a dozen or so all the way up to 55 years, but they were all generally in agreement: "Archaic" is the best way to describe the building industry as it is conducted today.

They also predict that the direction the industry should (and will) go is toward more off-site production, modular and panelized processes, and alternate materials that utilize composites and man-made components, with greater emphasis on life-cycle analysis, environmental impacts, durability and waste stream implications.

They predict field operations will be less and less about fabrication, and more and more about assembly. It was suggested that we'll see more utilization of machinery, like cranes, and even "fly-in" deliveries. Keep in mind that these are guys who only minutes before had dropped their tool belts to break for lunch, like tradesmen have been doing for generations.

Additionally, it was asserted that the industry will need more standardization and innovation, better use of modern communication tools and technologies, and "bigger systems thinking" if it has any chance of keeping up with other sectors. They cited the need for challenges and problems to be solved ahead of time rather than on the fly in real time, if the act of building is ever going to realize improved efficiency.

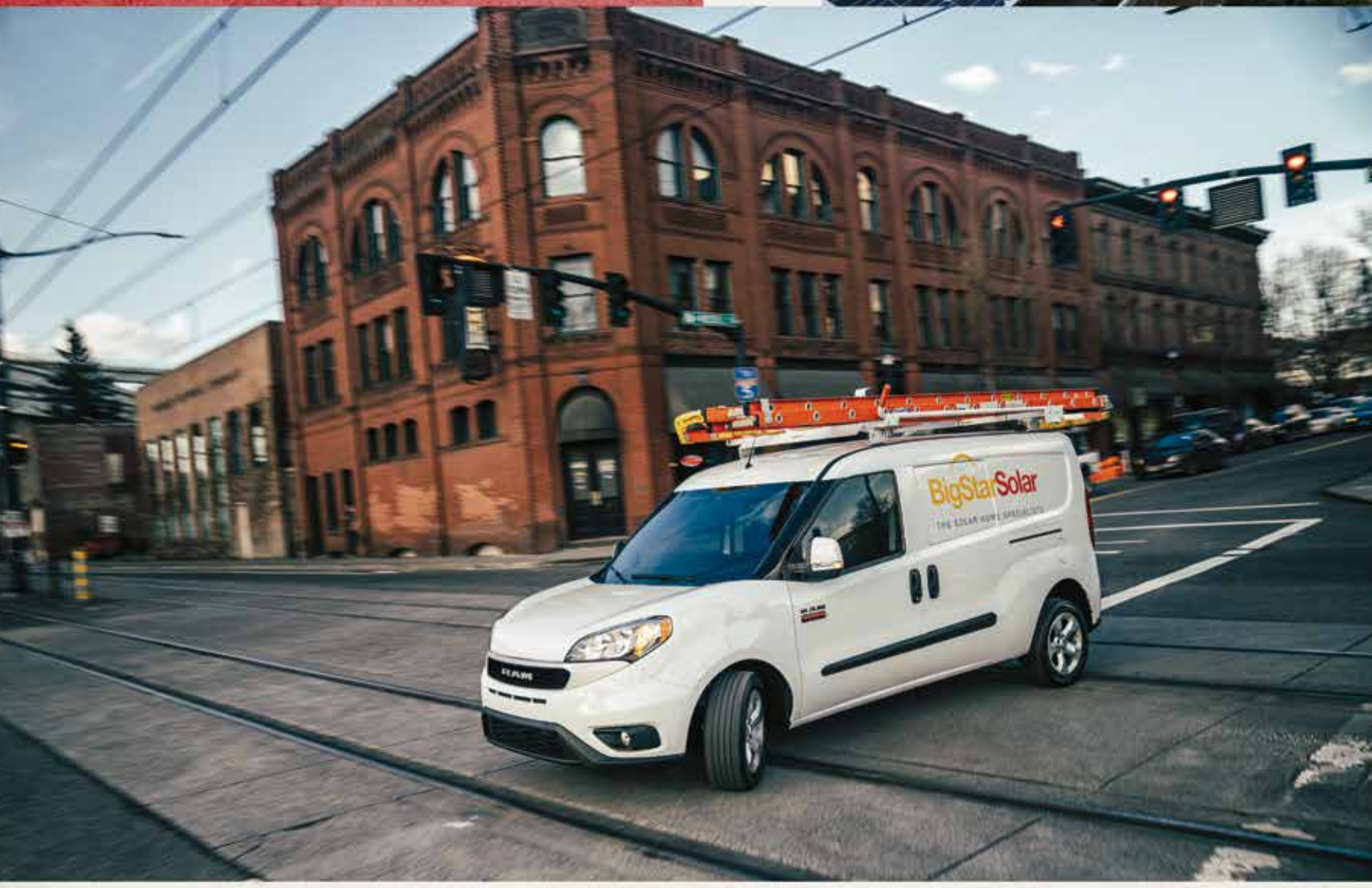
When I asked specifically about workforce issues facing builders, they were more circumspect, but the consensus was that if the industry wants to be competitive in the labor sector, compensation and benefits must be improved. The work also has to be interesting and challenging if it is going to attract and hold the attention of the modern workforce. They didn't express a desire for the work to be considered glamorous, but they would like to be respected, appreciated and valued.

It proved to be a most enlightening lunch conversation, one I would recommend to anyone who has a stake in the future of this industry. Over the years we have all been offered the "silver bullet" secret sauces served up by self-proclaimed "expert" consultants, each hawking their particular flavor of snake oil that's guaranteed to result in success in the building business. But in my opinion, there is a great deal more that can be learned while resting on the tailgate, listening to the voices of folks who have actually "built" something. **GB**

EMPLOYEE OF THE MONTH. EVERY MONTH.

RAM PROMASTER CITY®

AMERICA'S MOST EFFICIENT WORK VAN*
BEST-IN-CLASS HWY FUEL EFFICIENCY
BEST-IN-CLASS PAYLOAD
BEST-IN-CLASS CARGO CAPACITY



RAMTRUCKS.COM/COMMERCIAL

Class is small Commercial van segment. Based on BIC cargo capacity, BIC payload, and BIC fuel efficiency. EPA est. 28 HWY MPG, 2.4L automatic 9-speed transmission. Actual results may vary. Ram is a registered trademark of FCA US LLC.

RAM COMMERCIAL

BUILT TO SERVE