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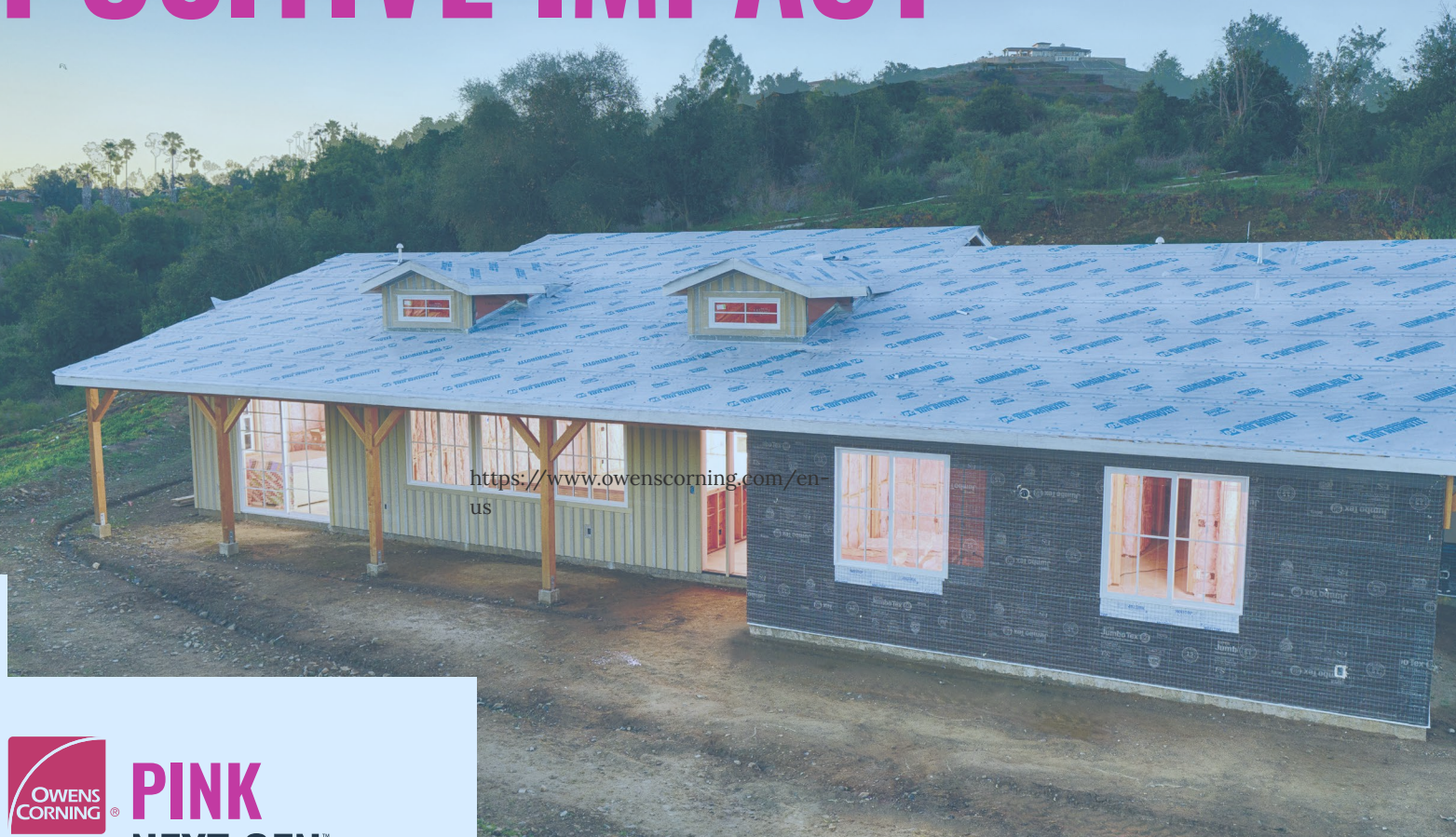
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² Based on savings per pound of fiberglass insulation in the first year of installation. insulationinstitute.org/wpcontent/uploads/2016/02/NAIMA024.pdf





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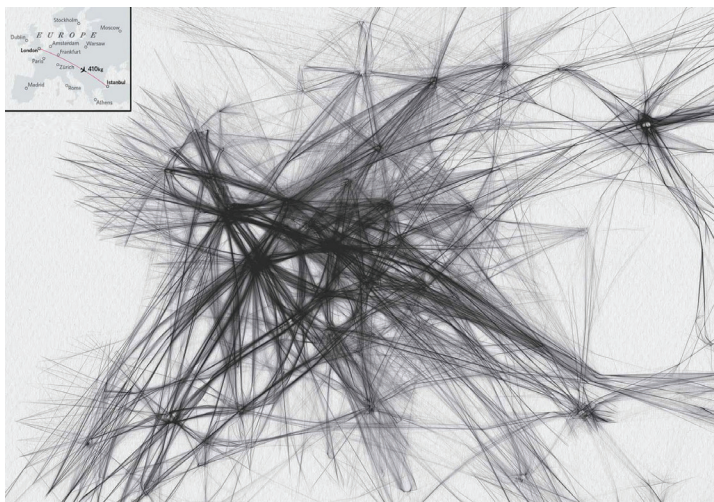
Can better data visualization win over Climate Change skeptics?

PERHAPS THE GREATEST OBSTACLE TO ADOPTING A “DECARBONIZED” FUTURE is convincing human beings that the changes affecting earth’s current weather patterns and systems are real, substantial and way-of-life threatening.

Better story telling can help. What if we could all agree on certain graphics that capture the “big picture?”

I know what you’re thinking: No imagery or data will convince everyone. If human nature were that predictable, the course of the ongoing COVID-19 pandemic might have gone differently. For the sake of argument however, maybe with Climate Change, we can tell the story better, with the use of creative and authoritative imagery.

A new book titled “Atlas of the Invisible,” by geographer James Cheshire and designer Oliver Uberti, attempts to do this by presenting evidence of man’s deepening impacts on the Earth, with unexpected “invisible” ways of seeing.



Carbon-filled skies? This image shows the invisible carbon trails left by aircraft flying over Europe for a week. SOURCE: ATLAS OF THE INVISIBLE.COM

For example, the duo tackles one of the most frustrating aspects of global warming: regional and seasonal inconsistency. These anomalies provide ample fuel for skeptics and their underwriters. Local or even nationwide weather patterns and temperatures sometimes run counter to the “hottest year on record” headlines. Some regions may have colder than normal winters, or bigger than average blizzards and sudden bursts of precipitation that run counter to the general drift of climate shifts.

To clear the air of this chatter, the Atlas presents data cleverly. For example, to illustrate the rise of global temperatures, the two men build a “grid” of detailed tiles where tiny areas change color from blue to orange/red, between 1899 and 2019, but overall colors are unaffected. This way, the small anomalies that mark cold spots become insignificant in comparison to the overall rise in global temperatures.

Why does comprehension of the problem matter? Because without acceptance of the human role in creating issues such as air pollution, extreme heat and wildfires, neither political nor architectural changes are likely to happen as swiftly as they must. As any person with addiction issues (our shared one seems to be fossil fuels) can tell you, until you acknowledge a problem, you won’t have the will to undertake healthy changes.

You’re about to dive into our annual building science issue. As you read about the many incredible efforts by builders, architects and product makers (maybe you’re one of them) to reduce resource waste and change our current climate trajectory, think about how you might use data constructively to win clients over to net zero goalposts, upgrade their insulation, materials and HVAC, and remove themselves from the problem side of the global warming scenario.

You can see a lot more imagery from the Atlas in this recently [published Guardian article](https://www.theguardian.com/environment/2021/08/24/atlas-of-the-invisible) (bit.ly/2WrQmOI), or order the book [here](https://atlasoftheinvisible.com) (atlasoftheinvisible.com). **GB**



Matt Power
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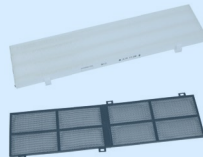
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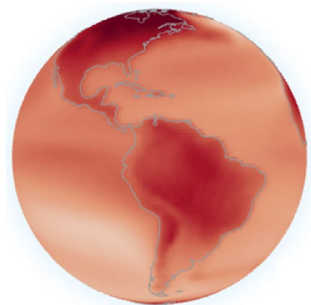
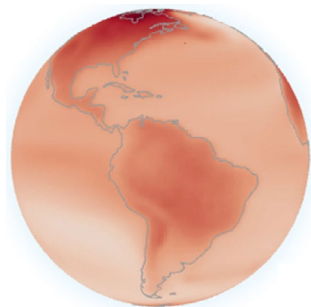
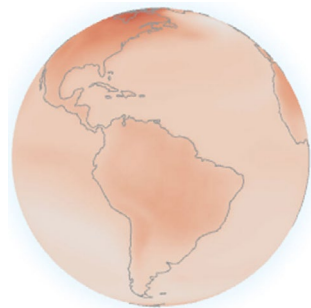
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Climate Change Reality Check

Continued global warming seems almost certain over the next 20 years, but there's still time to reduce the impacts, according to a new UN report.



Nations have delayed cutting back on fossil-fuel emissions for so long that increased global warming over the next two decades is now unavoidable, according to a report from the United Nations' Intergovernmental Panel on Climate Change (IPCC). Temperatures have increased by roughly 1.1 degrees Celsius, or 2 degrees Fahrenheit, since the 19th century. This is largely from use of coal, oil and natural gas for energy. Another 1.5 C will definitely occur by 2040, leading to increases in extreme weather and drought worldwide.

But that doesn't mean people should consider Climate Change a *fait accompli*, according to report co-author Robert Kopp, a climate scientist at Rutgers University. A coordinated carbon emissions reduction effort by nearly all nations over the next 30 years could keep the planet from getting any warmer. Otherwise, temperatures could rise by as much as 4 C by century's end.

The 10 biggest greenhouse gas emitters—China, the U.S., the European Union, India, Russia, Japan, Brazil, Indonesia, Iran and Canada—are behind in their reduction efforts. At their current pace, temperatures are likely to rise by 3 C, IPCC notes. The report is available at the [IPCC website](https://www.ipcc.ch/).

Degrees of destruction. An interactive map in the IPCC's new climate report shows the way the planet will heat up over the next several decades. Pictured top to bottom are scenarios with increases of 1.5 degrees Celsius, 2 C, 3 C and 4 C. CREDIT: IPCC



Going electric. Major building code changes, including increased residential electric heat pump installations and solar power requirements for non-residential structures, will impact new construction in California and elsewhere as of 2023.

CREDIT: CEC

New Code Hikes West Coast Building Performance

CEC's 2022 building code includes mandatory electric appliances and rooftop solar for new construction statewide.

Starting in 2023, new buildings in California must use less energy, and cut carbon pollution, through reduced use of fossil fuels for energy, according to the California Energy Commission (CEC)'s 2022 update of its building code. Requirements include use of residential electric heat pump space and water heating, versus units powered by natural gas. The 2022 code also extends the 2019 code's rooftop solar requirements from apartments, adding solar and storage requirements to new multifamily and non-residential buildings. The changes could cut greenhouse gas emissions by 10 million metric tons over the 30-year life of a building, CEC notes.

According to Pierre Delforge, the Natural Resources Defense Council (NRDC)'s senior scientist of building decarbonization, the code update shouldn't be taken lightly. More than 100,000 new housing units, and more than 100 million square feet of non-residential offices, retail and other non-residential buildings are built every year in California. "Every new building needs new heating, cooling, and hot water equipment, whereas furnaces and water heaters only get replaced once every 15 to 20 years in existing buildings," Delforge says. "New construction therefore commands a significant share of the equipment market."

California's shift to zero-emission buildings will also have an impact beyond the state's borders. Most new construction over the next several decades will occur in countries that are developing or strengthening their own building energy codes. "They often look at California and other climate leaders for inspiration, so we can expect California's policy to have global impacts," Delforge says.

Starter Homes Remain Out of Reach

It's harder than ever for first-time buyers to land an entry level new home.

The nation's residential housing shortage—now at almost 4 million units, according to mortgage lender giant Freddie Mac—is having the greatest impact upon buyers who want small, no-frills starter homes. According to a report by NPR, housing considered entry level in 1982 made up 40 percent of all new homes; by 2019, that total had dropped to 7 percent. Although there is no universal definition, a starter home is considered to be one that is 1,400 square feet or smaller, with 2-3 small bedrooms and 1 or 2 baths.

One culprit is the swath of upper-level homeowners who are leaving higher-priced areas for more-affordable ones, driving up prices and reducing inventory. Others are rising labor costs, higher prices for building materials, and tougher zoning regulations, all of which discourage builders, according to NPR. And then there are rising land values, the result of ever-shrinking territories in suburbs and cities, where buyers' jobs are.

These factors are keeping entry-level buyers from getting that first home, which can be depressing. "It's a sign of arrival," says Anthony Alofsin, author of "Dream Home: What You Need to Know Before You Buy," and an Austin, Texas-area architect. "It's a sign of psychological and emotional security. It has meant a huge deal for this country."



Unfulfilled dream. Buying a home is expected to remain a near-impossible obstacle for first timers to overcome, due to economic and socioeconomic factors. CREDIT: MONKEYBUSINESSIMAGES/ISTOCK

Study: Clean Hydrogen Fuel Remains an Aspiration, Not Reality

'Blue' hydrogen's green imprint is even worse than its base version, according to new research.



Wishful thinking. Hydrogen is not the industry savior that natural gas suppliers hope it is, according to a report by researchers at Cornell and Stanford.

CREDIT: HAYMARKETREBEL/IFLICHR

Hydrogen, currently being touted as a reliable, next-generation fuel to power cars, heat homes and generate electricity, may be worse for the environment than previously thought, according to a peer-reviewed study by researchers from Cornell and Stanford universities.

The problem, according to a report in The New York Times, is that most hydrogen is extracted from natural gas in an energy-intensive process that emits vast amounts of carbon dioxide (CO₂) and methane. The natural gas industry has proposed a way to capture that CO₂ and create an emissions-free, "blue" hydrogen. But even that fuel emits more carbon across its entire supply chain than simply burning natural gas, the study notes.

Experts agree that hydrogen could play a role in energy storage or powering certain types of transportation, such as aircraft or long-haul trucks, where switching to battery-electric power may be challenging. But even if blue hydrogen was deemed viable, current production methods make it financially impractical, the study notes. The report appears in the journal Energy Science & Engineering. **GB**

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FEATURES

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DOE ANNUAL BUILDING SCIENCE ROUNDUP: Silver Linings

Here's how Zero Energy Ready Home award winners have used the pandemic as an opportunity to normalize high-performance techniques and products.

WIND BREAKER: To protect this large home's residents from constant, cold winds, builders installed 11-inch insulating concrete forms and achieved HERS 34 performance.

HYBRID PERFORMER: At Walnut Farm, mixed insulation types and optional solar arrays promise near net-zero living.

FLATTENING THE CURVE: This home's carefully constructed structure helps keep temperatures stable inside, at a lower cost.

