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ENERGY SOLUTIONS

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TANKLESS

EDITOR'S NOTE The Inside Scoop

By Matt Power Editor-in-Chief

On to the Next Big Thing

Green Builder is shaking things up with a new look and a more finely tuned approach to accessing our content.

HINK ABOUT EVERY GOOD IDEA vou've ever had, ideas that turned out to be wildly successful in the long haul. When you first came up with them, how did your friends, family and colleagues react? In my experience,

the immediate reaction to the best ideas is usually criticism, skepticism or, in the worst cases. ridicule.

I remember reacting this way myself, back in journalism school in the late 1980s, when the trendwatchers at the Poynter Institute suggested that one day, readers would design their own magazines, receive only the type of content that interests them, and pay for only what they read.



Quantum Shift.

With a new logo, several new sections and crisp, updated look, this month's issue heralds our commitment to smart, digital content.

Now, however, I find myself advocating these same ideas. And that's exactly what we're doing at Green Builder. This past year, we've been setting up complex "back office" systems that give readers the information they're looking for from our magazine and online platform, then offer them content that matches their behavior and interests. When I say "they," I mean "you," of course. We know you're feeling the burn of the abrasive digital wind that carries advertisements, junk emails and involuntary pop-up windows. So whether you connect with us by smart phone, desktop or email, we're only letting the content through that matters to you. And the more you interact with us, the more we can now

streamline that experience.

It's a lot like the way you build or design a custom home. You get to know the clients, select a few floorplans they might like, and steadily narrow down product selections and amenities to fit their personalities and desires.

You'll notice the magazine looks a little different. That's because we've brought our printed content into direct alignment with our online presence. We're also changing up our schedule. Doing so, we're breaking many of the old rules of publishing to keep ourselves on the "bleeding edge" of innovation.

But that's what you've come to expect from *Green Builder*, just as you would expect it from yourself, as a risk-taker and free thinker in a tough industry. The industry and the world are changing. Beautiful homes will still be built, like the winners featured in this year's Green Home of the Year Awards issue, but they'll be smarter and greener than their predecessors. The need for shelter isn't going anywhere, and neither are we. But starting right here, right now, let's agree to keep moving forward-keeping what works, but ever-willing to discard what no longer serves. Enjoy the new, improved Green Builder "experience," and let us know what we can do to make your labors more bountiful and your time more valuable in 2016. – MP



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Green Building NEWS

The latest on sustainability and renewable energy

CONGRESS EXTENDS RENEWABLE TAX CREDITS

In a surprise move, Congress voted to extend the renewable tax credit for solar energy until the end of the decade.

AYBE IT'S BEST not to spend too much time wondering why the Grinches in Congress had a sudden change of heart. Our guess? They may be stingy, but they're not stupid. The renewable energy sector has skyrocketed in value, and analysts predict exponential growth over the coming decade.

Both the House and Senate passed the credit extensions.

Solar got the best deal, with investment tax credits slated to remain at 30 percent for the rest of the decade. Other renewables, including geothermal, marine technologies and small hydroelectric plants, received more conditional support: their tax credits were granted a one-year extension at the 30 percent rate. Wind energy



will continue to get a 2.3-cent-per-kilowatt-hour production tax credit (PTC) initially, but the credit will diminish every year, starting in 2017. By 2022, it will hit 10 percent.

Renewal of the rebates is expected to spur more than \$70 billion in new investment over the next few years.

Zero-Cement Block Now Available

Watershed Materials develops a masonry unit that achieves 2,500 psi-without cement.

N OUR OCTOBER ISSUE, we reported on Watershed Materials, which had developed a low-carbon masonry unit called *Watershed Block*, made by compressing locally-sourced aggregates with half the cement as a conventional CMU. In December, the company announced it had succeeded in developing a zero-cement Watershed Block, which combines lime, ground granulated blast furnace slag (a by-product of steel manufacturing) and natural aluminosilicates. The snow-white block achieves a compressive strength of 2,500 psi.

Though Watershed Materials has not yet calculated the carbon footprint of the new block, it is certain to be much lower than a conventional

CMU. The manufacture of lime. which acts as a binder, requires high temperatures, but produces fewer carbon emissions than the manufacture of cement. The block is made by compressing the mix in a specially developed machine and does not require kiln-firing.

The block, which is being manufactured in the company's pilot factory in Napa, Calif., is currently available for projects in Northern California.

For more info, visit Watershed Materials at www.watershedmaterials.com





The HERS Index in Less Than Three Minutes A new consumer-facing video explains the benefits of the HERS Index.

HE NON-PROFIT RESIDENTIAL Energy Services Network, or RESNET, has created a short, easy-tounderstand video, available on YouTube, which explains the HERS Index score to homeowners and potential homebuyers. The video, which is

narrated by John Bell, director of the Sustainable Housing Foundation, uses catchy graphics to compare a home's HERS score to the "miles per gallon" rating for vehicles and to explain the financial benefits of owning an energy-efficient home.

RESNET is encouraging HERS raters and Energy Smart Builders to link the video to their websites. See the video here: http://bit.ly/1SB7Dqs

Owens Corning Sets New Sustainability Goals

Owens Corning vows to reduce greenhouse gas intensity by 50 percent by 2020.

WENS CORNING CONTINUES to distinguish itself by setting ever more ambitious sustainability goals and standards for its operations and products, which include insulation, roofing and fiberglass composites. Late last fall, the company announced new commitments and

raised the bar on two of its sustainability goals. Here are the highlights: • The company will secure power supply agreements of new installed capacity "that represent the largest wind power agreements reported by an industrial company in the world."

• The company will dedicate a 2.4-megawatt solar canopy at its headquarters in Toledo. The canopy is expected to supply about 30 percent of the facility's annual electricity—an amount that offsets the greenhouse gases emitted by the facility's commuting employees.

These new sustainability goals set targets to reduce greenhouse gas intensity by 50 percent and toxic air emissions intensity by 75 percent, using 2010 as a baseline.



Sun Cover. A 2.4 megawatt solar canopy at Owens Corning's headquarters in Toledo is expected to supply approximately 30 percent of the facility's annual electricity needs.

In 2014, Owens Corning exceeded its 2020 goals for both greenhouse gas intensity and toxic air emissions. The company achieved a 34 percent reduction in greenhouse gas intensity and a 65 percent reduction in toxic air emissions. The goals were 20 percent and 50 percent reductions, respectively.

The progress in greenhouse gas emissions came through a range of strategies, including switching to foam blowing agents with lower global warming potential and reducing scrap waste.

Owens Corning achieved a 33 percent reduction in VOC emissions intensity and a 74 percent reduction in nitrogen oxide (NOx) emissions intensity during its first 10-year goal cycle (2002-2012), largely by replacing the formaldehyde-based binder in its insulation products with a starch-based alternative.

VISION House®



Green Builder Media proudly introduces our first entirely self-sufficient, off-grid project in the VISION House Series.

The VISION House at Mariposa Meadows and the ReVISION House at Rancho La Garita are perched high in the Rocky Mountains of Colorado. They unite extraordinary design, extreme performance, innovative products and intelligent technology

The goal of the project is to demonstrate how homes built in an extreme, high-altitude setting can be optimized for performance, self-sufficiency, durability and resource management. The homes will display solutions that can be applied in climate zones across the nation. The project will focus on key sustainability elements such as energy efficiency, renewables, water and resource conservation, healthy indoor air quality, durability and enabling technologies. Opening Summer 2016.

Learn more at www.greenbuildermedia.com/vision-house-marin

Follow the conversation on social media: **#VHMariposa**



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MARIPOSA **MEADOWS**



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CREATIVE MINES



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"One thing we want to create is a tool box for homeowners to look at all components of the home and identify the savings over time. The goal is to bring the level of sophistication of the automobile to the home." (p.61)

ON THE COVER **ENERGY SOLUTIONS**

Artist: Liza Kelley

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Page 24







Next-Generation Dwellings What will the homes of the future look like? The following pages offer us a glimpse.



These projects showcase innovative strategies for maximizing the power of the sun.

BY CHRISTINA B. FARNSWORTH

OLAR IS BIG, and getting bigger. This month, we've selected three ambitious projects that showcase the best in solar technology and innovation. Whether you're already installing solar, thinking about better ways to utilize systems and panels, or just curious, you'll find something inspiring in these cutting edge installations.

continued on page 14

Wholesome Design. Featuring a solarium for ng food and am airy solar canopy, the Home was the University of Buffalo's was the University of Buffal ry in the 2015 Solar Decathle

CASE STUDY 1: Storm-Ready Solar

This storm-resistant coastal housing serves as an energy hub during emergencies.

HE SOLAR DECATHLON, a biennial event sponsored by the U.S. Department of Energy (DOE), is a good place to look for inspiration and innovation. The inaugural Solar Decathlon was 2002 on the National Mall; the latest and seventh competition was held in Irvine, Calif. this past October.

This was Stevens Institute of Technology's third Solar Decathlon competition. This year, the team took the legacy of Hurricane Sandy into account, asking, "How can we design a home that both reduces energy use and adapts to the realities of a changing more extreme climate?"