CRITICAL MASS: R-29 SIP walls, supported by ultra-efficient HVAC and a heat recovery ventilator, mitigate temperature swings in this exceptional home.

A PLACE TO BREATHE EASY: For allergy sufferers and chemical sensitive buyers, homes like this one, with top-notch ventilation and air control, offer a life-changing relocation.

DATA-DRIVEN PERFORMANCE: United Way's way of getting things done right? Getting help from professional data analysis of the projected design's performance.

FIRST LOOK: Here are the homes up for top honors at DOE's next Housing Innovation Awards.



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A MILLENNIAL PRIORITY: Gasping for Air

When listening to young people talk about what's lacking in their lives, the idea that clean air is precious and in short supply comes up repeatedly.

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ReVISION HOUSE AUSTIN: QUIET, EFFICIENT, GREEN

Austin's heat and the combined forces of allergies and her dogs are no match for the cooling systems in Tiana Cooper's ReVISION house.

DEPARTMENTS

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64 Tailgate

"We respond to another disaster by rebuilding the same old way, in the very same places, with the same marginal systems and materials. We somehow expect a different outcome the next time our number comes up." **Page 64**

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SILVER



Champion material. Red Tree Builders makes a bid for the Housing Innovation Awards Grand Winner title with its Custom Homes on Spec entry. COURTESY OF NEWPORT PARTNERS

LININGS

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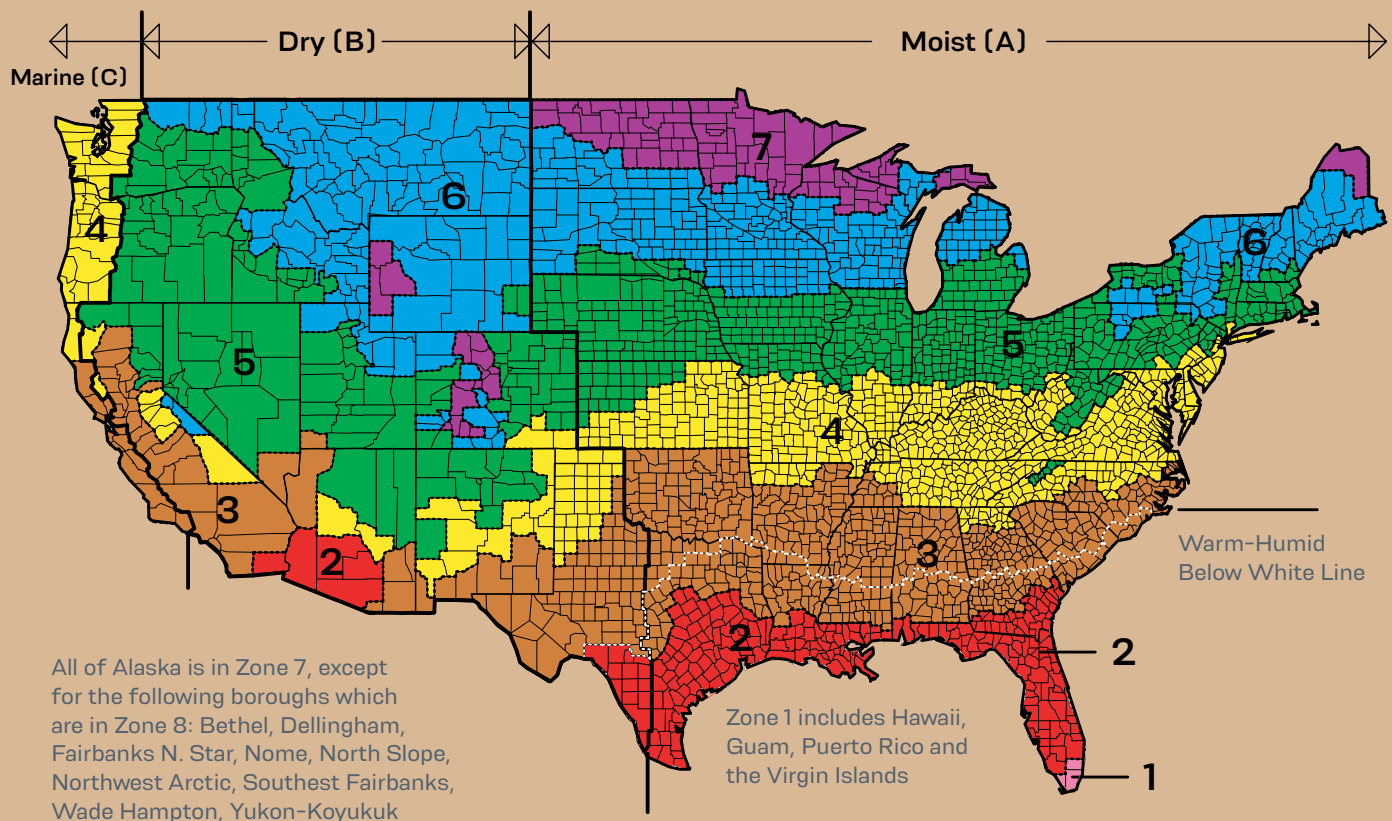
ZERO ENERGY READY HOME AWARD WINNERS HAVE USED THE PANDEMIC AS AN OPPORTUNITY TO NORMALIZE HIGH-PERFORMANCE TECHNIQUES AND PRODUCTS.

What was thought to be a short-term problem has turned into a continual challenge. As the pandemic rolls well into its second year, the public is beginning to carefully return to pre-COVID-19 habits. The construction industry is following suit, with builders unveiling new projects and construction techniques.

In this year's showcase of recent U.S. Department of Energy (DOE) Zero Energy Ready Home (ZERH) Housing Innovation Awards winners, we feature builders who are tackling traditional problems—climate control, utility costs, durability and overall design—while also trying to catch consumers' eyes.

There were ground rules: The ZERH program requires certification to Energy Star Certified Homes Version 3.0, A3.1 or 3.2, as well as the U.S. Environmental Protection Agency (EPA)'s Indoor airPLUS program, and the hot water distribution requirements of EPA's WaterSense program. The project must also meet the insulation mandates of International Energy Conservation Code (IECC), and other mandatory requirements of the DOE program.

This suite of ZERH homes also demonstrate how traditional forms can often coexist with cutting edge innovations.



Regional divide. The International Energy Conservation Code (IECC)'s energy efficiency requirement—a key part of Zero Energy Ready Home (ZERH) program qualifying criteria—varies by climate zone.

Rock solid. Year-round prairie winds led to construction of nearly 1-foot-thick, insulated concrete walls that help maintain a constant temperature throughout this eastern Minnesota home.

COURTESY OF AMARIS HOMES



Project Info

DESIGN: Amaris Homes, Woodbury, Minnesota, [minnesotagreenhomebuilder.com](https://www.minnesotagreenhomebuilder.com)

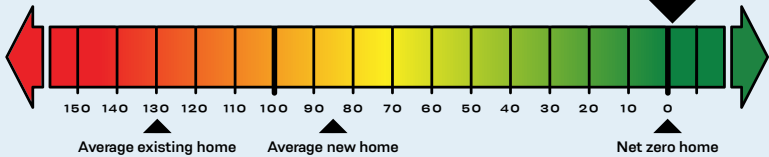
BUILDER: Raymond Pruban

COMPLETED: September 2019

CATEGORY: Custom Spec

HERS Index: -2

This home's score with PV



Size:
3,357 square feet

BEDROOMS: 4

BATH: 3.5

LAYOUT: 1 floor + basement

Wind Breaker

To protect this large home's residents from constant, cold winds, builders installed 11-inch insulating concrete forms and achieved HERS 34 performance.

LOCATED ON A HIGH OPEN BLUFF surrounded by corn fields, this Afton, Minnesota, home gets buffeted by winds nearly every day. But the strong prairie winds are no match for the concrete form walls wrapping this daylight basement farm house.

The home was constructed by custom builder and co-owner Ray Pruban of Amaris Homes. The energy performance and other features of the 3,357-square-foot home helped earn a Grand Award in the custom home category of the U.S. Department of Energy (DOE)'s Housing Innovation Awards competition for 2020.

To protect the home and its occupants from the heat-robbing effects of the strong winds, Amaris Homes constructed the structure's walls from 11-inch-thick

insulated concrete form (ICF) blocks. These provide solid 6-inch concrete walls covered inside and out with 2.5-inch layers of rigid foam. A 2-inch R-10 layer of rigid foam blankets the ground under the floor slab as well.

The above-grade walls of the basic ranch-plus-daylight basement are covered with house wrap and clad with engineered wood lap siding. The interior walls are framed with laminated-strand lumber (LSL) 2-by-4s, an engineered stud that is straight and smooth for level walls, and fewer future nail pops and drywall cracks.

The attic is vented. The attic floor is covered with two inches of R-14 closed-cell spray foam that effectively air seals around every wire and pipe that pokes through the ceiling. It also seals the

notoriously leaky top plates over all of the exterior walls and covers the 15.25-inch raised heel energy trusses.

The spray foam is topped with R-46 of blown fiberglass for an R-60 total. Outside, the roof is covered with half-inch oriented strand board (OSB) sheathing that is protected with an ice and water shield 36 inches past the wall line, then topped with 15# roofing felt, and covered with architectural asphalt shingles. Two-foot overhangs at the eaves and 1-foot overhangs at the gable ends provide shade, rain and snow protection.

Fiberglass-framed windows were selected in part due to their rigid frame construction, which allowed for larger fixed glass in the great room and entertainment rooms. The double-pane



Average Monthly Energy Bill

\$0

Calculated



Annual Savings

\$4,700

Calculated versus typical new homes

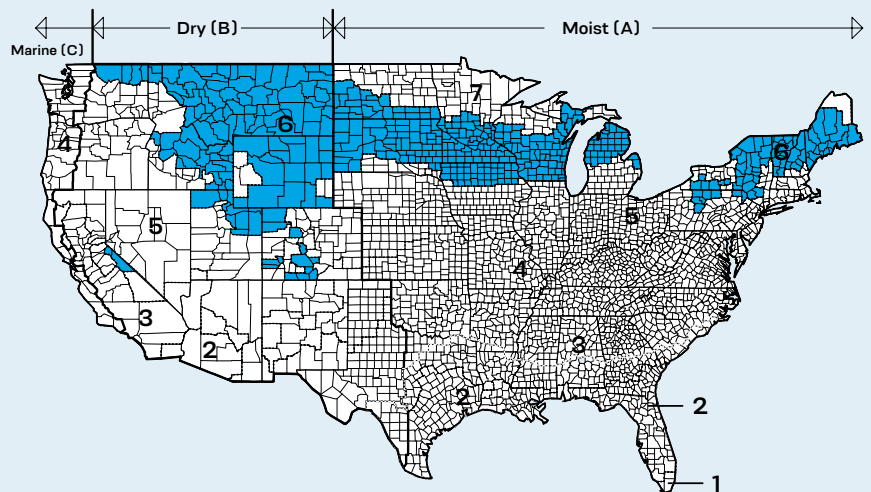


Saved in the first 30 Years

\$218,900

Includes fuel escalation rates,
2019 EIA Energy Outlook

Climate IECC, 6A, cold



Key Features

AIR SEALING: 0.64 ACH 50; sill plates sealed with acoustic sealant; top plates spray foamed.

APPLIANCES: ENERGY STAR smart refrigerator, dishwasher and clothes washer.

ATTIC: Vented attic, R-60 total: 2-inch R-14 closed-cell spray-foam on attic floor and up on 15.25-inch raised heels, 15-inch R-46 blown fiberglass.

ENERGY MANAGEMENT SYSTEM: Smart thermostats, automated blinds, smart lighting, smart outlets, smart irrigation system, PV tracking, smart refrigerator; all Wi-Fi controlled.

FOUNDATION: Insulated basement, R-33 total: 13.2-inch R-23 ICF, water-proofing membrane, plastic dimple board covered by synthetic stucco below and above grade, 2-inch R-10 under-slab rigid foam.

HOT WATER: Gas tank, 0.88 EF, 50 gallon; PEX piping; recirculation pump.

HVAC: Gas furnace, 98 AFUE; radiant floor heat in basement, 19 SEER 5-stage heat pump.

LIGHTING: 100 percent LED, low-profile ceiling fixtures, smart phone controllable.

ROOF: Truss gable roof: 0.5-inch OSB sheathing, ice and water shield, 15# felt, asphalt shingles, ridge vent, baffles every bay, 2-foot overhangs.

SOLAR: 11.34-kW PV, 36 panels, solar edge optimizers.

VENTILATION: ERV; MERV 16 furnace filter; timed bath fans; garage exhaust fan.

WALLS: ICF, R-24 total: 11.25-inch ICFs, housewrap, engineered wood lap siding.

WATER CONSERVATION: EPA WaterSense certified; drought-resistant landscaping.

WINDOWS: Double-pane, argon-filled, low-e2, fiberglass casement frames, U=0.23, SHGC=0.25; automated blinds on west and south windows.

OTHER: Electric vehicle charging station; air quality sensor; accessibility features.

Power savers. LED lighting, ENERGY STAR appliances, smart thermostats and lighting, and automated window blinds contribute to the home's energy savings.

COURTESY OF AMARIS HOMES



windows have two low-emissivity coatings that minimize heat transfer, and the windows have an insulation U-Factor of 0.23. Low-expanding foam at the window to frame connection as well as at the window jamb-to-framing connection ensures an airtight seal at the windows.

INTERNAL FUNCTIONS

Amaris Homes included 11.34 kilowatts of solar panels on the roof. These could give the homeowners—Ray and his wife, Lolli—an estimated energy savings of \$4,700 per year compared to a home built to the state code (the 2012 International Energy Conservation Code [IECC]), and achieving a Home Energy Rating System (HERS) score of -2. But even without the photovoltaics (PVs), the dwelling would score a HERS 34, far below the typical 80 to 100 HERS score for new homes.

The home is oriented to take advantage of south- and west-facing exposures in terms of orientation on the lot and window locations for maximum solar gain in this cold climate. To control heat gain in the summer, all windows in the great room have automated blinds.

To bring fresh air into the home,

Pruban installed an energy recovery ventilator (ERV). The air ducts cross in a heat exchanger where heat and humidity are 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 is also cleaned by passing through a high-filtration Minimum Efficiency Reporting Value (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, timer-controlled exhaust fans.

Blower door testing, which is required in the DOE Zero Energy Ready Home (ZERH) program, showed that the house had a whole house air leakage rate of 0.64 air changes per hour at 50 Pascals (ACH 50).

The house is equipped with a 98 percent efficient natural gas furnace. A high-efficiency 19 Seasonal Energy Efficiency Ratio (SEER) five-stage central heat pump supplements the home's heating and provides summer cooling and humidity control. All of the rigid metal ducts are within the conditioned space of the home, and the main and lower levels are zoned.

SILVER LININGS



A 50-gallon gas water heater with an 0.88 efficiency factor provides domestic hot water and in-floor heating for the basement slab. Plumbing fixtures are all EPA WaterSense labeled low-flow varieties. The main plumbing loop is 0.75-inch cross-linked polyethylene (PEX) and all of the branch lines are half-inch PEX. A recirculation pump speeds hot water to distant fixtures for shorter wait times.

Energy Star appliances and 100 percent LED lighting add to the energy savings. Key lighting areas such as the exterior, great room, entertainment room, office and master bedroom have smart Wi-Fi lighting; they are also smart phone controllable. Low-profile LED ceiling lights were selected so that no recessed cans had to be installed in the ceiling.

FRINGE BENEFITS

The home meets all of the clean air and moisture management requirements of the EPA's Indoor airPLUS program (itself a DOE ZERH requirement); this equates to lower indoor humidity, better filtration

and ventilation, and fewer contaminants in the home.

Amaris opts for low-volatile organic compound (VOC) paints, stains and adhesives to help keep contaminants out of the house. A motion-sensor-controlled exhaust fan was installed in the garage to remove pollutants. An air quality sensor was installed to monitor indoor air quality.

Pruban also added several aging-in-place features, such as wider doors and hallways, lever-style door handles, a zero-barrier shower in the master, and below-counter drawers and microwaves for easy wheelchair access.

The home uses water-saving EPA WaterSense-rated irrigation and drought-resistant landscaping. The yard was landscaped with a 1,650-square-foot rain garden in the front yard south of the driveway. The garden was designed, guttered and graded to accept 100 percent of the garage roof rain water and 50 percent of the house roof rain water, plus any runoff from the driveway approach, landing and turnaround.



TIGHT ENVELOPE.

Spray foam and acoustic sealant give the home 0.64 ACH 50 performance.

INSULATED FOUNDATION.

R-33 walls include water drainage.

COURTESY OF AMARIS HOMES



Full house. Walnut Farm in Williamsburg, Virginia, features one- and two-story midwestern craftsman models that are loaded with energy efficiency, durability and indoor air quality details inside. COURTESY OF HEALTHY COMMUNITIES

Project Info

DESIGN: Healthy Communities, Williamsburg, Virginia, healthycommunitiesva.com

BUILDER: Jay Epstein

COMPLETED: June 2020

CATEGORY: Production

HERS Index: 9

This home's score with PV

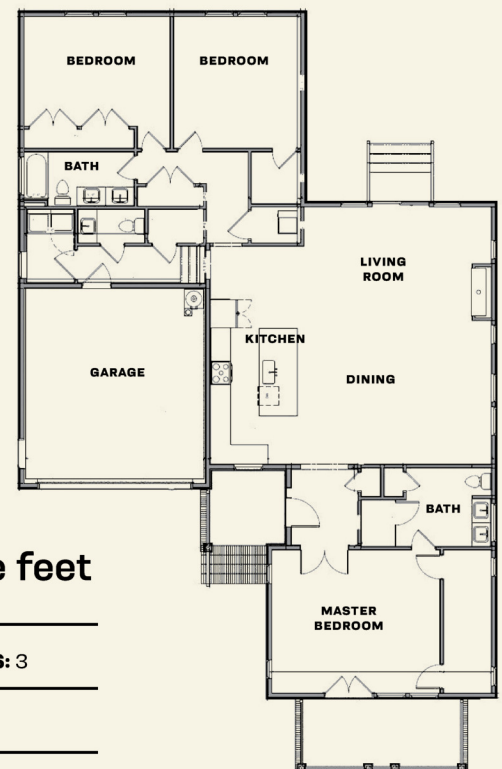


Size:
2,227
square feet

BEDROOMS: 3

BATH: 2.5

LAYOUT: 2 floors



Hybrid Performer

At Walnut Farm, mixed insulation types and optional solar arrays promise near net-zero living.

BUILDER JAY EPSTEIN, owner of Healthy Communities in Williamsburg, Virginia, has been interested in energy-efficient homes for several years. He sees Walnut Farm, the state's first Zero Energy Ready Home (ZERH) community, as the culmination of a lifetime of improving his craft. The 75 single-family production homes are one- and two-story midwestern craftsman designs that are loaded with big front porches and wood trim details outside, and energy efficiency, durability and indoor air quality details inside.

"Walnut Farm is unlike any community Healthy Communities has built in the last 40 years," he says. "Each previous community has been a building block and learning lesson that has brought us to today's 'product.'"

The judges must have agreed with this assessment, because they selected

one of the homes at Walnut Farm, a 2,227-square-foot, two-story, three-bedroom, 2.5-bath dwelling, for a 2020 DOE Housing Innovation Grand Award in the Production Home category.

Of the eight Healthy Communities homes completed to date, five homeowners have chosen to install solar panels at construction. This includes the award-winning model, which has a 5.94-kilowatt (kW) array of 18 solar panels on the roof that should cover most of the home's electric needs. With the photovoltaic (PV) system installed, the dwelling achieves a Home Energy Rating System (HERS) score of 9. Even without the PV, the home scores a 46, far lower than typical new homes. With PV the home should save its owners an estimated \$2,100 annually compared to a home built to the state's energy code, which is equivalent to the 2015 International Energy Conservation Code (IECC).

Options for homes at Walnut Farm include a storage battery. The inverter is upgraded to allow for a plug-in electric vehicle (EV) and an inverter transfer module can be added to allow for battery or generator backup.

ENERGY EFFICIENCY TIMES TWO

To achieve zero energy, power production is half of the equation; an energy-efficient home is the other half.

Healthy Communities starts with a highly insulated thermal building envelope. Epstein uses a combination of insulation types in the home's 2-by-6 advanced framed exterior walls. The wall cavities are filled with sprayed cellulose, or a "flash and batt" technique is used. The latter consists of spraying one inch of open-cell spray foam into the cavities to seal the framing to the exterior sheathing,



Average Monthly Energy Bill

\$30

Calculated



Annual Savings

\$2,100

Calculated versus typical new homes

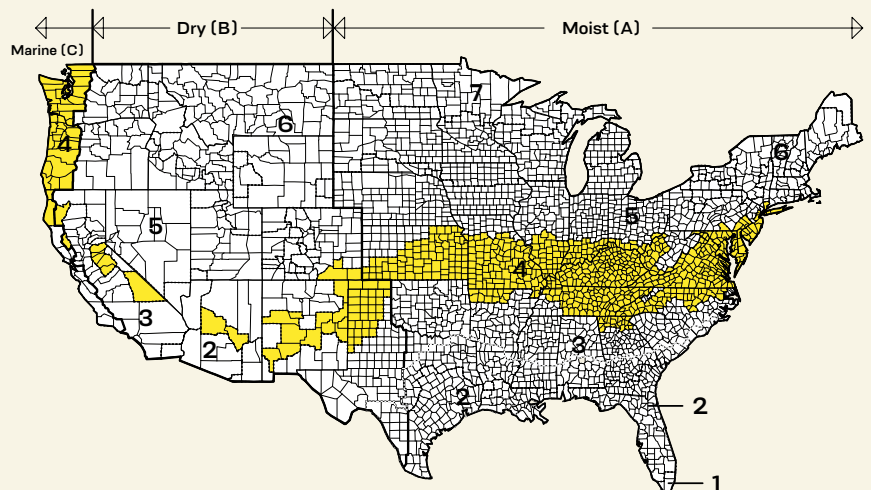


Saved in the first 30 Years

\$87,500

Includes fuel escalation rates,
2019 EIA Energy Outlook

Climate IECC,4A, mixed-humid



Key Features

AIR SEALING: 1.37 ACH 50; foam gasket and caulk at sill plates; open-cell spray foam in rim joists.

APPLIANCES: ENERGY STAR dishwashers, clothes washer, clothes dryer and refrigerator.

ATTIC: Vented attic: 14-inch R-49 blown-in cellulose; 14-inch R-50 open-cell spray foam in attic floor above garage and porch.

ENERGY MANAGEMENT SYSTEM: Smart climate controls; smart thermostat; solar tracking.

FOUNDATION: Unvented crawlspace; CMU walls insulated on interior with R-11 Batt; 8-mil vapor barrier over dirt floor; R-19 open-cell spray foam in rim joists.

HOT WATER: Energy Star-certified, 50-gallon, heat pump water heater; UEF 3.42, button-operated recirculating pump.

HVAC: Central heat pump, 10 HSPF, 19.8 SEER; rigid metal ducts.

LIGHTING: 100 percent LED; smart house system controls; daylighting.

ROOF: Gable truss roof: R-49 insulation, plywood sheathing, fire and ice underlayment, ridge vent, architectural shingles; 14-inch raised heel trusses; 8/12 pitch (optimal) for solar panels.

SOLAR: 5.94 kW; 18 rooftop panels, central inverter.

VENTILATION: ERV; MERV 8 or 13 filter supplies air to return of central heat pump, pulling from two house locations.

WALLS: 2-by-6, 24-inches on center, R-23 total: wall cavity flash and batt 1-inch open-cell spray foam plus R-19 fiberglass batt or spray-in cellulose; R-3.5 coated OSB exterior sheathing; fiber cement siding; open-cell spray foam in rim joists. Designed with 3D Building Information Modeling (BIM).

WATER CONSERVATION: EPA WaterSense fixtures; drought-resistant landscaping.

WINDOWS: Double-pane, argon-filled, low-e, vinyl single-hung frames, U=0.28, SHGC=0.22.

OTHER: EV charging station, low-VOC paints; UL GREENGUARD and Green Label Plus flooring; natural stone building material in bathrooms and entry.



then filling the wall cavities with fiberglass batts—in this case, R-19 batts that are compressed to R-16.

The exterior sheathing is an oriented strand board (OSB) product that has R-3.5 of rigid foam adhered to the interior side and a plastic coating on the exterior side that, when the seams are taped, serves as a weather-resistant barrier and air barrier. The rim joists are also sealed and insulated with 5.5 inches of open-cell spray foam. Durable fiber-cement siding covers the walls. The sill plate is sealed to the foundation wall with a sill-sealing foam gasket and expansive caulk.

The sealed and conditioned crawlspace is insulated along the interior walls with R-11 fiberglass batts that are wrapped in a vapor barrier and draped over the concrete block walls so they can be lifted for termite inspection. An 8-mil polyethylene vapor barrier covers the crawlspace floor.

The 8/12 pitch of the roof is an optimum angle for solar production and yields enough space to set two rows of vertically mounted solar panels on the south side. The roof trusses are 24 inches on center to align with the wall studs, and the truss

design incorporates some special features. The truss design is strengthened from 10 pounds to 15 pounds per square foot to accommodate solar panels.

The trusses incorporate a 14-inch raised heel to prevent cellulose from being compressed at the eaves. The floor joists are insulated with 14 inches of open-cell spray foam anywhere rooms are located above unconditioned space, such as with the garage or porches. The roof itself is sheathed with plywood, ice and water shield, and 30-year architectural shingles. Ridge and soffit vents provide ventilation to the attic.

Vinyl-framed, single-hung ENERGY STAR-rated windows have low-emissivity coatings and an argon fill to slow heat transfer. They have been tested for air tightness by the manufacturer at Healthy Communities. The double-pane windows provide an insulation U-Factor of 0.28 and a solar heat gain coefficient of 0.22.

The heat pump has a heating season performance factor (HSPF) of 10 and a cooling efficiency of 19.8 SEER. The central heating system incorporates an optional air cleaning technology that can remove up to 99.98 percent of airborne



SILVER LININGS

allergens from the filtered air. The system filters down to 0.1 micron, or 700 times smaller than a human hair, so it can effectively remove spores, mold, pollen, pet dander, dirt and dust.

Ventilation is provided by an energy recovery ventilator (ERV) that brings ducted outside air to the air handler of the heat pump through a MERV 8 filter. The controls can be set on the ERV or can be managed through the heat pump management module, which controls temperature, humidity and exhaust. It can be accessed through the internet. Energy Star bathroom fans run continuously at a preset lower level but are moisture sensor-activated to increase speed when needed.

A 50-gallon heat pump water heater is located in the garage as close to water fixtures in the home as possible. The Energy Star-certified water heater has an energy factor of 3.42. A push-button-activated recirculation pump helps speed hot water through the insulated pipes to reduce wait times.

Breathe easy. An energy recovery ventilator tied to the home's high efficiency central heat pump brings 99.98 percent fresh air into the home while removing stale air.

COURTESY OF HEALTHY COMMUNITIES

BUILT FOR FUTURE NEEDS

The most unique aspect of the homes at Walnut Farm is the way they are being designed. Epstein uses a computer modeling design system from Digibilt that generates an early, digital model of each house. This enables a builder and trade partners to see conflicts before construction. The product software creates a bill of materials in about 5 seconds. In five more seconds, a critical path schedule is produced that allows labor productivity to be tracked at an activity and trade level. The system automatically sends a text message to the individual trade foreman with a simple question at the end of each work day (e.g., "Is the second floor interior framing 50 percent complete? Yes or No?").

When they respond, the schedule is automatically updated. If the answer was "no", the follow-up question is, "what percentage is complete?" followed by "what was the cause of the delay?" Every step from that point is automated via this simple text-messaging interface. The builder and their trade partners receive automated construction instructions and schedules are updated accordingly.

AIR LOCK. The home carries an air leakage rate of 0.64 air changes per hour at 50 Pascals (ACH 50).

HEAT BARRIER. Dual-pane windows provide an insulation U-Factor of 0.28 and a solar heat gain coefficient of 0.22.

POWERFUL OPTION. An electric vehicle charging station adds to a HERS score of 9.



Sustainable showcase. Boasting an impressive Home Energy Rating System (HERS) score of 14, the Mantell-Hecathorn home is equipped with triple-paned windows, a hydronic radiant floor heating system, an electric vehicle charging station, and rooftop-mounted solar panels.

COURTESY OF MANTELL-HECATHORN BUILDERS AND MARONA PHOTOGRAPHY

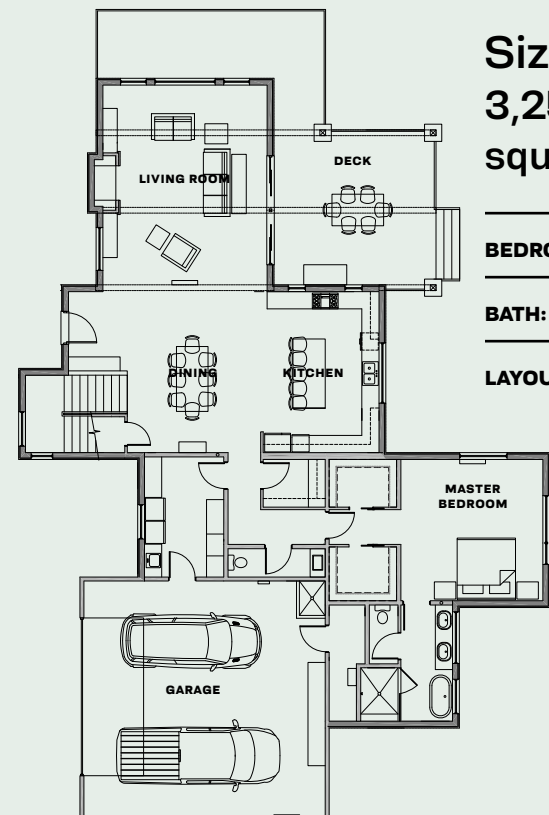
Project Info

DESIGN: Mantell-Hecathorn Builders, Durango, Colorado, m-hbuilders.com

BUILDER: Greg Mantell-Hecathorn

COMPLETED: December 2019

CATEGORY: Custom for Buyer (greater than 3,000 square feet)



Size:
3,259
square feet

BEDROOMS: 3

BATH: 2.5

LAYOUT: 2 floors

HERS Index: 14

This home's score with PV



Flattening the Curve

This home's carefully constructed structure helps keep temperatures stable inside, at a lower cost.