The team's winning answer is the SURE (SUstainable and REsilient) HOUSE, a high-performance solar-powered house, not only armored to take weather extremes but prepared with a source of emergency power in the aftermath of a storm.

The two-bedroom SURE HOUSE is 999 square feet. In style, it is a midcentury modern beach house, but it sips energy à la the 21st century and closes up tight to resist bad weather.

SURE HOUSE features what the Stevens Institute team describes

as a "storm-rugged PV system" that not only continues to supply power when the grid is down, but can also help neighbors. The array is designed to safely allow a small amount of "islanded"-that is, cut off from the main grid—energy generation during a power outage, without any batteries at all. Part of this energy is directed to a hub outside of the house, allowing neighbors to charge their electronic devices via exterior USBs.

A separate building-integrated PV array is integrated into lightweight fiber-composite shutters that shade the home's southern facade. The solar modules are flexible and thin, using plastic polymer instead of the traditional "heavy glass sandwich layers." The light weight makes it easy for homeowners to easily raise and lower the storm shutters.

When lowered, the solar shutter system locks into place using a series of latches and watertight EPDM seals. The fiber-composite material consists of "a sophisticated matrix of reinforcement fibers:" glass, carbon and even biofibers such as flax combined with plastic binders. The material is high strength, low weight and durable enough to survive fierce storms.

The domestic hot water system was also designed for resilience. The BIPV array delivers DC power to the control unit and heating element, which means it functions without an inverter or the need to be tied continued on page 16



Storm-Resistant Solar. Designed by a team from Stevens Institute of technology, this coastal cottage includes a resilient PV array incorporated into a durable awning.

SURE HOUSE SOLAR STRATEGY

http://surehouse.org

Innovative Water Heating

Hybrid heat pump water heater functions without an inverter, and it does not need to be tied to the ower grid.

CREDIT: DOF

Emergency Power

The PV array produces up to 10,000 watts when the grid is functioning; when the grid is down, the transformerless inverter switches to "Resiliency Mode." Isolated from the grid, the array still produces up to 3,000 watts.

Grid-Tied Solar

NRG Home Solar supplied the LG solar panels for the rooftop array, which provides the bulk of the home's renewable energy

Building-Integrated PV Flexible solar cells are

integrated into custom modules fabricated by Pvilion, a local company. The flexible, impact-resistant modules are integrated into storm shutters producing solar energy when the shutters are open.



Dual Function. The solar awnings can be easily raised to provide shade or lowered to protect the building.

into the power grid. An integrated heat pump is triggered when there's not enough direct solar energy to keep the water temperature above the set point. Even in "heat pump mode," this system is 70 percent more efficient than a conventional electric water heater.

With its tight envelope, thick insulation and heat recovery ventilation, SURE HOUSE exceeds Passive House standards for energy

use and can be physically raised to avoid what the team described as "periodic nuisance flooding." The combination of the shutters and a louver system helps to keep out both the high summer sun and lowerangle sunlight, which can also raise indoor temperatures.

SURE HOUSE not only won first place overall, it was also the clear winner in market acceptance, one of 10 juried categories.



Flood Plan. The light, bright interior of the SURE HOUSE is protected by fiber-composite sheathing and flood shutters.



CASE STUDY 2: Mainstream Model

Solar shingles and an attractive rebate program are making net-zero homes from Addison Homes appeal to buyers in this South Carolina market.

DDISON HOMES IS committed to making *zero energy* a mainstream option, modeling a vision of sustainable construction that's attractive, affordable and attainable for homeowners. Its 2,700-square-foot InVision Zero SC is not only the first zero-energy home in Greenville, S.C., it is also the first area's first Active House.

Active House is an international alliance of manufacturers, designers and nonprofits started in Denmark around 2007. The international Active House Alliance emphasizes comfort, environment and energy. The standard gives importance to optimal natural daylighting (including interior rooms), as well as indoor air quality and resource efficiency. Builder Todd Usher says the light, bright interiors are key to the appeal of the InVision Zero house, which was built as a model home in the company's Trailside development. A dozen VELUX skylights and windows, including VELUX tubular *SUN TUNNEL* skylights, flood the home with natural light without increasing energy use. There is little need to turn interior lights on during the day.

Usher says, "While there's always been a niche for extreme efficiency, we envision broadening this market by building attainable, sustainable homes designed to expand the power of *zero*," says Usher. "An Active House [also] fosters wellness." Benefits of a healthy home include increased concentration and learning, improved sleep quality, reduced allergy symptoms and lowered risk of poor health. To achieve indoor air quality, the home features a Lennox *PureAir* purification system and no- and low-VOC paints and finishes.

The house also meets relevant International Code Council (ICC) codes, something that helps appraisers rate its green value here in the U.S.

Without solar power, Usher says, the InVision Zero home's HERS continued on page 19

INVISION ZERO SC SOLAR STRATEGY

www.addison-homes.com

Solar Shingles

An 8.2-kW array consists of DOW POWERHOUSE shingles from Dow. The shingles are wind and hail resistant and come with a 20-year warranty.

N II

Sunny Rooms VELUX venting skylights, roof windows and sun tunnels bring natural light and fresh air into the home. This daylighting not only benefits occupants' health and well-being, it reduces the need for artificial lighting during the day

A Lennox *XP25* heat pump (up to 23.5 SEER) and a Navien tankless gas water heater minimize heating loads. An Energy Star-rated laundry pair from Electrolux are among the home's efficient appliances. score would be in the 40s. With the 8.2-kW *DOW POWERHOUSE* solar shingle PV system, its HERS score is 0.

Solar energy has been given a boost in South Carolina. Local utility Duke Energy recently adopted net metering and began offering a "dollar a watt" one-time rebate on PV systems. This followed adoption of legislation passed at the end of 2014. Solar installation costs around \$4 per watt, and a system on an energy-efficient, high-performance home generally ranges from 5-8 kilowatts. That means average rebates of between \$5,000 to \$8,000 for homeowners, which reduces the cost some 25 percent.

Usher says InVision Zero will sell for 380,000, but federal and local rebates will bring the price down to 350,000.

Addison Homes is building 16 homes in Trailside to the standards of the DOE Zero Energy Ready Home program, but since committing to solar its zero-energy model home, several clients with houses underway in the neighborhood have opted to go with solar as well.

ENERGY SOLUTIONS

Breakthroughs in Storage

EMAND FOR RESILIENCE is driving several companies to create gridcompatible storage solutions. Silicon Valley-based JuiceBox Energy is one of them. Last April, the company announced the release of an 8.6-kWh lithium-ion storage system. A *JuiceBox* consists of an array of lithium-ion batteries and intelligent battery management system housed in a UL-rated enclosure. It integrates with the Schneider *XW+* inverter. The controller manages the inverter/charger interface and includes redundant protection mechanisms to prevent over voltage and other unsafe conditions. The system is designed to support grid-tied, grid-isolated and off-grid configurations; it can be installed in new and existing solar PV arrays. The controller constantly monitors the battery, PV output and building loads and "chooses" a mode of operation based on factors such as utility rates; for example, it can reduce peak consumption by switching to stored energy once the sun goes down, and during a grid outage, it can power the home's critical loads.

Recently, JuiceBox Energy partnered with Rising Sun Solar to install its first residential energy storage system in Hawaii, on the island of Maui, and in December, a *JuiceBox* was integrated into a 3.7-kW residential PV array in San Diego. **WWW.JUICEBOXSOLAR.COM**



JuiceBox Specs. A 8.6-kWh lithium-ion battery pack with proprietary charge control and energy management system is coupled to the Schneider Conext XW+ inverter, which is now listed and approved for use in Hawaii.

CASE STUDY 3: Urban Renewal

A solarium regulates temperatures and allows occupants to grow food in this flexible urban design.

ARTICIPATING IN THE Solar Decathlon for the first time, the University of Buffalo took second place among the 14 teams with its Garden, Relax or Work-or GRoW-Home. Designed for an urban environment, the home features living space that expands and contracts with the growing seasons and centers on what contestants call a "GRoWlarium." This

greenhouse-like space can be enjoyed as living space in benign weather and used as a greenhouse the rest of the time. It also encloses, buffers and moderates the conditioned space.

The University at Buffalo team considered four themes for their sustainable residential design: "nurture active stewardship, think functional flexibility, live with nature and recognize energy hierarchy."

The home was designed to flex with Buffalo's climate, which is characterized by hot summers, cold winters and comfortable swing seasons. A tight thermal envelope encloses 770 square feet of conditioned living space, divided into 489 square feet of "wet module work area"—primarily the kitchen and bathroom—and continued on page 22



Adaptable Rooms. Sliding doors and a movable partition allow occupants to manage light, heat and airflow.



Active Array

The 7-kW PV array consists of 24 Silevo panels with a rated efficiency of 17.2 percent. A solar thermal system provides hot water

Flexible Design

The sliding glass doors allow occupants to manage energy and airflow for maximum comfort and efficiency. The planters can be rolled inside at night, releasing stored heat and reducing demand on the HVAC system.