AFTER YEARS OF BUILDING upscale high-performance homes for countless satisfied customers, builders Greg and Tara Mantell-Hecathorn finally got to construct their own U.S. Department of Energy (DOE) Zero Energy Ready Home (ZERH)-certified dream home. Located in the beautiful mountains of Durango, Colorado, this 3,259-square-foot, mountain-modern design incorporates soaring ceilings, exposed beams, oversized triple-pane windows and patio doors, natural stone, Douglas fir and stucco, and a standing seam metal roof.

Visually stunning inside and out, the home also showcases the building science expertise Mantell-Hecathorn Builders has come to be known for. The company has been constructing homes that far exceed the county and local building codes for decades, and has built homes

to the high-performance requirements of the DOE ZERH program since 2012. Mantell-Hecathorn is the only builder in southwest Colorado to construct all of its homes to ZERH criteria, with 17 homes certified to date.

"We have long felt that a third-party verified home that is certified under a nationally recognized program provides the best assurance that our homes meet our high performance and sustainability goals," says Greg Mantell-Hecathorn. "The DOE ZERH program provides the best verifiable platform for high standards, while allowing the flexibility to be adapted to the wide variety of custom homes that we build."

This dedication has paid off. The builder was honored with DOE Housing Innovation Awards (HIA) in 2015, 2016 and 2017, and a Grand Housing Innovation Award in 2019 and 2020 in the custom home

category. The 2017 HIA winner was the home of Hunter and Miranda Mantell-Hecathorn, co-principals of the company, and son and daughter-in-law of Greg and Tara. The house has been featured in the local Home Builders' Association Parade of Homes, subdivision Real Estate Tour, and Local Solar Homes Tour.

"This is a showcase home," Greg Mantell-Hecathorn adds. "It proves that a unique mountain-modern design can also embody comfort at 0 degrees or 90 degrees, along with tiny utility bills, long-term durability, healthy non-toxic indoor air, low maintenance, high quality and practicality."

The home achieved a Home Energy Rating System (HERS) score of 44, not including the photovoltaic (PV) system. A typical code-built home would score an 80 to 100; a net zero home would score 0. When the 7.3-kilowatt (kW) solar PV



Average Monthly Energy Bill

\$50

Calculated



Annual Savings

\$2,450

Calculated versus typical new homes

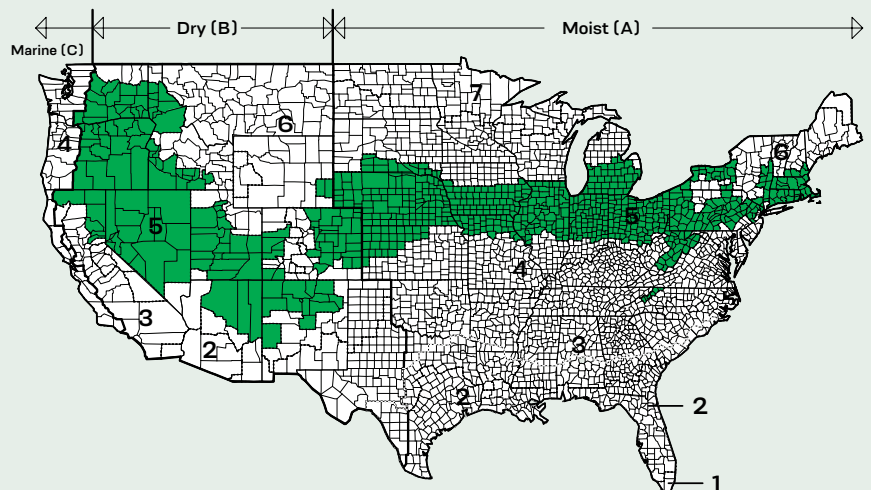


Saved in the first 30 Years

\$112,700

Includes fuel escalation rates,
2019 EIA Energy Outlook

Climate IECC,5B, cold



Key Features

WALLS: Double wall, R-44 total: 2-by-4 stud 24-inch on center (o.c.), 1/2-inch gap, 2-by-6 stud 24-inch o.c., 7.5-inch blown fiberglass, 2-inch closed-cell spray foam, 1/2-half coated OSB sheathing, 1-inch EPS foam under stucco, 3/8-inch rainscreen behind stone and wood siding.

ROOF: Shed truss roof: 3/4-inch roof sheathing, standing seam metal roof, 24-inch raised heel.

ATTIC: Vented: 23-inch R-70 fiberglass; Vaulted: R-70 fiberglass; 8-inch closed-cell spray foam and R-19 batt.

FOUNDATION: Unvented crawlspace: 8-inch poured-in-place concrete, 2-inch EPS on interior and on exterior, liquid-applied crystalline waterproofing.

WINDOWS: Triple-pane, low-e2, aluminum-clad wood casement frames, U=0.19, SHGC=0.50; automated interior motorized blinds.

AIR SEALING: 1.25 ACH 50; all foam-sealed top plate, wall and floor penetrations.

VENTILATION: HRV ducted to each room; switch-activated boost mode; 12 MERV filter.

HVAC: Radiant floor heat from a 95 AFUE boiler; 16 SEER AC.

HOT WATER: Combi uses HVAC boiler to heat 50-gallon tank, 0.88 energy factor; cross-linked polyethylene (PEX) piping; recirculating pump.

LIGHTING: 100 percent LED; lighting controls; automated window blinds; daylighting.

APPLIANCES: ENERGY STAR dishwasher, clothes washer and refrigerator.

SOLAR: 7.3 kW; 24 305-W rooftop panels; central inverter.

WATER CONSERVATION: EPA WaterSense fixtures and toilets; drought-resistant landscaping.

ENERGY MANAGEMENT SYSTEM: Smart thermostats; cell to lighting; windows; security equipment; sound; HVAC.

OTHER: Electric vehicle charging; accessibility features; reclaimed redwood; no- or low-VOC formaldehyde cabinets, sheathing, floor finishes, mastics, paints, caulks and carpet.



Hot property. Radiant floor heat and a highly insulated, draft-free building envelope keep the owners wrapped in warmth throughout the Colorado winters.

COURTESY OF MANTELL-HECATHORN BUILDERS AND MARONA PHOTOGRAPHY

system is included, the HERS score drops to 14, and projected annual energy costs are cut by more than two-thirds—to \$595 per year, or almost \$50 every month. Even without the PV, the annual energy costs are expected to be \$1,980, a savings of more than \$1,000 per year compared to a home built to the 2015 International Energy Conservation Code (IECC).

TOOLS OF POWER PERFORMANCE

The home has double walls consisting of an interior 2-by-4, 24-inch on-center stud-framed wall, a half-inch gap, and a 2-by-6, 24-inch on-center stud framed wall. These two walls form a 9.5-inch deep cavity that is insulated with 2 inches of closed-cell spray foam plus 7.5 inches of blown fiberglass, then wrapped in another inch of rigid expanded polystyrene (EPS) foam beneath the stucco, stone and wood siding. The walls are sheathed with a

coated oriented strand board (OSB) product that is topped with one inch of EPS rigid foam under portions of the house. Stucco and a 3/8-inch rainscreen run behind stone and wood siding.

The vented attic has 23 inches (R-60) of blown fiberglass. Over the living room, the vaulted ceiling trusses are filled with 8 inches of closed-cell spray foam, plus R-19 fiberglass batts for an R-value of R-70. The foundation is an unvented crawlspace, insulated on the interior and exterior with 2 inches of EPS.

Mantell-Hecathorn used expanding foam to seal every penetration through the floors, walls, and top and bottom plates. The builder used tape on any stacked studs to seal the gap between the studs. He also used tape along the top plate on the outside from the top of the wall sheathing to the top plate. Fire-rated can covers were installed over every can light, and spray foamed to air seal around them to



SILVER LININGS



the drywall in the attic.

The home achieved an air tightness of 1.25 air changes per hour at 50 Pascals (ACH 50). To provide ventilation, a heat recovery ventilator (HRV) was installed to bring in fresh air through a MERV 12 filter and to exhaust stale air. The HRV was separately ducted to provide fresh air to every room in the house and to exhaust air from several locations, including the kitchen and bathrooms, which have boost switches to remove steam more quickly.

HEAT REPELLENTS

The home meets all requirements of the EPA Indoor airPLUS program, including the use of low- and no-VOC and formaldehyde-free products. ENERGY STAR appliances, LED lighting and low-flow WaterSense-labeled fixtures add to energy and water savings.

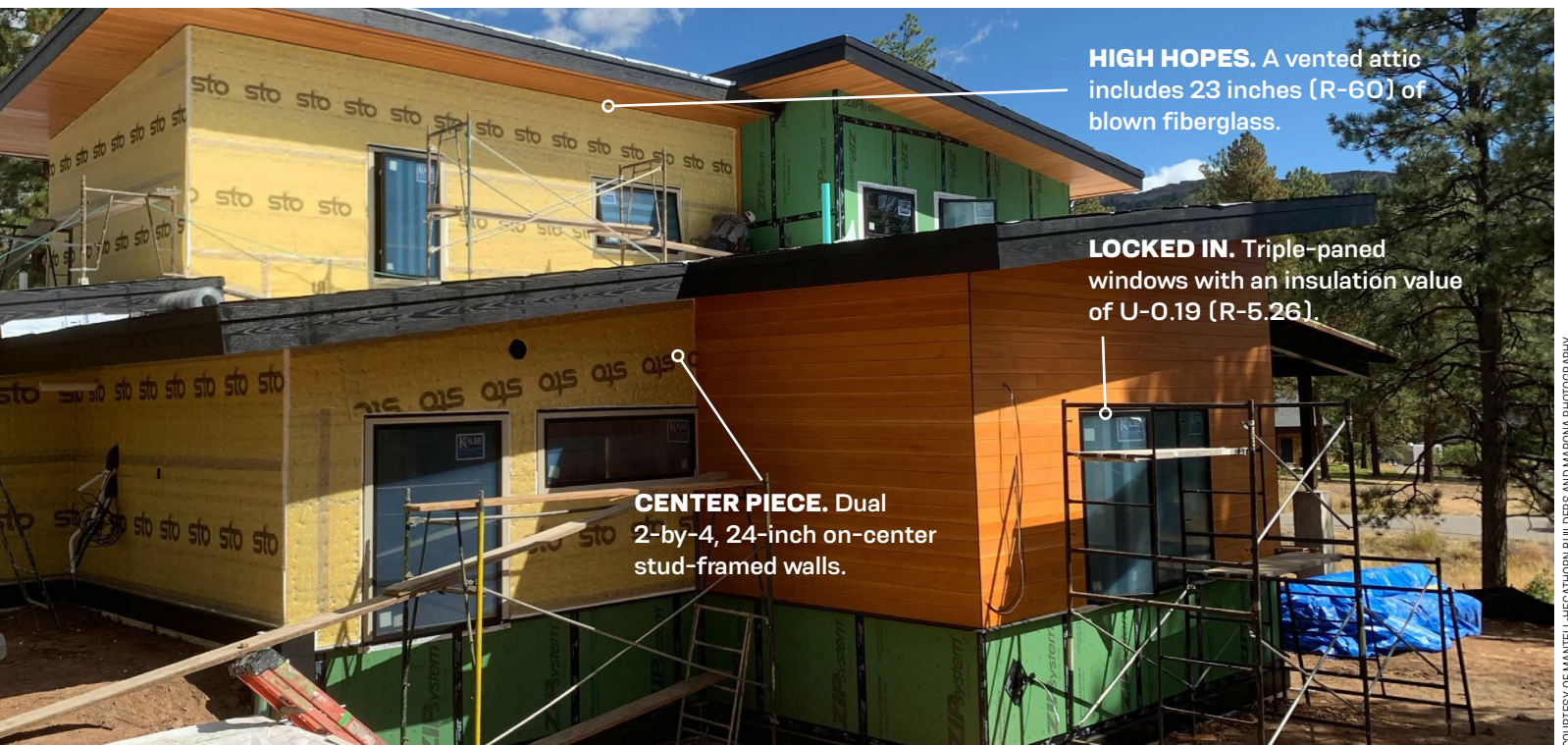
A 95 percent efficient boiler provides domestic and hot water for the hydronic radiant floor heating for both floors, controlled by four smart thermostats. Cooling is provided by a SEER 16 wall-mounted mini-split heat pump installed in the living room, and three ceiling cassette-style mini-splits installed in the upstairs hall,

upstairs bunk room and master bedroom.

The windows are triple-paned, with an insulation value of U-0.19 (R-5.26). They have two low-emissivity coatings to help minimize radiative heat transfer through the glass. The windows are not gas filled due to the high altitude. All of them have aluminum-clad wood frames. The windows have a high solar heat gain coefficient (SHGC) of 0.50 to allow in beneficial solar heat gain in the winter.

Motorized blinds were installed on the interior side of the windows and can be set to operate automatically on a schedule to keep out unwanted summer solar heat gain. Meanwhile, lighting controls are integrated with the home automation and energy management system.

Hunter Mantell-Hecathorn says projects such as this one for his parents are an example of the company's motto, "personal attention to detail, one home at a time." Mantell-Hecathorn Builders limits the number of projects it takes on to three to five per year so that Hunter or Greg can personally be on site daily to ensure that quality standards are being met by the subcontractors and crews.



HIGH HOPES. A vented attic includes 23 inches [R-60] of blown fiberglass.

LOCKED IN. Triple-paned windows with an insulation value of U-0.19 [R-5.26].

CENTER PIECE. Dual 2-by-4, 24-inch on-center stud-framed walls.

COURTESY OF MANTELL-HECATHORN BUILDERS AND MARONA PHOTOGRAPHY

Clean air affair. TC Legend Homes built this 2,538-square-foot, two-story home in Everson, Washington, with an emphasis on improved environmental control and indoor air quality.

COURTESY OF ZIGZAG MOUNTAIN ART



Project Info

DESIGN: TC Legend Homes, Bellingham, Washington, tcleghomeshomes.com

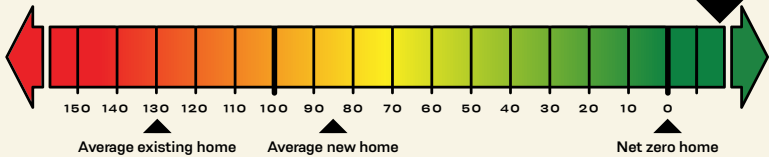
BUILDER: Ted Clifton

COMPLETED: March 2020

CATEGORY: Custom for Buyer (less than 3,000 square feet)

HERS Index: -19

This home's score with PV



Size:
2,538
square feet

BEDROOMS: 4

BATH: 3

LAYOUT: 2 floors

Critical Mass

R-29 SIP walls, supported by ultra-efficient HVAC and a heat recovery ventilator, mitigate temperature swings in this exceptional home.

GETTING USED TO not fiddling with the heating system was the only difficulty for the homeowners of a new U.S. Department of Energy (DOE) certified Zero Energy Ready Home (ZERH) built by TC Legend Homes in Everson, Washington.

“We were used to a forced air furnace with a nighttime setback temperature several degrees lower than the daytime temperature,” says the homeowner. “But in a high-mass, super-insulated home, that simply isn’t necessary. Even in cold weather, it would take several days with no heat to cause a significant temperature drop. We don’t have to touch the thermostat.”

So, instead of experiencing daily temperature fluctuations of 64 to 72 degrees Fahrenheit, the homeowners are enjoying a constant temperature of 68 degrees. And thanks to exceptional air sealing and

insulation, the home is better than net zero.

Builder Ted Clifton, Jr., likes to call the building “energy positive,” producing enough power to run the home and an electric car or two. The home’s Home Energy Rating System (HERS) score reflects this; a HERS score of 0 or lower would equal a net zero energy home. The TC Legend home achieves a -19 when the 12.4-kilowatt (kW) solar system is included. Even without the photovoltaic (PV) system, the home would score a HERS 33, well below the HERS 80 to 90 of typical new homes.

The exceptional performance won TC Legend a Grand Award in the Custom for Buyer category of DOE’s 2020 Housing Innovation Awards (HIAs). This is TC Legend’s sixth DOE HIA winner and the third Grand Award for the custom builder, who has certified 27 homes through the

program in Seattle and Bellingham, Washington, since 2004.

CARBON NEUTRAL GOALS

TC Legend nearly always starts with a super-insulated structural insulated panel (SIP) wall and roof over an insulated concrete form (ICF) foundation. The 2020 award-winning home is a two-story, 2,538-square-foot home constructed on a slab-on-grade foundation with 5.25-inch ICF stem walls that provide an insulating R-24.3 perimeter around the structure.

The walls are constructed of 6.5-inch R-29 SIPs consisting of two layers of oriented strand board (OSB) sandwiching a graphite-enhanced expanded polystyrene core. TC Legend’s in-house crew can assemble the walls and roof in three days, because the panels come to the site



Average Monthly Energy Bill

\$0

Calculated



Annual Savings

\$2,450

Calculated versus typical new homes

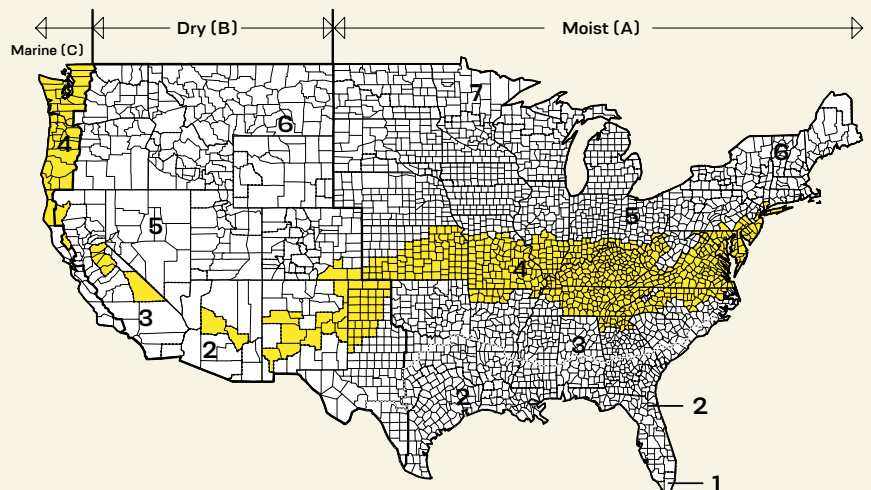


Saved in the first 30 Years

\$103,200

Includes fuel escalation rates,
2019 EIA Energy Outlook

Climate IECC,4C, marine



Key Features

AIR SEALING: 0.47 ACH, all SIP seams caulked and taped; aerosol whole-house sealant.

APPLIANCES: ENERGY STAR refrigerator, dishwasher, clothes washer and clothes dryer.

ATTIC: No attic.

ENERGY MANAGEMENT SYSTEM: Automated, internet and voice-controlled lighting, blinds and HVAC; HRV triggered by CO₂ and humidity sensors.

FOUNDATION: 4-inch R-20 rigid foam under slab, 5-inch R-24.3 ICF stem wall.

HOT WATER: Combi uses space heating air-to-water heat pump, 3.93 COP; 80-gallon hot water storage tank and 40-gallon buffer tank to prevent short cycling.

HVAC: Air-to-water heat pump, 3.92 COP (heat), 6.75 COP (cool), 23.02 EER. Uses HRV ducts to distribute hot and cold air, plus radiant floor.

LIGHTING: 100 percent LED; day lighting; clerestory windows; automated and remote controls.

ROOF: SIP roof: 12.25-inch R-59 graphite SIPs, membrane, standing seam metal roof.

SOLAR: 12.4 kilowatt, 40 310-watt panels; roof sized for 80-plus panels; wired for future battery.

VENTILATION: HRV, ducted; MERV 13 filters; humidity and CO₂ sensed; boost setting.

WALLS: SIPs, R-29 total: 6.5-inch R-29 graphite SIPs, house wrap, fiber cement siding.

WATER CONSERVATION: EPA WaterSense fixtures; central manifold plumbing with PEX pipe; drought-resistant landscaping; rainwater collected to central sump for irrigation.

WINDOWS: Triple-pane, argon-filled, low-e3, vinyl-frame, U=0.14 fixed, U=0.16 casement, SHGC=0.33 to 0.44 tuned to direction; automated window blinds.

OTHER: Electric vehicle charging; no-VOC paint; GREENGUARD Gold SIPs; Americans with Disabilities Act (ADA) features.

Power packed. A highly insulated shell and rooftop solar result in a house that is “energy positive,” producing enough power to run the home and charge a future electric vehicle.

COURTESY OF ZIGZAG MOUNTAIN ART



measured and precision cut to the house plan dimensions for doors, windows and wall sections. Almost no framing is required—just caulking and taping seams, installing windows and doors, house wrap and fiber cement lap siding.

TC Legend uses insulated splines to connect the panels. Thicker 12.25-inch, R-59 SIPs are used to construct the roof. The panels are covered with a three-layer durable breathable membrane underlayment and topped with a 24-gauge standing-seam metal roof.

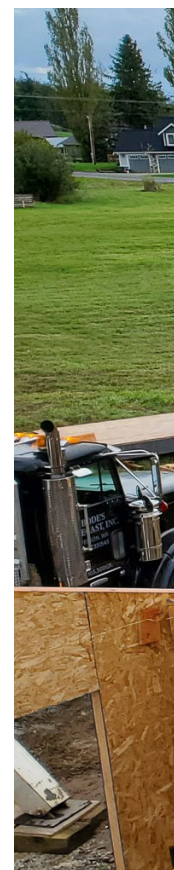
The rigidity of the two adhered layers of OSB provides exceptional shear strength for the walls and roof, making SIPs an excellent choice for structural stability in areas prone to high winds and earthquakes, such as in western Washington state. Because of the structural strength of the walls and roof, no roof trusses are needed and all interior walls can be non-load bearing, providing for cathedral ceilings and greater design flexibility for interior spaces.

Although SIPs are known to provide draft-free construction, the home was further air sealed by using the AeroBarrier process, in which atomized particles

of acrylic are sprayed into the rooms while the home is pressurized with a blower door. The pressurized air carries tiny acrylic particles, which adhere to and seal off any leaks. In this case, the home was sealed to 0.47 air changes per hour at 50 Pascals (ACH 50), tighter than the 0.60 ACH 50 required by Passive House Institute U.S.A.

Triple-pane, argon-filled vinyl-framed windows complete the thermal envelope. The windows have three low-emissivity coatings to slow heat transfer. The casement style windows have a U-Factor of 0.16 and the fixed windows have a U-Factor of 0.14. Most windows are south facing to allow sunlight to warm up the exposed sealed concrete floors for intentional passive solar heat gain in the winter.

A wraparound porch and overhangs help to limit unwanted solar heat gain in the summer. Automated blinds on the south and east windows can be scheduled through the home automation system to help control heat gain, heat losses, daylight and views. The large south- and east-facing windows and clerestory south-facing windows bring daylight into the main level as well as into the upper



SILVER LININGS



loft-level bedrooms to supplement the 100 percent LED light fixtures. The lighting is controlled by the same internet- and voice-activated system that controls the window blinds, the HVAC and the ventilation systems, which are also controlled by humidity and CO₂ sensors.

IT'S ALL ABOUT THE AIR

One of the most unique aspects of the home is its HVAC systems. The home's primary space conditioning system is a highly efficient (COP 3.92 heating, 6.75 cooling) air-to-water-source heat pump that provides space heating and cooling in three ways. It supplies hot or chilled water to a coil within the supply side duct of the heat recovery ventilator (HRV). The HRV distributes the heated or chilled air via ventilation ducts. The air-to-water heat pump also provides hot and chilled water to fan coil units located in the first-floor master bedroom and the second-floor library, which is open to the first-floor living space.

There is also a third heating system, an in-floor hydronic system, which also uses water heated by the air-to-water heat

pump. Testing of the cutting-edge \$1,000 HRV coil has been so successful that the two backup systems (the fan coils and the hydronic floor heating and cooling) may not be needed.

The air-to-water heat pump also warms an 80-gallon tank for domestic hot water. The system includes a 40-gallon buffer tank to prevent heat pump short-cycling. The HRV unit provides ventilation throughout the house by drawing stale and moist air from the bathrooms and laundry, and supplying fresh conditioned air to the living and sleeping rooms. The air is filtered through MERV 13 filters.

The HRV has wireless controls and can be operated remotely through the home's automation system. It has humidity-triggered sensors in the shower rooms and CO₂-triggered sensors in the living room. It can also be set for timed or continuous operation. The air intake damper can be closed in the event of smoke or bad outdoor air quality. The boost setting can be activated to remove forest-fire smoke or other contaminants that might come in when doors are opened.



Star attraction.

Attention to sustainability details such as indoor air quality and ENERGY STAR appliances have made Thrive Home Builders one of Denver's most-successful builders.

COURTESY OF THRIVE HOME BUILDERS



Project Info

DESIGN: Thrive Home Builders, Denver, Colorado, [ThriveHomeBuilders.com](https://www.thrivehomebuilders.com)

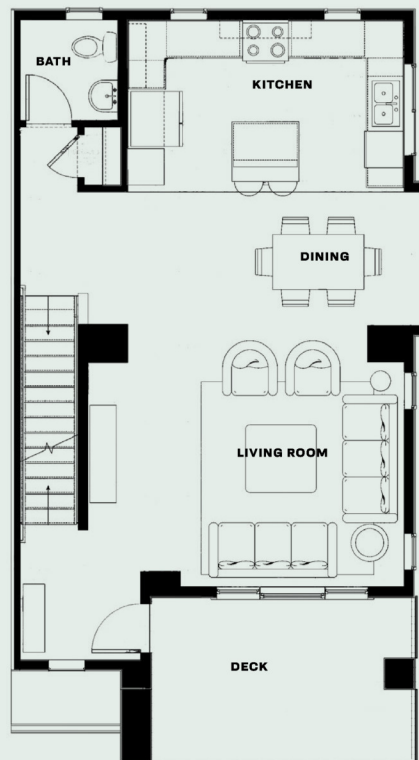
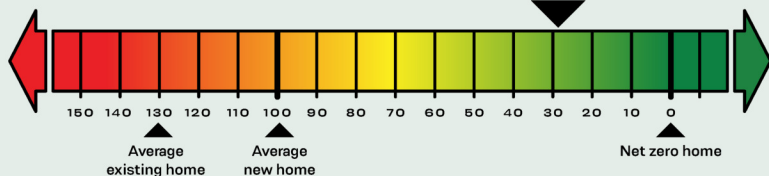
BUILDER: Bill Rectanus, vice president of home building operations

COMPLETED: 2020

CATEGORY: Attached Housing

HERS Index: 29

This home's score with PV



Size:
1,793
square
feet

BEDROOMS: 2

BATH: 2.5

LAYOUT: 3 floors

A Place to Breathe Easy

For allergy sufferers and chemical sensitive buyers, homes like this one, with top-notch ventilation and air control, offer a life-changing relocation.

THIS IS it!" proclaimed the little girl as she pranced through the rooms of the new home by Thrive Home Builders. It wasn't the model home's clever modern décor that caught her attention. It was the awareness that she had no allergy symptoms for the first time since her parents had begun touring houses in their search for a new home.

Stories like this aren't unique among Thrive homeowners; others tell of putting the inhalers in a drawer the day they move in and not touching them again, or fewer asthma-related trips to the hospital.

Health is what attracted the buyer to this 1,793-square-foot, three-story town home at WestRidge Rowhomes, in Wheat Ridge, Colorado. "Having a healthy home

is huge with having a three-year old and definitely something we looked into before purchasing," notes the owner. "I have really been impressed in the fact that neither of us have been sick this last winter season; we have stayed healthy through this pandemic. This house has hugely impacted that since we have had to stay inside so much lately."

Thrive Home Builders achieves high indoor air quality in part because it adheres to the high performance requirements of the U.S. Department of Energy (DOE) Zero Energy Ready Home (ZERH) program. The Denver area builder is nearly tied for total number of DOE ZERHs built, having certified 1,019 since the program began in 2012. Thrive has

been recognized with DOE Housing Innovation Awards annually since 2013. This includes a Grand Award every year, as well as a total of four in the Production Home category, one in the Affordable Home category, and four in the Multifamily category, with one of those occurring in 2020.

QUALITY COMPONENTS, QUALITY RESULTS

All 87 townhomes at WestRidge are (or will be) constructed to DOE ZERH requirements.

The walls are made with 2-by-6 studs framed at 24 inches on center (o.c.) and incorporating advanced framing details like two-stud corners, right-sized headers, and ladder blocking at interior walls



Average Monthly Energy Bill

\$40

Calculated



Annual Savings

\$1,750

Calculated versus typical new homes

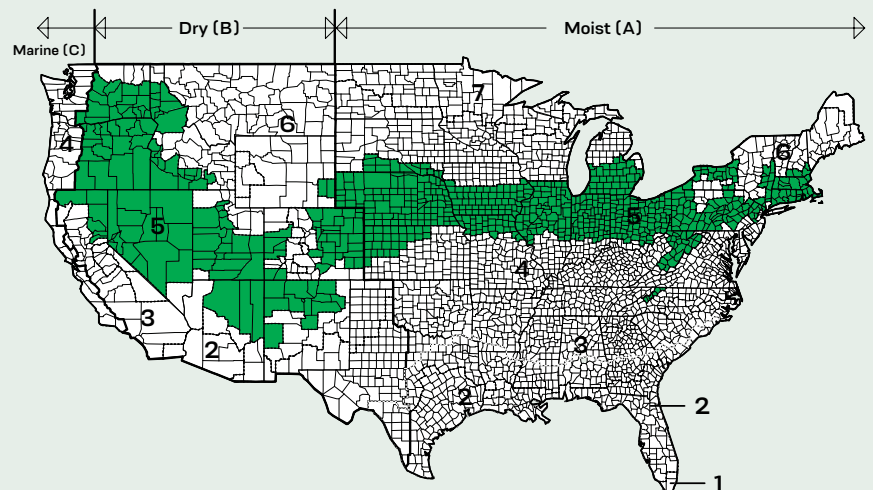


Saved in the first 30 Years

\$81,300

Includes fuel escalation rates,
2019 EIA Energy Outlook

Climate IECC, 6A, cold



Key Features

WALLS: 2-by-6, 24-inch on center, R-23 total: 5-inch blown fiberglass, 7/16-inch OSB sheathing, textured house wrap; stucco, brick veneer, and fiber cement siding.