Thermal Buffer

The GRoWlarium buffers the home from extreme heat and cold and can be used to grow food all year round. It blurs the lines between indoor and outdoor living and encourages engagement with nature



Food Security. The University of Buffalo team grew several varieties of tomatoes in their project home's "GroWlarium," along with herbs, flowers and other veggies.

281-square-foot dry module relax area. The building envelope is constructed with structural insulated panels (SIPs), two high--performance sliding glass doors and high-performance fixed windows. Another 1,440 square feet of shaded exterior deck extend the living space.

In cold weather, plants can be started inside the 320-square-foot GRoWlarium. A canopy covers and shades the enclosed portion of the house and serves as a trellis for plants. Rolling planters can be wheeled outdoors for the summer.

Montante Solar and SolarCity are among the project's sponsors, and the home also features an active solar array: a 7-kW, 24-panel PV system. With a rated efficiency of 17.2 percent, the array will produce 9 MWh per year, almost twice as much energy as the house consumes. A four-zone HVAC system works on an as-needed basis to condition space within the house, and an energy recovery ventilator improves efficiency. GB

BUILDING SCIENCE

On the Horizon

HAT IF ALL THE GLASS SURFACES of all the world's skyscrapers could generate clean electricity? One company, SolarWindow Technologies, has developed the concept into a marketable product: a transparent, energy-generating coating that can be installed on glass and plastic.

Organic photovoltaic cells, which consist of active lavers and conducting layers, have been engineered to absorb light in the UV and near-infrared spectrums but allow visible light to pass through. Unlike conventional solar cells, these organic PV cells don't require direct rays of light to function; they even work in the shade or under artificial light. Consequently, SolarWindow can be applied to all four sides of a building. The flexible veneers can also be applied to existing windows.



The SolarWindow Technologies team, led by Dr. Scott Hammond, worked with NREL through a Cooperative Research and Development Grant to develop SolarWindow.

Though not commercially available yet, the company has issued a number of "forward-looking statements" regarding its product. Among them, it claims the technology has the potential for a one-year payback, and that one 50-story building can generate 50 times the energy of a similarly sized building equipped with rooftop solar array. Rather than building a new manufacturing facility, SolarWindow Technologies plans to license the technology to other companies that already manufacture glass and/or windows. The initial target is commercial windows for skyscrapers and other commercial buildings, but eventually, the SolarWindow coating will be available for many types of windows, curtain walls, and other surfaces.

Learn more: HTTP://SOLARWINDOW.COM





Bill Rectanus is the vice president of Homebuilding **Operations for Thrive** Home Builders. His responsibilities include the management and oversight of the construction,

purchasing and customer service departments. In addition to his daily responsibilities, Bill is also responsible for the implementation of Thrive Home Builders' "High Performance Building Initiative." Bill is very active in the Denver homebuilding industry, where he serves on the Board of Directors for the Home Builders Association of Metro Denver. www.thrivehomebuilders.com

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2015 Green Home of the Year AWARDS

This year's homes have upped the ante on overall sustainability. Several of our winners have achieved net-zero energy or are net-zero ready; in addition, our expert panel of judges evaluated the projects on comprehensive criteria, including siting, the depth of building science employed, materials sourcing and reuse and overall resilience. We hope you find these homes as inspiring as we do.



Sam Hagerman is co-founder and co-owner of Hammer & Hand, a Portland- and Seattlebased construction company dedicated to inciting evolution in building through service, craft and science. Founded in 1995, his firm specializes in high-performance building in

the commercial and residential realms, with projects such as Pumpkin Ridge Passive House, recent

recipient of U.S. Department of Energy's Housing Innovation Award. Sam is an active member of the U.S. building science community, both through his leadership of the national Passive House movement (he served as inaugural president of Passive House Alliance U.S.) and through his high performance building praxis at Hammer & Hand. www.hammerandhand.com



Steve Byers gets up every day (nearly) excited to go to work and lead the incredible staff of professionals at EnergyLogic. Based in Colorado, EnergyLogic serves a wide variety of clients in the residential and light commercial energy efficiency and sustainability spaces. "In short, we help make buildings better," he says. Steve

started his professional life as a pilot in the Air Force, after graduating from the Air Force Academy. He "stumbled into" energy and sustainability and spent several wonderful years at Southface Energy institute in Atlanta before striking out on his own. He and his wife, Wynne Maggi, started a company which eventually morphed into EnergyLogic. He is blessed with a pair of talented daughters, a great community and the great hope that he will continue to find new and exciting things to do in this life. www.nrglogic.com



GREEN BUILDER Neighborhood

The 42 homes in this Seattle micro-community are super efficient and solar ready.

HE RAINIER VISTA Community, located in Seattle's Columbia City neighborhood, began as a partnership between Dwell Development and the Seattle Housing Authority in 2010. Dwell Development's owner, Anthony Maschmedt, committed to building 15 homes using green building techniques and high-performance technology that would help homeowners conserve resources and cut costs. The excitement and demand generated by the project led to an additional 36 homes over five years. The last home was completed and sold in July 2015.

continued on page 26

All 42 homes in the community are designed for zero-energy living and are 5-Star Built Green certified. This voluntary certification program, developed by the Master Builders Association of King and Snohomish Counties, establishes environmental standards for energy

From the Judges "This project is a great example of how to create a pleasing, efficient, zero-energy-ready high-density neighborhood."

efficiency, water use and indoor air quality. Each home features solarready rooftop configurations, advanced framing, high-impact insulation, triple-glazed windows, radiant heat systems powered by tankless water heaters and heat recovery ventilation systems. The community also includes the Cork Haus, Seattle's first speculative Passive House.

Dwell Development partnered with Julian Weber Architects (JWA), a local architecture firm that specializes in green homes and modern design. JWA was able to deliver 42 different blueprints, each designed to optimize energy performance, including specific window

placement and roof configurations that maximize solar gain. Environmentally conscious elements were integrated into the process, from initial designs to final interior touches, while unique

PROJECT STATS

NAME: Rainier Vista Community, Seattle, WA

DEVELOPER: Keith Hammer, Dwell Development www.dwelldevelopment.com

ARCHITECT/DESIGNER: Julian Weber, Julian Weber Architects www.jwaseattle.com

BUILDER: Anthony Maschmedt, Dwell Development www.dwelldevelopment.com

INTERIOR DESIGNER: Abbey Maschmedt, Dwell Development www.dwelldevelopment.com

PHOTOS: Tucker English Photography

reclaimed materials were carefully sought out for exterior siding, floors, countertops and tile.

The goal of the project was to create a community within the bustling Columbia City neighborhood that brings together likeminded individuals who value community, sustainability and modern design. The homes are arranged in micro-blocks: clusters of six to eight homes around an outdoor common area, which includes a shared garden and informal gathering spaces. The pedestrian-friendly location near the Light Rail Station and the retail and dining district in Downtown Columbia City help further reduce the community's carbon footprint.



First on the Block. The 1,711-square-foot Cork Haus features 100 percent natural cork siding from Thermacork. It is the first Passive House spec home built in Seattle, and it has earned a HERS Index score of -1.



Responsible Materials. The homes incorporate many recycled and reclaimed materials, including NovuStone countertops made from recycled glass, cabinets from Seattle cabinetmaker Abodian and flooring from reclaimed wood.



Energy Management. These efficient homes utilize ductless mini-split heat pumps for space heating and tankless units for domestic water heating. Kirin home energy management systems allow homeowners to optimize energy use.

Efficiency Times Two

This cohousing duplex in Washington State generates enough solar energy for two families, plus their electric cars.

ELLINGHAM-BASED DESIGN/ BUILD FIRM TC Legend Homes loves to build overachieving homes. The firm's latest project features a 9.9-kW PV array, which not only produces enough solar electricity to meet its own energy needs, but will produce surplus power to charge two electric cars. Nicknamed the Power House, the home has earned a HERS Index score of -15. It is the first of its kind in Whatcom County.

From the Judges

"Excellent combination of alternative building practices with ICFs, SIPs, solar hot water with heat pump back-up, solar PV and rain catchment for landscape and gardening use."

> An airtight shell was built using insulated concrete forms (ICFs) and structural insulated panel (SIP) construction for the above-ground walls and roof. Numerous south-facing windows and passive solar design work in tandem with a highly efficient heat pump, solar hot water and a solar PV array to achieve better than netzero performance. This one-of-a-kind house *continued on page 30*

has no electrical bills (other than the monthly service charge for this grid-tied system), costs nothing to heat and uses no oil, natural gas or other fossil fuels. This home shows that cutting-edge energy efficiency technology can actually be affordable, in part by eliminating entire categories of expenses. And because one house is shared by two families, expenses are decreased for both.

Perhaps more remarkable than the home's efficiency is its modest price tag. Shared by two couples and three children, the 2,700-square-foot custom home cost under \$150 per square foot to build-significantly less than most other residential construction projects in Bellingham.