ROOF: Truss gable roof, 15/32-inch OSB, synthetic underlayment, ice and water shield at valleys and roof edges, 30-year asphalt shingles.

ATTIC: Vented attic: 17-inch R-50 blown fiberglass on attic floor.

FOUNDATION: Slab on grade: R-10 sub-slab and perimeter insulation, 4-inch gravel, vapor barrier, frost-depth walls.

WINDOWS: Double-pane, argon-fill, low-e; vinyl single-hung, fixed, and sliding frames, U=0.3, SHGC=0.3.

AIR SEALING: 2.99 ACH 50: Paint-on flashing and foam seal all penetrations; closed-cell spray foam at rim joists; drywall gasket at top plates; caulking at outlets, switches and light fixture penetrations.

VENTILATION: Continuous exhaust, MERV 8 filter on furnace.

HVAC: Gas forced-air furnace on main floor, 92 percent efficient; 13 SEER AC.

HOT WATER: Tankless water heater; smart recirculation pump; 0.96 EF.

LIGHTING: 100 percent LED; daylighting.

APPLIANCES: ENERGY STAR refrigerator, hood/exhaust fan and dishwasher.

SOLAR: 2.56-kilowatt rooftop panels.

WATER CONSERVATION: EPA WaterSense fixtures; drip irrigation; recirc pump.

ENERGY MANAGEMENT SYSTEM: Energy monitoring system for photovoltaic and energy usage; smart programmable thermostat.

OTHER: Prewired for future electric vehicle charging station; certified cabinets, plywood, particleboard; no-VOC paints and finishes.



to provide more room in the walls for insulation. The walls feature 5.5 inches of dense-packed blown fiberglass, which is then sheathed with oriented strand board (OSB), wrapped in corrugated house wrap, and sided with a combination of stucco, brick veneer and fiber cement siding.

An engineered truss roof is designed to maximize solar energy potential. It is sheathed in 15/32-inch OSB, covered with a synthetic underlayment and ice and water shield at the valleys and roof edges, and topped with 30-year asphalt shingles. The vented attic is insulated with 17 inches (R-50) of blown insulation.

The slab for the slab-on-grade foundation is wrapped in R-10 of high-density rigid foam under the slab and at the slab edge. As part of Thrive's radon-resistant construction practices, the insulated slab sits on a 4-inch base of clean gravel, topped by a vapor barrier. An active radon mitigation system has also been installed.

Redundant air sealing measures include the taped house wrap, gaskets and foam sealing around all penetrations, two inches of closed-cell spray foam at all rim joists, drywall gaskets at all top

plates at the attic interface and on the garage-house connection wall, and caulking of all outlets, switches and light fixture penetrations in drywall at exterior walls and ceilings. With these measures, these production townhomes achieved a blower door-tested air tightness of 2.99 air changes per hour at 50 Pascals (ACH 50). Continuous exhaust provides ventilation and exhaust fans provide moisture removal.

The homes are equipped with a 92 percent efficient gas furnace and SEER 13 air conditioner. All ducts are located within the conditioned space of the home. Ducts are mastic sealed, and the system has a compact layout to limit duct length and improve distribution efficiency. The central air handler has a MERV 8 filter.

All of the home's LED lighting and the refrigerator, exhaust fans and dishwasher are ENERGY STAR labeled. Plumbing fixtures are EPA WaterSense rated for additional utility savings. The home is prewired for a future electric vehicle.

A 2.56-kilowatt (kW) array of solar panels was installed on the roof. The solar panels help bring down the already low

SILVER LININGS



Ratings winner. WestRidge Rowhomes achieved a Home Energy Rating System (HERS) score of 29, partly due to high insulation levels in the attic, walls and under the slab, along with ENERGY STAR appliances and solar panels.

COURTESY OF THRIVE HOME BUILDERS

in vendor performance, identifying areas for future trainings.”

Another vital role for the QA department is developing training sessions for vendors and employees as a new Thrive product is brought to market. “Thrive consistently introduces cutting-edge products and techniques into our homes,” Rectanus notes. “We are aware that this continual innovation can be a challenge for our trades and construction staff. To ensure successful implementation of new technology, the QA department works alongside manufacturer representatives and third-party consultants to provide training for our vendors and employees.”

Thrive Home Builders recently implemented a project management software that allows two-way communication, in real time, between Thrive and its trade partners regarding items such as purchase orders, schedules, changes and issues with installation.

Another important indicator of success for Thrive is customer satisfaction. Thrive measures key customer satisfaction via a survey emailed to each homeowner after move-in, at midyear and at year’s end. Responses are sent to every Thrive employee for review and comment.

Thrive’s leadership reaches out to customers within 48 hours of closing to address any concerns and solicit customer feedback. Thrive also shares customers’ feedback with trade partners in multiple forums, including a vendor council, vendor appreciation events and meetings.

In the past four years, Thrive’s customer satisfaction scores have risen from 79.5 in 2016 to 88.6 in 2019. In addition, Thrive recognizes that referrals from homeowners are a key customer satisfaction indicator. In 2019, Thrive’s “recommend to a friend” customer satisfaction score 90.7, above the national industry average of 88.4, according to Rectanus.

electric bills from \$915 a year to \$452 per year, and generate annual savings of up to \$1,750 per year, compared to a home built to the 2015 International Energy Conservation Code (IECC).

STANDING APART

Thrive has also implemented numerous in-house quality management procedures. The company created an internal Quality Assurance (QA) division to develop continuous improvement across all departments, including construction, purchasing, architecture, warranty and vendor-partner relations.

The department has implemented a QA management program called FTQ360. “This program allows us to document and correct issues during construction, as well as review best practices, through a series of QA checklists at critical stages of construction,” Rectanus says. “All QA checklists are based on manufacturer’s installation guidelines and building science best practices compiled through working with industry experts and product manufacturers. It also generates internal reports that help us find trends



MULTI-LAYER WALLS. Walls feature 5.5 inches of blown fiberglass, sheathed with oriented strand board (OSB) in corrugated house wrap.

THICK BLANKET. The vented attic is insulated with 17 inches (R-50) of blown insulation.

ROCK SOLID. An insulated slab sits on a 4-inch base of clean gravel topped by a vapor barrier.

COURTESY OF THRIVE HOME BUILDERS

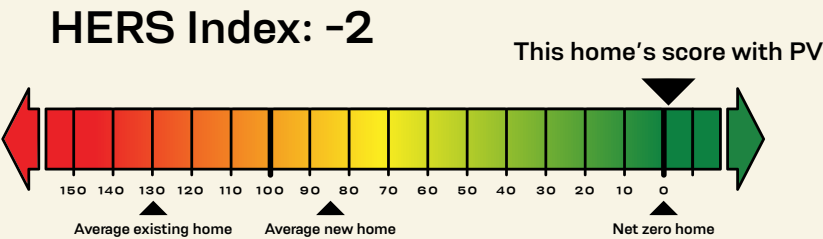


Net (very) positive. The United Way of Long Island's building information-modeled home is expected to save the homeowner more than \$400 a month in utility costs.

CREDIT: UNITED WAY OF LONG ISLAND

Project Info

- DESIGN:** United Way of Long Island, Deer Park, New York, unitedwayli.org
- BUILDER:** Rick Wertheim
- COMPLETED:** June 2020
- CATEGORY:** Affordable Multifamily

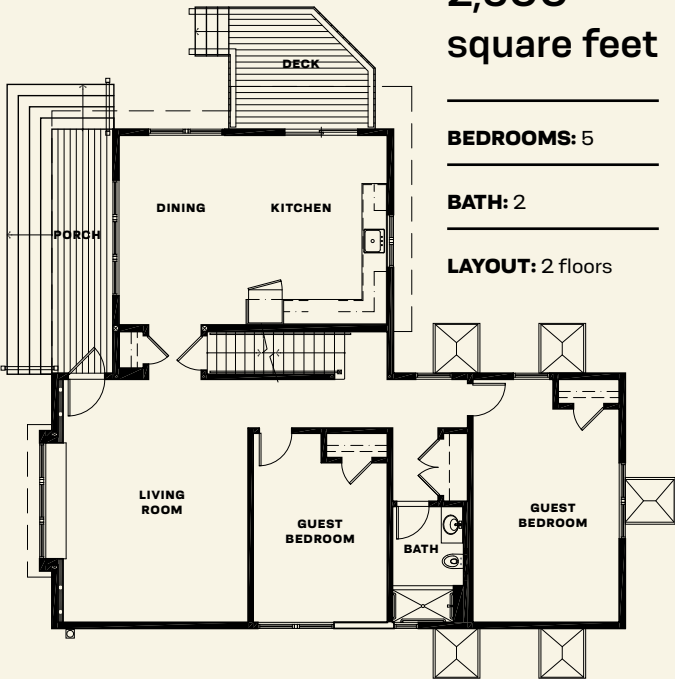


Size:
2,500
square feet

BEDROOMS: 5

BATH: 2

LAYOUT: 2 floors



Data-Driven Performance

United Way's way of getting things done right? Getting help from professional data analysis of the projected design's performance.

THE CONCEPT of building information modeling (BIM) has been around since the 1970s. Nearly half a century later, it's coming into its own within the construction industry.

BIM produces integrated three-dimensional renderings of every aspect of a home, including framing, HVAC, plumbing and electrical. It allows a construction team to visualize how components fit together, giving team members a better understanding of the end product. They can see potential conflicts in sequencing of construction steps, and potential problem areas such as maintaining a continuous air and thermal barrier around a home's conditioned space.

United Way of Long Island, New York, used BIM to successfully visualize construction of its five-bedroom, two-bathroom, two-story home in Port Jefferson Station, New York. The 2,500-square-foot house earned a grand award in the U.S. Department of Energy (DOE) Zero Energy Ready Home (ZERH) 2020 Housing Innovation Awards (HIAs).

"This is the first project United Way has constructed using BIM," says Rick Wertheim, senior vice president of Housing and Green Initiatives for the United Way of Long Island Housing Development Corporation, a nonprofit organization that builds or renovates about six homes per year for its nonprofit partners. The

agency has constructed 21 homes certified to DOE's ZERH program. It has won six HIAs and five grand awards in the affordable homes category since 2015.

The winning home achieved a Home Energy Rating System (HERS) score of 37 without photovoltaic (PV), or -2 with PV, enough to power the home and an electric vehicle. The home is expected to save about \$5,300 a year in utility costs, which is critically important to the nonprofit agency that owns the home, according to Wertheim.

NOTHING BETTER THAN BIM

The design included a novel attic truss specifically crafted to accommodate a ducted mini-split heat pump tucked into



Average Monthly Energy Bill

\$0

Calculated



Annual Savings

\$5,250

Calculated versus typical new homes

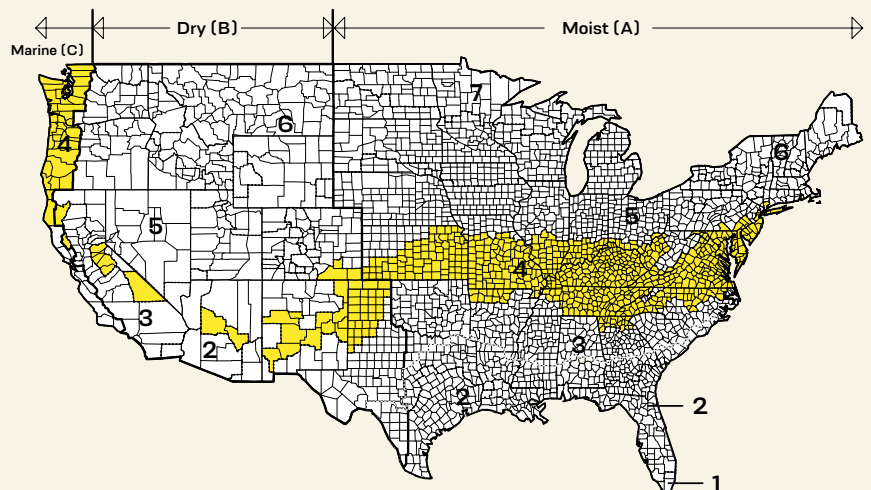


Saved in the first 30 Years

\$218,800

Includes fuel escalation rates,
2019 EIA Energy Outlook

Climate IECC,4A, mixed-humid



Key Features

AIR SEALING: 1.7 ACH 50.

APPLIANCES: ENERGY STAR refrigerator, dishwasher and clothes washer.

ATTIC: Vented attic: 14-inch R-50 blown-in fiberglass on flat ceiling; 18-inch R-65 blown-in fiberglass in vaulted roof; trusses incorporate mechanical chase insulated to R-50 with 3-inch spray foam and R-30 batt.

ENERGY MANAGEMENT SYSTEM: Smart thermostat is Wi-Fi and voice controlled.

FOUNDATION: Insulated basement: 8-inch concrete walls; elastomeric water proofing; 2-inch graphite EPS.

HVAC: Ducted and ductless mini-split heat pumps; 9.6 HSPF; 15.5 SEER.

HOT WATER: Heat pump water heater; UEF=3.7; 80-gallon central manifold and PEX piping.

LIGHTING: 100 percent LED with motion sensors; daylighting with interior windows.

ROOF: Truss gable roof: coated taped 5/8-inch OSB sheathing; ice and water shield fiberglass composite shingles; standing seam metal roof.

SOLAR: 9.2 kilowatt rooftop panels.

VENTILATION: ERV separately ducted; indoor air quality sensor; MERV 13 filters; dehumidifier.

WALLS: 2-by-6, 24-inch on center, R-33 total: closed cell spray foam plus blown fiberglass; 1-inch rigid EPS topped by 1/2-inch OSB; textured house wrap; spruce and engineered wood siding and trim.

WATER CONSERVATION: EPA WaterSense fixtures and toilets; drip irrigation; driveway.

WINDOWS: Thin triple-pane, argon-filled, low-e2, vinyl, casement style, U=0.18, SHGC=0.22.

OTHER: Accessibility features; all paint is low- or no-VOC; CARB compliant wood; walls are "flash" sealed with spray foam, which also seals the attic ventilation baffles to the top plates.

an insulated chase in the vented attic. Using the building information modeling tool was "very helpful for getting everyone on the same page" regarding schedule and sequencing of trades, and a great help in preparing for crucial pre-construction team meetings, Wertheim notes.