PROJECT STATS

NAME: Bellingham Power House, Bellingham, WA

BUILDER: Ted Clifton, TC Legend Homes www.tclegendhomes.com

ARCHITECT/DESIGNER: Ted Clifton, TC Legend Homes www.tclegendhomes.com

PHOTOS: Rachel M. Lee for TC Legend Homes



Local Panels. Solar PV panels were sourced from Bellingham-based Itek energy. The array produces enough energy to power both dwellings and two electric vehicle chargers.



Solar Heating. The acid-stained concrete slab foundation houses radiant heat tubing, which is powered by a solar thermal system with a highly efficient Daikin Altherma 5-ton monobloc heat pump for backup.



sophisticated home offers efficient use of space, expression through form and a myriad of green features.



ESIGNED TO ACCOMMODATE two or three family generations, this 2,900-square-foot home features paired living spaces on the first and second levels, each with separate kitchens and living rooms. These are highlighted on the front façade by window systems

From the Judges "This home is a

modern

architecture

designed to

incorporate sound

building science

house. An open stair with acrylic treads and glass rails winds from the basement to the third floor, channeling natural light down through the home and connecting all the levels. The home includes both a great example of

modern form and palette of materials, using durable cedar and fiber cement siding. The street side offers a permeable parking area with an electric charging station, while at the home's entrance, an acrylic overhang shelters foot traffic from rain. The glazed entry door opens into the family foyer, with access to the

that wrap the corners of the

PROJECT STATS

NAME: Brookline Residence, Brookline, MA

BUILDER: Matt Ayers, Aedi Construction www.aediconstruction.com

ARCHITECT/DESIGNER: Stephanie T. Horowitz, ZeroEnergy Design www.zeroenergy.com

PHOTOS: Eric Roth Photography

rear outdoor living space.

This super-insulated home features airtight construction, continuous exterior insulation, and well-insulated, triple-glazed windows. The walls and basement feature petroleum-free cavity and exterior insulation, including dense-pack cellulose, mineral wool on the exterior and FOAMGLAS insulation under the slab. On the rooftop, a solar electric system helps offset energy consumption.

Cisterns capture nearly all the stormwater from the site and roof surfaces and connect to a drip irrigation system to irrigate the landscape. Inside the home, consumption is limited with highefficiency water fixtures and appliances.



Form and Function. The open stairway not only channels natural light from the top floor to the basement, it also functions as the central return for the home's cooling system.



Passive Solar Design. The first-floor living space includes a wall of south-facing glass. Triple-pane Shuco windows include a coating that reflects heat into the home during winter and keeps some heat out during the summer.



REEN BUILDER



VERY HOME BUILT by Dwell Development is designed with the goal of net-zero energy use. The Reclaimed Modern home, built on an infill lot in Seattle, is no exception. The lot lines were adjusted to maximize solar siting, and an existing home was also renovated. "We use a holistic approach at Dwell Development similar to the farm-to-table idea, where we incorporate local materials into our homes

From the Judges

"Great use of an existing lot and reconfigured lot lines to accommodate good solar exposure and build two dwellings on a single lot, maximizing the infill density."

460

that are natural, recycled or repurposed. It's about making conscious choices," says Anthony Maschmedt, owner of Dwell Development.

The pathway leading up to the 3,140-square-foot three-story home is made out of concrete, repurposed from a public sidewalk removed during construction. The home's exterior incorporates salvaged wood and corrugated metal from a deconstructed barn in the Willamette Valley.

"We have always used a lot of materials continued on page 36 with high recycled content, but the idea of actually taking and reusing materials from old buildings slated for demolition was the next step—a natural evolution," says Abbey Maschmedt, design project coordinator for Dwell Development. The organic rusty hue coupled with the modern structure of the home creates an instant patina and a compelling addition to the vibrant urban neighborhood.

The exterior is coated with *Enviro-Dri*, an applied weather-resistive barrier. The pervious concrete keeps rainwater onsite, recharging the groundwater and lessening the burden on the stormwater infrastructure.

Triple-pane Atrium windows keep the heat inside. A Honeywell heat recovery ventilator (HRV) provides constant fresh air, and a radiant heat floor system—powered by a Navien tankless water heater—keep the home's interior comfortable and healthy. A 7.39kW PV array offsets the home's energy consumption, and Energy Star-certified appliances and WaterSense-certified plumbing fixtures ensure it is an energy and water miser.

PROJECT STATS

NAME: Reclaimed Modern House, Seattle, WA

DEVELOPER: Anthony Maschmedt, Dwell Development www.dwelldevelopment.com

BUILDER: Anthony Maschmedt, Dwell Development www.dwelldevelopment.com

ARCHITECT/DESIGNER: Julian Weber, Julian Weber Architects **www.jwaseattle.com**

LANDSCAPE ARCHITECT: Keith Hammer, Dwell Development www.dwelldevelopment.com

INTERIOR DESIGNER: Abbey Maschmedt, Dwell Development www.dwelldevelopment.com

PHOTOS: Tucker English Photography



Country in the City. Wood and metal elements from an old barn are incorporated in the fencing, siding and soffits over the deck.



Smart Home. A Kirio home energy management system ensures efficient use of energy in an already efficient home.





HIS TRADITIONAL-LOOKING NEW England home was designed by homeowners Elizabeth Wegner and Carl Benker with three goals in mind: durability, energy efficiency and health. The home reflects the couple's desire to substantially reduce their negative environmental impact on the world. It was built by Glastonbury Housesmith, which constructed the first LEED certified Gold house in Connecticut. The house was constructed to meet the most up-to-date residential building codes (2012 IRC, 2012 IECC) rather than those which are required in the state. The most notable requirements of the new codes are a stronger structure to withstand high hurricane winds and exterior insulation outside of the wall sheathing to prevent condensation-and subsequently, mold and/or rot-within the walls. An Uponor fire sprinkler system was also integrated with the domestic cold water plumbing.

From the Judges

"Traditional architecture, homey interior, yet strong net-positive energy performance and superior indoor air quality."

PROJECT STATS

NAME: Below Zero House, South Glastonbury, CT

BUILDER: Robert Dykins, Glastonbury Housesmith www.glastonburyhousesmith.com

ARCHITECT/DESIGNER: Elizabeth Wegner and Carl Benker

PHOTOS: Glastonbury Housesmith

The building envelope consists of a *Thermomass System CIP* foundation (R-20) and *FOAMGLAS* under the slab (R-17). The wall framing is sheathed with the Huber *ZIP System* panels, which are Structural 1 rated. Owens Corning's *PROPINK L77* blown-in fiberglass fills the stud bays (R-24), and Roxul *ComfortBoard* was installed between the sheathing and siding (R-11). The rafters are insulated to R-58 with 5 inches of Icynene *ProSeal* closed-cell foam and 6.5 inches of Owens Corning *PROPINK L77* blown-in fiberglass.

The house was built using many low-VOC, GREENGUARD-certified components, including insulation, drywall, joint compound, paints and wood finishes. Additionally, energy recovery ventilation was installed with dedicated ducts to remove air in trouble spots (such as bathrooms) and to supply pre-conditioned fresh air to the home.

The house meets LEED, NGBS, Energy Star, and DOE Zero Energy Ready standards; its performance has been verified by third-party review and onsite testing. It achieved a HERS score of -23 and was recognized in RESNET's Cross-Border Challenge this year.



Thoughtful Design. This custom three-bedroom home, with its emphasis on energy efficieny and sustainable, healthy materials, was designed by the homeowners and built by Glastonbury Housesmith, which also built the first LEED Gold-certified house in Connecticut.





P

An 83-year-old beach house gets a deep energy retrofit, but retains the grace and beauty of the original home.

iki

4



HIS 1932 HOME overlooks Truesdale Lake in Westchester County, NY. Once a popular gathering place, the structure had fallen into disrepair. Incorporating new and reclaimed materials, architect and builder Sylvain Côté has fully restored The Beach House for maximum comfort with a minimal carbon footprint. Completed in 2014, The Beach House is Energy Star Certified, with a HERS rating of 30 and

From the Judges "This is a great example of green, energy-efficient retrofit. We need more of these."

LEED Platinum Certification of 90. A high-velocity, small duct system from Unico, Inc. cools efficiently by removing 30 percent more humidity from the air than a traditional system. It delivers conditioned air through insulated flexible tubing, which snakes through floor, wall and ceiling cavities. The tubing has close to zero thermal loss, and the "hidden" ductwork allowed architectural freedom in the design and eliminated the need for soffits. Small, round air outlets quietly deliver air into each room.

Heating is provided by a radiant floor system from Viega, which reduced heating costs by an additional 30 percent.

A Fantech energy recovery ventilator brings in constant fresh outside air, and a whole-house HEPA filtration unit, also from Fantech, maximizes healthy indoor air quality. All systems within the home can be operated remotely, maximizing energy efficiency when the owner is away.

Durable, attractive synthetic slate tile from DaVinci Roofscapes makes up the majority of the roofing, but a building integrated photovoltaic (BIPV) *Sunslate System* from Atlantis Energy Systems



Open Plan. The public areas of the first floor include a great room with a central fireplace. The home was not expanded, but reduced from 1,840 to 1,780 square feet.

PROJECT STATS

NAME: The Beach House at Truesdale Lake, Lewisboro, NY

BUILDER: Sylvain Côté, Absolute Green Homes www.absoluteremodeling.com

ARCHITECT/DESIGNER: Sylvain Côté, Absolute Green Homes www.absoluteremodeling.com

PHOTOS: Sylvain Côté

was incorporated on the south-facing roof. Because it offers better aesthetics than solar panels, the *Sunslate System* satisfies historic and zoning commission codes.

"I'm a firm believer in making design beautiful, because if you don't, someone will replace it. And that is wasteful," Côté says.



Reclaimed Wood. All vanities and cabinets were built using wood reclaimed from a 200-year-old local barn. The kitchen cabinets also utilized sheathing from The Beach House's original roof, exterior walls and attic flooring.



Double Benefit. Rain is directed into collection barrels for watering plants and grass; excess water flows into a landscaped swale, which filters pollutants and reduces water runoff, improving the lake's water quality.



Efficiency Upgrade. Now, all lights are LED and are strategically placed to highlight reclaimed beams, glass doors, fireplaces and other focal points. Each light uses only 3 watts of electricity.

Water, food security and land stewardship are just as important as energy independence for this Texas ranch house.

10



AMILY AND COMMUNITY are the focus of this ranch, creating a space where the homeowners could age in place surrounded by family, food and the Texas countryside. Nestled on 100 acres in Texas Hill Country, this artist's compound is a colorful gem of self-sufficient living and connection with nature.

In the past few years, Texas has been plagued with drought and wildfire; the homeowners built this passive solar home in response to the changing landscape. A preliminary Wildfire Defense assessment was incorporated into the building site to minimize risk of loss.

An abundant one-acre garden and orchard are watered solely by a 30,000 gallon rainwater collection tank, which is also used to water Longhorn cattle and other livestock. An additional 40,000

From the Judges

"This project goes above and beyond energy efficiency and includes components of self-sufficiency: solar PV with battery backup and rainwater collection for domestic and livestock uses, as well as an area for planting and cultivating food."

PROJECT STATS

NAME: Rainwater Ranch, Burnet, TX

BUILDER: Native www.buildnative.com

ARCHITECT/DESIGNER: Stephen Colley, Stephen Colley Architecture www.stephencolley.com

INTERIOR DESIGNER: Jacqueline Burke, Jacqueline Burke and Associates

PHOTOS: Twist Tours Photography, Allison Cartwright

tank provides 100 percent of the family's domestic water. This solarpowered compound is complete with a battery backup system to support the energy needs for both the main house and detached living quarters.

The building envelope integrates 2 x 6 advanced framing, full fill spray foam insulation and *ZIP System* into an exceptionally energy efficient yet affordable home. Whole-home air filtration and a high-efficiency Carrier *Infinity* variable-speed heat pump provide a comfortable and healthy home environment. No-VOC paints and stains were used throughout.

Large overhangs and screened porches reduce exposure to the intense Texas heat and provide the family with additional living space. Handcrafted handrails, made by local blacksmiths, incorporate local materials.

This home has currently achieved a 10 HERS rating. The homeowners are already planning an expansion of the 8.7-kW solar array, with the ultimate goal of net-zero energy.



Family Plan. The generous ranch house includes a master bedroom, three bedrooms, great room and an art studio.



Firewise Façades. Featuring a durable stucco extension standards for wildfire resistance.



Hands on the Land. Taking special consideration to land stewardship and property management, the homeowners removed invasive species and planted natives themselves.

Firewise Façades. Featuring a durable stucco exterior and a Galvalume reflective metal roof, this Texas home is built and designed to local



A house in Bellingham, Washington, demonstrates innovative water and energy systems that meet the standards of the Living Building Challenge.

HE BIRCH CASE Study House was developed using the Living Building Challenge as a guide. The primary goal of this project was to implement numerous sustainable strategies, highlighting the successes and failures when designing, permitting and constructing Living Buildings.

From the Judges

"Really rigorous sustainability approach, informed by the Living **Building Challenge, the** 'moonshot' of green building. Kudos."

> To help realize the project, [bundle] design studio partnered with non-profits and building product manufacturers. Throughout construction, [bundle] hosted a workshop series with Sustainable Connections to present green materials and strategies to the local building community. [bundle] also partnered with Northwest Energy Efficiency Alliance (NEEA) for the NextStep Homes program and with WSU to field test a CO. heat pump that is used for domestic hot water and radiant floor heating.

The Birch Case Study house has proved continued on page 50

n Welch.

successful at demonstrating a number of pathways towards Living Buildings. Among the highlights, it is the first within the Bellingham city limits to choose not to hook up city water and sewer. Instead, the project achieves net-zero water usage through the use of onsite rainwater catchment, composting toilets and graywater reuse.

The use of FSC-certified lumber proved to be prohibitively expensive and difficult to source. Alternatively, [bundle] salvaged joists from the demolition of the 1920s Birchwood Elementary School, less than one-eighth of a mile from the site. All exposed joists, rafters, cabinet faces, shelving, handrails, decking and stairs were built from the salvaged lumber. The house also includes FSCcertified countertops, no-VOC paints and sealers, metal siding and insulation with high recycled content and an overall reduction in finish materials.



Onsite Water. A sloped steel roof from Metal Sales facilitates rainwater catchment. The flat TPO roof supports Sumas Gro Media and green sedum tiles from Etera, which absorb stormwater.

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Sun Room. The envelope strategy includes a passive solar solarium with Cascadia triple-pane 300 and 400 series tilt-and-turn windows and Energy Star CrystaLite skylights.



Fully Conceived. The walls are constructed with reclaimed lumber; durable metal siding is installed over Roxul rigid mineral wool insulation and a Prosoco air and water barrier.

Typcial Wall Section

- 1_Metal Panels_ Metal Sales 2_1x3 Furring Strips 3_2" Roxul ComfortBoard IS R-8 4_Prosoco Cat 5, Air & Water Barrier 5_1/2" Plywood Sheathing 6_Salvaged 2x15 joists from Birchwood Elementary 7_Single 2x6 top plate
- 8_2x6 Advanced inline framing 9 5.5" Roxul ComfortBatt R-23

This home, built onto an old farmhouse, meets the rigorous standards of Germany's Passivhaus program.



OCATED 30 MILES north of Prague, Czech Republic, this project is an energy-efficient 1,200-square-foot residence. The client requested a place to retreat: a private yet open space, full of light. The house was to be strikingly modern yet contextual. Built upon an abandoned single-story structure for housing pigs and chickens, it is an extension of an 18th-century farmhouse. In a dense rural context, the home re-interprets the traditional stone and timber house and translates it into modern form. Local artisans contracted to build the timber construction employed traditional techniques.

The house has an airtight envelope with low heat loss (less than .15W/m²K), electrical on-demand hot water and triple glazing. The new construction achieves the challenging performance requirements of a German passive house, and it exceeds LEED Platinum standards. The existing sandstone and brick masonry was mostly preserved or reused. New materials were selected for their low carbon footprints and longevity; these include locally harvested timber, bamboo flooring and white aluminum roofing. High-efficiency building systems recycle and retain heat energy.

The House is oriented south and west for natural daylighting and cross-ventilation. In winter, solar energy warms the northern wall, which acts as a passive thermal mass. Radiant heating transfers heat passively to the other masonry walls, and the thermal equilibrium

From the Judges "Built on an existing abandoned structure, preserving or reusing the existing masonry and selecting locally harvested and renewable materials-this is a good example of material reuse and selective material-sourcing."

between floors is maintained with an HRV unit. New wall assemblies are "open" to both sides, have low permeability, are without thermal bridges and are insulated with hydrophobic insulation. Natural and forced air circulation on both sides prevent the settling of moisture within the assembly. This thoroughly modern home features efficient appliances from Bosch, Siemens and Miele, plumbing fixtures from Franke and Kludi and LED lighting from Philips.

Combining the old and the new was a cost-effective strategy for creating a cozy, healthy home. At \$115 per square foot, it attains high standards at a low cost. GB

PROJECT STATS

NAME: House for a Writer in Bohemia, 30 miles north of

BUILDER: Karel Zikmund, Zikmund Hriste

ARCHITECT/DESIGNER: Elan Neuman Fessler, Emergenative Architecture www.emergenative.com

INTERIOR DESIGNER: Elan Neuman Fessler, Emergenative Architecture www.emergenative.com

PHOTOS: Emergenative Architecture



Good Wood. Bright, clean and modern, this home features locally harvested timbers and bamboo flooring







the garden and sky.

www.greenbuildermedia.com

Country Views. This modern addition, located a quarter mile from rail transit, was designed to maintain the rural connection with views of

GODEWATCH

The Latest Rules, Regulations and Codes Impacting Sustainable Construction

N.C. Puts the Brakes On Renewables

North Carolina considers a bill that lowers the cap for renewable energy sourcing.