In addition to visualizations, BIM software can generate a bill of materials and a critical path schedule that allows labor productivity to be tracked at an activity and trade level. The software sends out an automated text message to each individual trade foreman with a simple question at the end of each workday (e.g., "Is the second floor interior framing 50 percent complete? Yes or No?). When they respond, the schedule is automatically updated. If the answer was "no," the follow-up question is "what percentage is complete?" followed by "what was the cause of the delay?"

Every step from that point is automated via a simple text-messaging interface. The builder and trade partners receive automated construction instructions, and can see updated schedules.

WALL TO WALL EFFICIENCY

A DOE Zero Energy Ready-certified all-electric home should be low maintenance, and this one is, according to Wertheim. The home's walls are sided with an easy-care engineered wood siding product. The walls are constructed of 2-by-6 studs installed at 24 inches on center. They incorporate advanced framing techniques to reduce the amount of lumber needed and to provide more room for insulation.

A 1.125-inch graphite-enhanced expanded polystyrene (EPS) rigid foam insulation board wraps the studs, and is covered with half-inch oriented strand board (OSB) sheathing that is installed with 3-inch construction screws for increased wind resistance in this high-wind-zone location. A coating of closed-cell spray foam is sprayed on the inside face of the EPS in every wall cavity. The rigid foam, spray foam and blown fiberglass in the wall cavities provide a total wall insulation value of R-33.

The builder achieved a low air leakage of 1.7 air changes per hour at 50 Pascals

(ACH 50), with exceptional air sealing practices spray foaming the wall cavities, installing gaskets at the top and bottom plates, and installing rigid foam blocking between trusses at the eaves. All interior wall top plates were spray foamed after the ceiling gypsum board was installed. The floors were air-sealed at the rim joists with closed cell spray foam where the gasketed plates and floor joists meet the foundation wall, and all floor-to-floor penetrations and bypasses were gun foamed or fire caulked.

The exterior frame sits on 8-inch poured concrete foundation walls protected with a roll-on capillary break over the footings, and an elastomeric foundation water proofing on the exterior of the walls. These are then wrapped with two inches of EPS graphite-enhanced foam insulation. The above-grade portion of the EPS is protected with fiberglass-reinforced panels.

The main gable roof is topped with architectural asphalt shingles over a coated 5/8-inch OSB sheathing product that is taped at all seams; an ice-and-water shield provides additional protection at eaves and rakes. Two shed roof sections are topped with highly reflective standing-seam metal roofing over a full shield coverage. The shed roof tops a vaulted ceiling with 18-inch parallel chord roof trusses at 24 inches on center, along with 14 inches (R-50) of fiberglass loose-fill insulation. The gable roof has raised heel roof trusses to allow full coverage of the 18 inches (R-65) of blown fiberglass over the top plates in the vented attic.

This attic space lies over a flat ceiling in the second floor and has uniquely designed roof trusses that provide a 2-by-4-foot attic chase just large enough to house a ducted mini-split heat pump with short ducts that reach to the second-story bedrooms. The chase is made of 5/8-inch drywall and encased in 3 inches of closed-cell spray foam plus R-30 of batt insulation, for an R-50 insulated and air-sealed chase that is thermally connected to the living space of the home. A second ducted mini-split heat pump in the conditioned basement serves the main floor. Both heat pumps have a heating efficiency of 9.6 HSPF and cooling efficiency of 15.5 SEER.



SOMETHING (NOT) IN THE AIR

A whole house dehumidification system was installed for swing-season humidity control. The home's ventilation system includes an energy recovery ventilator and exhaust fans that are connected to each other and to sensors. It's the first time United Way-Long Island has used such a setup, Wertheim notes.

The energy recovery ventilator (ERV) is ducted separately from the HVAC. The whole house dehumidification is ducted separately as well and communicates via a controller. In addition, the two heat pump air handlers have MERV 13 filters in the return boxes of each blower unit.

All lighting is LED based and motion sensed. Well-placed triple-pane, U-0.18, SHGC-0.22 vinyl-framed windows with argon fill and two heat-blocking low emissivity coatings allow in plenty of daylight, which is conveyed to interior spaces through framed openings in interior walls.

The refrigerator, dishwasher and clothes washer are all ENERGY STAR qualifying. The home has a smart thermostat that is Wi-Fi, voice and smartphone controlled. Designated switches are Wi-Fi and smart home connected. **GB**



Splitting airs. The home features a pair of mini-split heat pumps—one in the attic, one in the basement—to improve overall internal temperature control. The two units combine for a heating efficiency of 9.6 HSPF and cooling efficiency of 15.5 SEER. CREDIT: UNITED WAY OF LONG ISLAND



TIGHT WALLS. Exceptional air sealing practices mean low air leakage of 1.7 air changes per hour at 50 Pascals (ACH 50).

SUPER GLAZINGS. Triple-pane, U-0.18, SHGC-0.22 argon-filled windows provide two heat-blocking, low emissivity coatings.

STRONG FOOTING. The exterior frame sits on 8-inch poured concrete foundation walls.



Elevated goals. BPC Green Builders nabbed a Custom Homes for Buyer (more than 2,500 square feet) category award for its hillside Passive House in North Stamford, Connecticut. COURTESY OF NEWPORT PARTNERS



Winning intuition? This Brenner model from Delaware-based Insight Homes is up for Grand Award honors in the Production Homes Category. COURTESY OF NEWPORT PARTNERS



Natural feeling. [bundle] design studio joins the cast of Housing Innovation Award winners with its entry in the Attached Homes category. COURTESY OF NEWPORT PARTNERS

First Look

Here are the homes up for top honors at DOE's 2021 Housing Innovation Awards.

BY GREEN BUILDER STAFF

For eight 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 feature 29 homes from 27 builders across 14 states. Winners of this year's competition were selected for each of six main award categories in August, and a Grand Winner was announced from each category during the [Energy & Environmental Building Alliance High Performance Home Summit](#) in September (results were not available at press time).

More about these award-winning homes may be found at the [DOE Tour of Zero site: \[energy.gov/eere/buildings/doe-tour-zero\]\(https://energy.gov/eere/buildings/doe-tour-zero\)](#)

Affordable Homes

HABITAT FOR HUMANITY SOUTH SARASOTA COUNTY, Venice, Florida

HAYNES CONSTRUCTION, Seymour, Connecticut

LOPEZ COMMUNITY LAND TRUST, Lopez Island, Washington

UNITED WAY OF LONG ISLAND, Deer Park, New York

Attached Homes

[BUNDLE] DESIGN STUDIO, Bellingham, Washington

CLIFTON VIEW HOMES, Coupeville, Washington

GARBETT HOMES, Salt Lake City

PHILGREEN CONSTRUCTION, Fort Collins, Colorado

TARGA HOMES, Seattle

Custom Homes for Buyer (less than 2,500 square feet)

TC LEGEND HOMES, Bellingham, Washington

TIM O'BRIEN HOMES, Pewaukee, Wisconsin

S.D. JESSUP CONSTRUCTION, Pilot Mountain, North Carolina

ZERO NET NOW, Esopus, New York

Custom Homes for Buyer (more than 2,500 square feet)

BPC GREEN BUILDERS, Wilton, Connecticut

[BUNDLE] DESIGN STUDIO, Bellingham, Washington

DELTEC HOMES AND OLD SCHOOL REBUILDER & CO., Asheville, North Carolina

ENERGY VISION HOMES, Hollis, North Carolina

Custom Homes on Spec

C & B CUSTOM HOMES, Cottonwood, Arizona

CHARIS HOMES, North Canton, Ohio

DWELL DEVELOPMENT, Seattle

MARTHA ROSE CONSTRUCTION, Sedro Wooley, Washington

MODULE DESIGN INC., Pittsburgh, Pennsylvania

RED TREE BUILDERS, Asheville, North Carolina

Production Homes

GARBETT HOMES, Salt Lake City

HEALTHY COMMUNITIES, Williamsburg, Virginia

INSIGHT HOMES, Bridgeville, Delaware

MANDALAY HOMES, Prescott, Arizona

MCSTAIN NEIGHBORHOODS, Denver

THRIVE HOME BUILDERS, Denver

Special Honors

DAVIS SCHOOL DISTRICT, Farmington, Utah



Gasping for Air

When listening to young people talk about what's lacking in their lives, the idea that clean air is precious and in short supply comes up repeatedly.

BY MATT POWER, EDITOR-IN-CHIEF

FIVE YEARS AGO, the phrase “struggling to breathe” probably would have shown up in the obscure footnotes of a few medical journals. But that was before COVID-19, before the suffocation of George Floyd, before the smoke from runaway wildfires reshaped our new normal. We’re all gasping for fresh air.

This past summer, our staff sat down with a group of young people from all over the U.S. to discuss their housing priorities and concerns, with “healthy living” as a baseline. They spoke with a lot of candor about the frustrations of renting older properties; their aspirations for safer, healthier living situations. You couldn’t help but feel their anxiety and concern, as they described living situations where they were caught between toxic wildfire smoke outside their windows, and an indoor environment laced with unvented cooking fumes and poorly conditioned air. It’s hard to get on the treadmill, or work out to “Yoga with Adriene” when your lungs are filled with crud.

As a group, these new homeowners, renters, students and would-be buyers want better building science in their lives. They’re not fooled by cooktop and microwave range hood vents that exhaust smoky vapors back into living spaces. They know what energy recovery ventilators are, although their landlords may not. They know their homes need better insulation, better sealed windows and doors. They’re nobody’s fools.

How do they know? Because they can quantify their discomfort through the lens of new technology. The question of “which came first?” may be academic at this point. They know that their homes are toxic with VOCs and excessive humidity, thanks to [Awair or Foobot](#) air sensors. But they also know that a dry cough that started when the wildfires did has only become worse. Diagnosis and symptoms align all too closely.

For building pros, this awareness is a warning that if you ignore these issues, you could face costly retrofits, even lawsuits down the road. Better to see it as an opportunity: By replacing shoddy ventilation equipment, installing [ERVs](#) and better filtration, most of the legitimate concerns of these young people can be addressed.

This article is the third in a trilogy of special reports on how millennials are reshaping housing and lifestyles. The Millennial Influencer Group was made possible with support from [Lee Industries](#), [Panasonic](#), [Rockwool](#) and [Whirlpool Appliances](#).

If a Tree Falls

"In my house in Maine, drastic temperature changes are a big issue. We have no air conditioning. We used to have a tree, but we lost that—so now, the sun beats in and it's hard to focus because it gets so warm. I go down in the basement to use my treadmill, because it's 20 degrees cooler.

"We have an air monitor, so now that I own a house I've been thinking about fun things like radon and mold. We've also been affected by wildfire smoke, even here. These problems are global, so I sleep at night knowing I'm doing my best on climate justice issues."

KRISTEN FULMER, RECIPRIC, PORTLAND, MAINE



Fine-tuned ERV? Panasonic just released a [new energy recovery ventilator \(Intelli-Balance 200\)](#) that accepts MERV 13 filters, a step toward solving the growing problem of importing smoke from outdoors into the home.

Landlord Re-Education 101

"We're renting an older house in Orlando, so insulation and all-around sealing is something we've repeatedly tried to work with the landlord about...but we say: 'Hey, it's still really hot in here and you're wasting all this energy.'"

HOLLY BRIDWELL, CLIMATE FIRST BANK, ORLANDO, FLORIDA

The Gas Must Go

"We love to cook. But we have an Awair monitor that's shown us one of our biggest obstacles (to healthy living) is cooking with gas. So, we're moving to electric induction cooking. Healthy living to me is a space with privacy, function and good indoor air quality. But mental health is also huge—having space to escape."

CHRISTOPHER MATOS-ROGERS, REALTOR, ATLANTA, GEORGIA

Trapped by Toxic Air

"The one thing I wish I had in my (rental) house is a kitchen exhaust vent that goes to the outside, instead of just blowing fumes around the kitchen.

"What I end up doing is cooking food that won't put out a lot of smells, because there's no exhaust fan, and I don't want to breathe all that stuff. I mostly stick to frozen vegetables and ground turkey. I cook often, but cook the same thing a lot.

"We also have no air conditioning. If you open the windows, it's all smoky outside, so we sit inside and sweat, or breathe terrible air. Thankfully, the smoke doesn't always make it over here to the west side of the mountains."

BRENT WEBB, PERFORMANCE INSULATION ENERGY RATER, SEATTLE, WASHINGTON



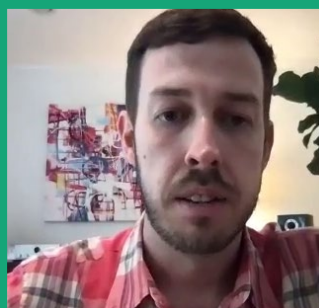
KRISTEN FULMER



HOLLY BRIDWELL



CHRISTOPHER MATOS-ROGERS



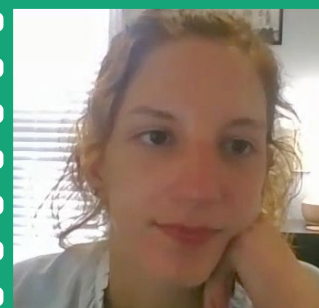
BRENT WEBB



DEAN YOUNG

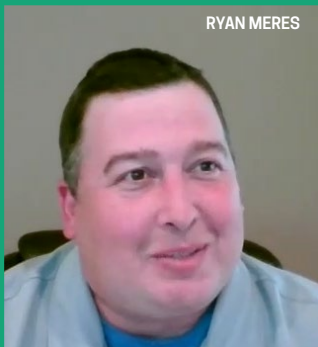


NICOLE LEBLANC





RYAN MERES



JEROME FOSTER II



JON YOUNG



Gasping for Air

"I'm at the stage where I just want more fresh air. My old apartment was 600 square feet with no control. Now I'm renting a house, but still have no control over my indoor air."

"We live in San Francisco, so sometimes I want to open the window. But then the humidity goes up, or wildfire smoke comes in, so it's hard to find a balance. Since I'm renting the house, I can't exactly put an ERV in. I haven't really broached that subject with the landlord."

DEAN YOUNG, AWAIR, SAN FRANCISCO, CALIFORNIA

Longing for Smarter Tech

"I'm trying to work out more, to live a healthier lifestyle. I'd love to have a Nest thermostat in my home, like I did at my last place. I didn't have to think about it. It allowed me to save energy and mental space."

NICOLE LEBLANC, WHIRLPOOL, ST. JOSEPH, MICHIGAN



Digital tools. Smart technology available to millennials has made them more aware of airborne threats.

CREDIT: BILL OXFORD/ISTOCK

Homesteading with a Conscience

"My wife and I are avid cooks. We have a garden, and we get all of our meat from ButcherBox, so it's all grass fed, grass finished, organic chicken. My No. 1 upgrade would be an induction cooktop... that's the last gas appliance I need to replace in order to get off gas completely."