BY LAUREEN BLISSARD

N A VERY SHADY MOVE, North Carolina State Senate Finance Chairman Sen. Bob Rucho spearheaded the initial passage of a bill (HB 332) that would freeze renewable energy rates. In doing so, he cut off discussion, refused to allow a head count and declared it passed by voice vote despite a "louder and possibly more numerous chorus of 'No' votes." Members of Rucho's own party even complained about the way the vote was handled. His colleagues on the other side of the aisle were extremely upset, and understandably so.

Rep. Mike Hager inserted the provision in an unrelated bill, and the Senate Finance Committee approved that maneuver. There was a request for a division of the vote, which would have provided for an individual vote tally. However, it appears Sen. Rucho chose to ignore Senate rules adopted earlier this year and proceeded with a voice vote. However, after that first passage, it was sent from the Senate Commerce Committee to the Senate Committee on Finance, where it is currently parked.

HB 332 would cap a renewable energy sourcing requirement on the utilities at 6 percent, instead of increasing it to 10 percent by 2018 and 12.5 percent by 2021. It would also reduce the guaranteed market for renewables by requiring utilities pay a standard rate for power from much smaller plants.

CODE INFORMATION

In mid-July, HB 255 was passed by the legislature and signed into law by the governor. The bill creates a new, 17-member building code council, complete with a 17-member residential committee and a 9-member building code committee (see sidebar on page 55). Appointed by the governor, the committees will review proposals for codes, including the North Carolina Energy Code.

The residential codes can only be revised "every six years, to become effective the first day of January/February of the following year, with at least six months between adoption and effective date. The first six-year revision under this subsection shall be adopted to become effective January/February 1, 2019, and every six years thereafter." As written, the state will adopt some form of the 2018 I-codes, skip the 2021 I-codes and then consider the 2024 I-codes.

Finally, this bill reduces funding to the building codes department by raising the monetary limit needed to require a permit. The construction or alteration cost threshold used to be \$5,000; it is now \$15,000. However, this bill also (potentially) reduces the building



Back Room Decision? SB 332, which would cap renewable energy sourcing requirement for utilities, was pushed through the North Carolina State Senate without a discussion.

official's workload. The following provision transitions the inspection (and subsequent liability of compliance) from the building official to either a licensed architect or engineer:

"... a city shall accept and approve, without further responsibility to inspect, a design or other proposal for a component or element in the construction of buildings from a licensed architect or licensed engineer provided all of the following apply:

• (1) The submission is completed under valid seal of the licensed architect or licensed engineer.

• (2) Field inspection of the installation or completion of construction component or element of the building is performed

The New N.C. Building **Code Council**

HB 255 creates a new 17-member building code council, composed of a 17-member residential committee and a nine-member building code committee, to be structured as follows. (Committee designation: R = Residential, B = Building Code):

- Two licensed architects (B),
- One licensed general contractor (B),
- One licensed general contractor specializing in residential construction (R: Chair).
- One licensed general contractor specializing in coastal residential construction (R),
- One licensed engineer practicing structural engineering (R & B),
- One licensed engineer practicing mechanical engineering (B),
- One licensed engineer practicing electrical engineering (B),
- One licensed plumbing and heating contractor (R),
- One municipal or county building inspector (R),
- One licensed liquid petroleum gas dealer/contractor involved in the design of natural and liquid petroleum gas systems who has expertise and experience in natural and liquid petroleum gas piping, venting and appliances,
- One representative of the public who is not a member of the building construction industry,
- One licensed electrical contractor (R),
- One licensed engineer on the engineering staff of a state agency charged with approval of plans of stateowned buildings (B),
- One municipal elected official or city manager (B),
- One county commissioner or county manager,
- One active member of the North Carolina fire service with expertise in fire safety, as recommended by the North Carolina State Firemen's Association (R & B).

by that licensed architect or licensed engineer.

• (3) That licensed architect or licensed engineer provides the city with a signed written document stating the component or element of the building so inspected is in compliance with the North Carolina State Building Code or the North Carolina Residential Code for oneand two-family dwellings.

OBSERVATION(S)

First, the freezing of the renewable energy rates shouldn't come as a surprise (if passed). This is the same state legislature that refuses to use science to guide future coastal policies related to sea-level rise, preferring to instead stick its collective head in the sand. The lack of professionalism when conducting the vote was rather appalling,

Solar Staller. In 2014, North Carolina installed 397 MW of solar electric capacity, ranking it 2nd nationally. Will HB 332 put the brakes on this progress?

and it's shocking that there was no avenue for recourse. As for HB 332, 6 percent is a paltry number; in the landscape of other state renewable energy standards, even 10 percent is relatively low. Given the state's existing industry, we feel they could easily hit, and most likely exceed, the 10 percent target.

Next, HB 255 is a broad bill. The change to the code adoption process is interesting in that there is neither a single energy efficiency professional, nor a low-income housing voice, on the entire council. It would be nice if there was the opportunity for one (but obviously not both) of those representatives on the council via the "representative of the public" seat. However, that spot is reserved for someone not in the building industry, which really makes that council member tantamount to an HOA member. We're not sure what that seat is supposed to contribute to the process, other than provide political cover to the state that they are allowing general public involvement. The reduction in potential permit revenue reduces building and remodeling costs, but is also something that nearly every building department in the country *doesn't* need. GB

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COURTESY OF The Green Builder[®] Coalition

The Green Builder[®] Coalition is a not-for-profit association dedicated to amplifying the voice of green builders and professionals to drive advocacy and education for more sustainable homebuilding practices.

(http://GreenBuilderCoalition.org)

For more information, contact Mike Collignon, executive director at mcollignon@greenbuildercoalition.org

IAQ: Breathe Easier

Products, Research and Advice for Improving Indoor Air Quality

Why Homeowners Don't Use Range **Hoods-and Why They Should**

Home occupants are not using range hoods to control moisture, but "smart" range hoods will do this task automatically.

MATT POWER, EDITOR-IN-CHIEF

ONTROLLING MOISTURE BUILD-UP in the home is one of the most important strategies for ensuring healthy indoor air. A continually moist environment harbors biological pollutants such as mold and dust mites, which can trigger asthma and other respiratory illnesses. Regular use of kitchen exhaust ventilation systems can help control moisture, yet, according to a study published by the Forum for Family and Consumer Issues (FFCI), most people don't use range hoods for moisture control, but for other issues, such

Center at the University as is homeowner ignorance about the importance of warding the importanc of Minnesota estimates modern home. that cooking a dinner for usage, the Center for Real Life a family of four releases interviewed 78 households, 1.22 pints of water into the air. This amount more than doubles if a gas range is used."

as smoke and odors. The study, "The Cold Climate "and Use of Kitchen Ventilation: Impact on Indoor Air Quality, Housing Information Impact on Indoor All Quality, found that noise is a major factor, the importance of ventilating a

As part of a study of kitchen Kitchen Design at Virginia Tech asking many questions about when and how people use kitchen range hoods. The big three: noise, ignorance and belief that it's "not necessary."

The participants in the interview cooked regularly and frequently: 68 percent cooked complete meals

five or more times per week and 97 percent prepared dinner on a regular basis.

The majority of participants (84 percent) had electric ranges, but most also owned a microwave oven. An interesting finding is that 32 percent used the microwave oven about the same as their range top, and 31 percent used the microwave oven more than the range top.

Use of Kitchen Ventilation	Percent (n)	
Reasons for Using Ventilation (General)	Get odors out	47 (33)
	Get smoke out	45 (32)
	Get steam out	23 (16)
	Remove heat	20 (14)
	Control grease	14 (10)
	Clean the air	11 (8)
Reasons for Not Using	Too noisy	48 (22)
Ventilation (General)	Not necessary	48 (22)
	Don't think about it	20 (9)

Note: Participants could give more than one response, so percentages do not equal 100.

Most of the participants (92 percent) reported having mechanical kitchen ventilation systems. The most common type was an updraft system—a hood attached to a cabinet over the cook top or range. The most common features in the ventilation systems were a light (91 percent) and a multi-speed fan (84 percent). Over half of these systems (55 percent) were ducted to the outside; however, 17 percent of the participants did not know if their ventilation systems exhausted to the outside.

Here's the really interesting part: Only 8 percent of the participants used their ventilation system whenever they cooked, while 8 percent used ventilation "almost never," and 15 percent used ventilation only "once in a while."

The table above describes the most frequent reasons that people cited for using or not using their kitchen ventilation systems. The most common reasons cited for using a kitchen ventilation system were to control odors and smoke. Noise was the most common reason for avoiding the kitchen ventilation system.

Smart Hood. This Energy Star-qualified Broan Elite range hood includes a heat sensor that automatically switches the fan to high when it detects high temperatures.

Participants gave various reasons for using their kitchen ventilation systems specifically with cook top cooking, typically to solve problems with odor, smoke and steam. Kitchen ventilation was less common when only the oven was being used: 46 percent never used ventilation, while 28 percent only used ventilation for oily/greasy foods and 17 percent for smelly foods.

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OUR RECOMMENDATIONS

Since people are more likely to use a fan if it isn't noisy, always spec an Energy Star-rated unit. Range hoods that have earned the Energy Star label are not only 70 percent more efficient, they must also meet standards for noise and efficacy:

Minimum Efficacy Levels	2.8 cfm/watt
Maximum Sound Levels	2.0 sones

The Energy Star website includes a searchable database: http://1. usa.gov/1jTvHsy

One of the best innovations in range hood technology in recent years has been particle- and heat-sensing devices. In our view, these devices should become the *de facto* standard across the industry. Further, it's time for range hoods to be integrated with the Internet of Things. For homeowners, reluctant or not, there would be clear health benefits to regular use of range hoods. And for those who choose not to use the hoods, devices that are "smart" can automatically kick on anyway, clearing the air for everyone else who lives in the building.

To read the full study, visit: http://bit.ly/1PReChg

Building SCIENCE

Innovative Solutions for High-Performance Homes

Dark Roofs: An Untapped Solar Resource?

The color of a metal or clay or concrete tile roof makes a huge difference in solar reflectance and absorption. It's time to harness this wasted energy.

BY MATT POWER, EDITOR-IN-CHIEF

F YOU'VE EVER read through the technical specs for roofing products, you've probably noticed that there's a big difference in the solar reflectance of clay or concrete tile, depending on its color. Boral's Ebony blend, for example, has a solar reflectance of just 5.1, while its *Barley Stone* scores 60. And that same *Ebony* product has a solar absorption of 94.9. That's a lot of energy being absorbed, and gradually released.

Which begs the question, with dark roof coverings, where does all that unreflected energy go? The answer is pretty obvious: it's absorbed by the tiles and radiated more slowly in all directions after that. In the U.S., most research on this process has focused on how much of the energy gets through into living spaces. Also, there's a load of research (and marketing push) out there about reflective surfaces and coatings for hot climates-but almost nothing about using the heat captured by dark roofing to augment heating systems in cold climates.

Measuring Materials

Solar Reflectance is the fraction of the incident solar energy which is reflected by the surface in question. It is usually correlated with the solar reflectance, but the two quantities are not necessarily equal. For example, a white coating with a solar reflectance of 0.8 typically has a visible reflectance of about 0.9.

Solar Reflectance Index (SRI) is a measure of the roof's ability to reject solar heat, as shown by a small temperature rise. It is defined so that a standard black (reflectance 0.05, emittance 0.9) is 0 and a standard white (reflectance 0.8, emittance 0.9) is 100. Materials with the highest SRI values are the coolest choices for roofing. Due to the way SRI is defined, particularly hot materials can even take slightly negative values, and particularly cool materials can even exceed 100

Solar Potential? Dark roof tiles, such as these Ebony concrete tiles from Australian manufacturer Boral, may represent an untapped solar resource.

ACTIVE SOLAR: A BETTER APPROACH

The real potential of dark roofs is to use them as active, not passive systems. A typical cold climate installation guide for clay tile roofs includes several details for venting the roof to avoid ice dams and trapped moisture. The end game of these designs is to discharge the "unwanted" hot air through some form of ridge vent.

Hot Idea. American Solar has installed solar air heating on the roofs and siding of 10 federal agricultural buildings.

What if, instead of discharging that heated air, it were to be captured and mechanically vented into living spaces? The pitfalls would be related to improper installation of such a system, inadvertently causing poor roof ventilation that results in ice dams and other problems. But with a simple thermostatic control tied to a vent, it seems to me, you could have a fairly low-tech solution—for example, simply add a duct at the ridge peak attached to a thermostatic control.

In fact, at least one company is already capitalizing on this idea. American Solar uses conventional metal siding and roofing products as active solar collectors, using a fan to move air behind the siding or roofing, then delivering the heated air to the building. The process collects 10 to 15 times the solar heat energy than is used to power the fans.

Most of American Solar's installations have been on commercial buildings. For example, in 2008, at Hills Air Force Base, American Solar installed heat recovery fans in two buildings with corrugated brown siding. Fans were also installed to recover heat from one of the roofs. According to the company, the installed cost was \$7 per square foot, and the fans are able to deliver air that is heated 50°F above outside air temperatures. Another installation in Maryland involved replacing a deteriorating corrugated metal roof with a new standing-seam "solar air heating roof," which is used for direct heating of the shop space below. The total capacity of the system is 2 million BTU/hour-the largest solar air heating roof in North America.

Solar Air Heating Specs

A solar air heating roof, installed by American Solar on a gymnasium at Ft. Meade, is used to preheat air and for direct space heating.

- Roof area: 9,275 sq. ft.
- Saving per year: \$5,000
- Solar roof rate of heating: 64 BTU/sq. ft./hour
- Ventilation air preheating: 40,000 BTU/sq. ft./year
- Direct space heating: 10,000 BTU/sq. ft./year
- Water preheating: >33,000 BTU/sq. ft./year

Testing showed that solar-heated air temperatures regularly reach temperatures that are 25 to 30 degrees higher than outside air, achieving temperatures well above 100 °F for more than 1,000 hours per year-ideal for preheating domestic hot water.

www.americansolar.com

What's exciting about this idea is that it's a fairly low-tech way to add solar heating to a building. Much of the infrastructure is already in place on most buildings. You're just adding a thermostatically controlled fan and some ductwork.

Systems can be more advanced, however. Another one of American Solar's projects, a fitness center at the Army's Fort Meade, combines hydronic (hot water) and air for space heating in the cavity below the standing seam roof panels. Thus, the roof is able to do double duty. We hope to see this idea applied to the residential sector soon. GB

Resilient Housing

BUILDINGS AND SYSTEMS THAT ARE READY FOR ANYTHING

Engineered Sustainability

A deep-energy retrofit, the first phase of the ambitious ReNEWW project, has slashed this home's HERS score to near zero.

EDITED BY GREEN BUILDER STAFF

N JULY 2013, Whirlpool Corporation partnered with Purdue University on a retrofit of a late 1920s bungalow in West Lafayette, Indiana. The goal: to create more livable spaces while lowering operational costs and environmental impacts.

Called the ReNEWW house, for Retrofitted Net-zero Energy, Water and Waste, the structure will be renovated in three phases, with each phase lasting roughly a year. Phase one, a deep-energy retrofit, was completed in the summer of 2014.

On Sept. 12, 2014, the house officially opened as a "living lab." "Originally, we partnered with Whirlpool to establish a graduate co-op program where four engineering students would split their time between six-month rotations at Whirlpool and two semesters at Purdue," says Eckhard Groll, the Reilly Professor of Mechanical Engineering and director of the Office of Professional Practice at Purdue University. "This was the foundation for the ReNEWW House, as it provided a living dynamic in which to get real world data."

Heat Harvester. The laundry pair includes the Whirlpool *Duet HybridCare* clothes dryer, which regenerates energy during the drying cycle to reduce overall energy consumption.

Home School. The ReNEWW house includes 2,864 sq. ft. of conditioned space, three bedrooms, two baths and a basement laboratory.

Up to three graduate students participating in the Whirlpool Engineering Rotational Leadership Development (WERLD) program will live there throughout the project. They and Purdue researchers will monitor more than 70 data points inside and outside the home to evaluate its performance.

ANSWERING A NEED

One goal of the ReNEWW project is to demonstrate the feasibility of renovating a 1920s home to meet or exceed new home efficiencies, while maintaining all the charm and character of an older home.

"There are a lot of examples of net-zero energy homes; almost all of them are new builds," says Eric Bowler, senior engineer and ReNEWW House project manager for Whirlpool Corporation. "The fact is, this country's inventory of building stock stands at approximately 130 million units. If we really want to reduce the dependence on foreign energy resources, we need to look at retrofits."

ReNEWW House Energy Strategies

INSULATION. Lapolla Industries provided its *FOAM-LOK* spray foam insulation, which was applied in the wall stud cavities on the main floor, in the basement and in the attic. *FOAM-LOK* includes Honeywell's *Solstice*, an ultra-low global warming potential (GWP) and non-ozone-depleting formulation. The ReNEWW House application marks the first time *Solstice* has been used in a residential structure.

HEATING AND COOLING. Enertech Global provided a *GeoComfort Compass Series* geothermal system. For every one unit of energy that is put in, this efficient system collects three free units from the earth.

APPLIANCES. Whirlpool Corporation installed a high-efficiency Whirlpool laundry pair and kitchen suite that contribute to the overall goal of net-zero energy.

Included in the laundry pair is the ventless Whirlpool *Duet HybridCare* clothes dryer, which uses a refrigeration system to dry and recycle the air that a conventional unit would vent outside. The Whirlpool *Duet* steam front-load clothes washer has been rated a CEE Tier III, the highest possible efficiency rating available.

The kitchen suite includes a Whirlpool 6.7-total-cu.-ft. double oven electric range with induction cooktop, the industry's first; a Whirlpool *Gold Series* dishwasher with *Sensor Cycle*, and a Whirlpool 20-cu.-ft. counter depth French door refrigerator with a temperature-controlled, full-width pantry and *Accu-Chill* temperature management system. The refrigerator utilizes *Solstice* low-GWP foam blowing agent.

While there are several academic programs in the U.S. that utilize net-zero energy homes for research purposes, these homes are typically new builds and vacant, says Groll. Living in the home allows students to realistically replicate the impacts residents have on their homes.

PHASE ONE: A DEEP-ENERGY RETROFIT

Green Goose Homes, a builder in the Lafayette, Indiana, area that focuses on using advanced techniques and products to build resource-efficient homes, served as the ReNEWW House's general contractor, providing jobsite supervision and management. Several leading building materials manufacturers are also helping to take this 84-year-old home into the future (see sidebar above).

Prior to the start of the project, the ReNEWW House received a 177 HERS rating with an estimated annual energy cost of \$3,728. Three months later, with the deep-energy retrofit completed, the house was reevaluated and received a HERS rating of 1. The post-renovation estimated annual energy cost is just \$126.

This tremendous improvement did not come as a surprise to Bowler. "To establish a baseline, we installed numerous thermo **LIGHTING.** ETi Solid State Lighting, Inc., a subsidiary of Elec-Tech International Co. on behalf of Whirlpool Corporation, provided LED lighting products, which use 80 to 90 percent less electricity than traditional incandescent light bulbs. These include recessed light kit fixtures, composed of an LED light bulb, module and integrated trim that fit into existing cans.

"Using the best insulation, adding a geothermal unit or upgrading to the most efficient windows can be done with any traditional home with minimal changes."

WINDOWS, DOORS AND SIDING. Ply Gem supplied the siding, windows, trim and exterior doors. The windows feature triplepaned, krypton-filled lites with frames and sashes welded together into single, weathertight units made from recycled materials. The custom-built fiberglass doors feature composite frames and low-maintenance materials that won't dent, warp, rot or crack. The siding, made with 50 percent recycled

materials, incorporates a polystyrene foam insulation backing that wraps the home's exterior envelope with a continuous blanket of insulation up to 1.25 inches thick. Low-maintenance cellular PVC trim is utilized throughout.

RENEWABLES. SolarZentrum North America (SZNA) contributed the certified *Combined Heat and Power (CHP) Solar PV-Therm* modules. The *CHP* solar module will simultaneously provide up to 900 watts of combined electrical and thermal energy. It's also capable of producing up to 30 percent more electricity, and up to four times more total combined energy output, than a conventional solar panel.

couples, relative humidity sensors, water and gas flow meters and an electricity monitoring system," he says. "The data gathered offered us the ability to create and validate a simulation of the home's energy consumption to predict efficiencies based on upgraded materials, appliances and fixtures in isolation or as an integrated system."

LOOKING AHEAD

As Whirlpool Corporation and Purdue University work together toward phases two and three of the ReNEWW House project, researchers will continue monitoring temperature, relative humidity and energy consumption, Bowler says.

Eckhard Groll wants to take it one step further: "One thing we want to create is a tool box for homeowners to look at all components of the home and identify the savings over time. The goal is to bring the level of sophistication of the automobile to the home. In a car, sensors closely monitor road conditions and make adjustments, and engine diagnostics alert drivers when repairs may be needed. In the home, most people only know if the air conditioner or furnace is running or not." **GB**

Source: Whirlpool Corporation

THE INTERNET OF THINGS

Seeking Connection

A new survey shows that connected technology makes homes more attractive to homebuyers, with solar panels topping the list.

BY GREEN BUILDER STAFF

RECENT SURVEY CONDUCTED by the U.K. firm Barclays Mortgages asked property buyers in the U.K. whether they would pay more for a home equipped with smart technology. About a third (28 percent), said they would pay over £3,310 extra (\$5,031). But if you read the survey results closely, it's really as much an endorsement of solar energy as a nod to the latest IoT gear.

The *Digital Home Report* raises some interesting points about where the public stands psychologically with regards to smart home technology. For example, in some areas, the public is right on the edge of the curve, with people were more willing to spend on fast Internet than to have a big garden.

Below is a table showing the five connected technologies for which homebuyers would be most likely to pay extra, along with the five least popular technologies. Solar panels top the list.

U.K. homeowners surveyed showed more interest in technology and devices that could save energy and money—smart meters and heat sensors, for example-rather than those that simply offer convenience. When asked which current technologies they are most likely to invest in in the near future, homeowners listed fiber-optic broadband, built-in USB sockets, smart meters, smart thermostats and solar panels as their top five picks. These results echo many surveys conducted in the U.S., which reveal that Americans are most interested in the smart home categories of safety/security and energy management.

For those of us in the building industry, most encouraging is the fact that people seem to be thinking more deeply about how they will

use new technology, and what to invest in first, and they're starting with the less sexy infrastructure and working up to gadgets. GB

Read the full report here: http://bit.ly/1000e7g

CONNECTED TECHNOLOGY FOR WHICH HOMEBUYERS WOULD PAY EXTRA (BY POPULARITY)

Top 5		Bottom 5	
1	Solar panels (31%)	1	Smart Fridge (4%)
2	Fiber Optic Cable (21%)	2	Smart Doorbell (5%)
3	Smart Security Alarm (19%)	3	Smart Oven (5%)
4	Sensor Technology (16%)	4	Mobile Signal Box (8%)
5	Smart Thermostat (15%)	5	Induction Cooktop (8%)

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Schlage

Introducing the Schlage Sense Smart Deadbolt. www.schlage.com Cover 2

SIPA at a time.

COMING NEXT MONTH

The Hot 50

It's back! Green Builder editors share their 50 favorite green products of the year. Whether showcasing new technologies or improving upon established ones, these are the products that will keep the industry moving forward. Also in this special Awards Issue, we'll present the results of our annual Readers' Choice survey

Clopay

America's favorite garage doors. www.clopaydoor.com

James Hardie

It's time to build something timeless. www.jameshardie.com

The leader in condensing technology. www.navien.com

Owens Corning

The smartest way to build a home. www.owenscorning.com/building-genius

Saving the environment one panel www.sips.org Cover 4

GREEN BUILDER

FROM THE TAILGATE

New Offerings for the Sustainable Minded

By Ron Jones

Sending a Message

Y THE TIME anyone has a chance to read this column, the 2016 edition of Design & Construction Week (DCW) will be underway in Las Vegas, just a few days following the conclusion of the 2016 Consumer Electronics Show (CES), the annual event produced by the Consumer Technologies Association, also held in Las Vegas.

As I organize my schedules for the respective events, I am struck by the glaring contrast in the "keynote" presentations being promoted at the two shows. CES 2016 lists among its keynote presenters the CEOs of General Motors, Intel, Volkswagen Passenger Cars, Netflix, Robert Bosch GmbH, Qualcomm, AT&T, NBC Universal, Fox Networks Group, MediaLink and Universal Music Group, as well as the CMOs of Johnson & Johnson and JP Morgan Chase, not to mention the president of Samsung SDS and the secretary of the U.S. Department of Transportation.

On the other hand, DCW lists only one "keynote" presenter: "comedian and all-around nice guy!" Jay Leno, former late night television host. If memory serves, Leno will be following the 2015 keynote delivered by retired NFL player Terry Bradshaw.

In prior years, I can recall attending opening ceremonies featuring the likes of former British prime minister Margaret Thatcher, retired general Norman Schwarzkopf, legendary journalist Charles Kuralt, and, in the months following 9/11, the former mayor of New York City, Rudy Giuliani, to name just a few.

My purpose here is not to be snarky, sarcastic or disrespectful to anyone. Mr. Leno is a hugely talented entertainer, and I'm sure his presentation/performance will be appreciated and remembered. But with all the challenges facing the development and building industry—the same ones confronting every sector of business and the economy—doesn't the keynote event of an industry's largest and most visible annual event merit a presentation intended to challenge, motivate, inspire, question, or at least to inform?

It's not as if we don't have plenty of serious concerns to explore. I have to ask: Has the industry simply turned its back on issues like climate change, rapidly evolving technologies, emerging regulations, labor and materials, plus the economic uncertainties of building in the year to come? I hardly think so, but if I'm wrong, it is truly a sad day for all of us.

The homebuilding industry desires to be taken seriously, wants to have a legitimate voice in the national dialogue, and seeks to be respected on the national stage. So would it not make sense to use this annual opportunity to create a few headlines beyond reporting suspect attendance figures? To ask some tough questions, propose innovative solutions and elevate the conversation we are all part of?

In fairness, the proposed schedule for Design & Construction Week also includes what is being called the "Presidential Candidates Forum 2016 | Building Opportunity: Solutions for the American Dream," and it is possible that some of the important topics I have mentioned could be part of that event, although as of this writing there are no confirmed participants from the pool of invited candidates. Let's hope that changes, and that the attendees of the DCW will care enough to show up. **GB**

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