"The worst thing about our home is probably the poor foundation waterproofing. It creates periodic wetness in the basement, which is bad for air quality."

RYAN MERES, PROGRAM DIRECTOR, RESNET

Primed for Transformation

"I live in a dorm in New York City. One thing I wish I had was more space-saving things is my apartment, things that have multiple purposes."

"I'm interested in housing and living and creating communities that have architecture that's in tune with nature, windows that follow the wind pattern, housing that isn't so monotone."

JEROME FOSTER II, EXECUTIVE DIRECTOR, ONE MILLION OF US, NYC

Three Dog Nights

"I have one dog and my partner has two dogs. The problem is that the return grill (for the air handler) is on the ground, so it fills up and clogs with pet hair all the time."

"Aside from that, a kitchen exhaust is definitely on my most wanted list. I don't like how air just creeps in to my place and there's no way to control. In a lot of places in Texas, operable windows are not an option."

JON YOUNG, DVR ENGINEERING CONSULTANTS, HOUSTON, TEXAS



Foul play. Dirty return vents, sometimes due to bad design (floor vents with pets) or lazy landlords can make indoor air even worse.

CREDIT: KOBZEV3179/ISTOCK

Take a Breath and Vent

Microwave exhaust fans are among the most commonly ignored features in today's kitchens. Don't put your health on the back burner: improve your kitchen ventilation for healthier living. **BY MICHELE LERNER**

WHEN ATLANTA REAL ESTATE AGENT Christopher Matos-Rogers and his husband installed indoor air quality monitors to track radon, they quickly learned a big lesson. Cooking without adequate ventilation contributed heavily to the volatile organic compounds (VOCs), PM2.5 fine particulate matter and carbon dioxide (CO₂) in their home.

"Being home during the pandemic put a greater focus on the health and safety of our home's indoor air quality," says Matos-Rogers, a member of Green Builder Media's Next Generation Influencer Group. "Properly venting our over-the-range microwave was done as part of a larger ventilation project we completed early this year, including installing an energy recovery ventilator (ERV) on both floors, upgrading our bathroom exhaust fans and venting the microwave to the outside."

While there are many sources of indoor air pollution, one of the prime culprits is the ubiquitous microwave exhaust fan.

These have been given the appropriate nickname of "forehead greasers" by the expert team at Lawrence Berkeley National Laboratory, which has done in-depth research on how to effectively remove kitchen contaminants, according to Nathan Kahre, business development manager for EnergyLogic in Denver. "Unfortunately, it's still a common practice to install recirculating microwave range hoods that pull air from the cooktop through a small filter and then blow that air back out into the kitchen," says Kahre, a member of Green Builder Media's Next Generation Influencer Group. "They do nothing more than distribute these contaminants far out into the kitchen and the rest of the living space."

SWEEPING DIRT UNDER THE HOOD

No matter how little cooking you do or how neat a chef you are, your stove is one of the dirtiest things in your house when it comes to indoor air quality, says Ken Nelson, northwest regional sales manager for Panasonic Life Solutions in Olympia, Washington.

"Even if you do something as simple as boil a piece of spaghetti, you're creating vapor that includes the starch from the spaghetti," says Nelson. "When you inhale it, you're also inhaling the outgassing from other materials in your home that cling to the vapor, all of which ends up in your lungs and can cause health issues."

Cooking is one of the largest producers of fine particulates and VOCs in our homes, says Kahre.

Among the pollutants found in cooking emissions are particulate matter, nitrogen dioxide, carbon monoxide and toxic chemicals such as formaldehyde and polycyclic aromatic hydrocarbons,

Invisible dangers. Cooking at the kitchen range sends health-threatening materials into the house—pollutants that include fine particulate matter, carbon monoxide and nitrogen dioxide.

CREDIT: FG TRADE/ISTOCK

according to “Reducing Exposure to Cooking Pollutants: Policies and Practices to Improve Air Quality in Homes,” a report by the Environmental Law Institute. Health impacts associated with these pollutants, especially particulate matter, include cardiovascular disease, respiratory disease and cancer, according to the report.

Unfortunately, a microwave fan doesn’t exhaust most particulates, says Nelson.

HOME ON THE RANGE—BEST PRACTICES FOR RETROFITTING

The simplest solution to control contaminants is to remove them from the home at the source with a range hood, says Kahre. Some modern microwaves do vent to the outdoors, but “none can do this as well as a range hood.”

Range hoods that vent to the outdoors are considered more effective than other kitchen exhaust system types, particularly ductless or recirculating range hoods that use a filter before blowing the air back into the room, according to ELI’s report.

In a new construction home, venting a microwave fan or a more-traditional range hood is simple, since premade exterior vents and standard ductwork make most vents easy to vent, says Kahre.

RETROFITTING EXTERNAL VENTING IS MORE CHALLENGING

“The toughest thing about retrofitting a range hood is the ductwork,” says Nelson. “If you have a 10-foot-high ceiling, that might work. But if you have an 8-foot-high ceiling, you might have to cut through the attic.”

A range on an island or an interior wall makes running ductwork

outside more difficult and can require drywall demolition or relocation of the range, notes Kahre. “Anything that can create air movement up and across the face of the pan will be better for removing contaminants even at lower speeds,” he says. “Under cabinet or island hoods often have difficulty creating this effect, especially when large pots are placed on the back burner, blocking the air flow.”

When selecting a range hood, Kahre recommends looking for one that vents outside and doesn’t recirculate air; one that is large enough to cover as much of the stove top as possible; and one that operates quietly enough that people will be more likely to use it. He says quality range hood prices range from \$250 to more than \$1,200, depending on the size, materials and functionality. A contractor would need to install the range hood for proper ducting.

Matos-Rogers hired an HVAC company that specializes in designing systems from a building science perspective for their ventilation project. Ventilating the microwave took less than one day and cost about \$1,500.

“This seems fairly typical, though less-complex retrofits could cost less,” Matos-Rogers says. “Our microwave isn’t located on an exterior wall and couldn’t be vented through the roof, which required running a longer duct to an outside wall. The contractors had to remove the microwave to cut a hole in the cabinet for the ducting, and then it went right back in place when they were finished. We just had to order the manufacturer’s adapter to connect the ducting, as it had been discarded during the original installation.”

MANAGING NOISE POLLUTION

Regardless of the type of range hood or exhaust fan you have in your kitchen, it is useless unless you use it. A recent study by the Center for Real Life Kitchen Design at Virginia Tech found that only 8 percent of people use their range hood regularly. Twenty-three percent use it almost never or only occasionally. For many people, the fan is just too noisy.

Panasonic’s [WhisperHood IAQ](#) range hood, which is part of the company’s [Cosmos Healthy Home System](#) indoor air quality line of products, offers an extremely quiet kitchen ventilation system.

“Fan noise is measured in sones, with an older kitchen fan typically measuring 6 or 7 sones,” says Nelson. “The *WhisperHood* range hood can be as quiet as 0.3 sones, depending on the speed.”

While it’s best to address pollution at the source in the kitchen, Nelson says installing a fan in a nearby powder room or other room can help pull pollutants from the air.

“Panasonic makes a bathroom fan with a trigger that automatically turns the fan on and off when it senses moisture in the air,” Nelson says. “They’re easy to install and quiet and help pull moisture and pollutants. No range hood is as quiet as a bathroom fan, so that’s why we recommend putting bathroom fans in nearby rooms. You don’t want an automatic trigger on your range hood to start it up at 2 a.m.”

For Matos-Rogers, spending the time and money to install an exterior vent on the microwave was worthwhile. “Tracking trends on the IAQ monitors gives us verifiable data,” he says, “while our senses notice the lack of smoke buildup and lingering smells from cooking.” **GB**



Need to vent. The typical recirculating range hood does little more than pull air from the cooktop through a filter and then back into the kitchen. The more-efficient, safer models vent outside and do not recirculate air.

CREDIT: ANDRII ATANOV/ISTOCK



QUIET, EFFICIENT, GREEN

Austin's heat and the combined forces of allergies and her dogs are no match for the cooling systems in Tiana Cooper's ReVISION house.

BY MICHELE LERNER

REDUCING HER ENVIRONMENTAL FOOTPRINT was the top priority for millennial influencer Tiana Cooper when she planned to remodel her Austin, Texas home. But, resiliency is also extremely important. "I want to be self-sufficient so that if there's a power outage like the one Texas experienced earlier this year, I won't be out in the cold," she says.

Cooper chose LG's 350-watt NeON 2 solar modules to provide a reliable source of power for her home and electric vehicle (EV). In addition, she opted for a multizone heating and air conditioning system, which works together with Greenfiber insulation for an energy-efficient, comfortable home. The central vacuum system from H-P Products provides indoor air quality benefits as well as easy cleaning, and the LiftMaster garage door opener provides ventilation and safety benefits whether Cooper is at home or away.

"Like most people, I'm just really busy with work and travel, so the most important thing about this house remodel is that all the products work together as a system and can be accessed remotely," says Cooper. "It makes it super easy to live here and will save me money on utility bills in the long run. These energy-efficient, smart technologies will help me make sure the house performs optimally."

What do millennials want when it comes to housing? We've got the rare, up-close inside scoop! [Follow Tiana](#) as she traverses the home shopping, buying and renovating process, with *Green Builder's* expert advice on her side.

All facts and figures come from COGNITION data. To learn more, visit: greenbuildermedia.com/cognition-smart-data



Millennials lead the home improvement charge, with approximately **82% implementing at least one home improvement project** this year.

Adaptability of HVAC system

Triple-digit temperatures and humidity are the hallmarks of an Austin summer, but even the mild winters were uncomfortable in Cooper's house. She realized the decades-old HVAC system wasn't working well.

"It didn't have zoning, so there would be parts of the house that were super freezing or hot," says Cooper. "Plus, I was paying a lot in utilities."

Cooper travels often and doesn't always use every part of her house, so it didn't make sense for the environment or her budget to condition areas of the house that were unused. She selected two indoor systems, one to retrofit into an existing ducted system and a second ductless system, both connected to the outdoor heat pump.

"We installed the ductless indoor system into the largest pantry I've ever seen," says Terry Frisenda, executive sales manager at LG Electronics. "When Tiana travels, the dogs stay in the pantry, so it's smart to be able to cool that room individually and raise the temperature in the rest of the house."

Technology makes it easy to change systems and create new zones with ductless or ducted systems, says Frisenda.

"We've solved one of the oldest struggles of heating and air conditioning, which was uneven temperatures not only from one level to another in a house but even from one end of a large ranch house to another," says Frisenda. "Ductless systems can easily be used to individually manage temperatures. Instead of running a larger system, you can consume less energy with individual systems."

In addition, the inverted compressor installed by LG uses less power than a standard heat pump because it runs at variable speeds rather than via a simple on and off switch. The system provides more-stable temperatures and requires less backup power, meaning fewer solar panels and a smaller generator are needed to run the HVAC.

Power down. The inverted compressor by LG uses less power than a standard heat pump because it runs at variable speeds. The system provides more stable temperatures and requires less backup power, meaning it would require a smaller generator to power the HVAC should the power go out.

COURTESY OF LG ELECTRONICS



ACCORDING TO A RECENT SURVEY OF REMODELERS, CONSUMERS ARE INVESTING IN:

Energy efficiency retrofits:

- Installing solar
- Installing super-efficient heat pump water heaters and HVAC systems
- Installing EnergyStar appliances
- Installing smart thermostats and energy monitoring systems
- Replacing old roofs with energy efficient metal and/or cool roofs
- Sealing attic venting
- Putting ducts inside conditioned space
- Adding a radiant barrier

Water retrofits:

- Installing LED lighting and natural lighting via tubular skylights
- Replacing inefficient windows and doors
- Upgrading pool pumps to more efficient models

Indoor Air Quality retrofits:

- Upgrading vent fans and range hoods
- Installing ERVs and whole-home air filtration systems
- Installing proactive IAQ monitoring systems



**Up to 20%
can be saved**
on heating and cooling
bills with a new energy
efficient system.



Backup plan. Solar modules from LG Electronics means Cooper is less reliant on the electric grid in Texas, which has been particularly plagued by rolling power outages. Shown here is the installation of LG NeON 2 350-watt modules by NATIVE Solar.

COURTESY OF NATIVE SOLAR

Supplemental sun power

Cooper opted for solar modules from LG Electronics to reduce her dependence on the sometimes-unreliable electric grid in Texas, which has been plagued by rolling brownouts and blackouts, as well as the devastating failure of the grid during the unusual ice and snow storm early in 2021.

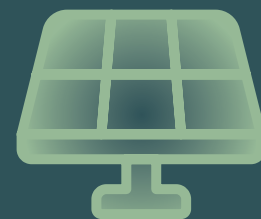
“Tiana had two overarching goals for her home: to get it as close to being net zero as possible and to future-proof the home to make it more resilient,” says Brian Lynch, director of solar and storage for LG Electronics.

Cooper’s home has a large south-facing roof, which is ideal for generating solar power.

“The solar modules we produce now have a better design, with wires instead of ribbons. These are more beautiful, and they absorb more light,” says Lynch. “New technology has drastically reduced the cost of solar modules while increasing their efficiency.”

While 440-watt modules are now available, Cooper chose to install 35 LG NeON 2 350-watt modules because they produce plenty of electricity at a lower cost. Lynch estimates that Cooper’s electric bills will be near zero or have a negative balance over the course of a year.

LG’s solar panels are designed for sustainability and guaranteed to produce at 90 percent of its capacity at the end of 25 years, compared with the 80 percent of capacity of most solar panels, says Lynch.



52% of millennials have implemented remodeling projects

that have increased home performance and sustainability, including installing solar panels, smart lighting, eco-friendly appliances, and heat pump technology.



Big dividends. Greenfiber's 85 percent post-consumer recycled paper insulation locks in 1.34 tons of carbon dioxide during the lifetime of the home—the equivalent work of 807 trees.

COURTESY OF GREENFIBER

Insulation offers comfort and sustainability

Adding insulation when remodeling is a standard part of improving energy efficiency, but there's nothing standard about Greenfiber.

"Our insulation is made from 85 percent post-consumer recycled paper, so it starts from a tree, is used by consumers and then recycled for the insulation," says Laura Woodford, director of marketing for U.S. Greenfiber. "The coolest thing is that we sequester carbon, and can lock 1.34 tons of carbon dioxide during the lifetime of the home, which is equivalent to what 807 trees can absorb."

Greenfiber is delivered regionally to cut down on transportation emissions, and developed at an electrically run plant that uses 13 times less energy than it takes to manufacture fiberglass insulation, Woodford says.

While Greenfiber offers sustainability benefits and increases the energy efficiency of any home, Woodford says the *Sanctuary* cellulose insulation product that was installed in Cooper's attic and some interior walls provides wellness advantages, too. It equalizes the temperature throughout the house, gives the peace of mind of fire resistance and provides 60 percent noise reduction.

"When I heard that Greenfiber had the additional benefit of soundproofing, I was sold," says Cooper. "I have a home office near busy rooms and because I do podcasts, I need quiet. Now I can have energy efficiency, and some peace and quiet!"

85%

of millennials said that they would **PAY MORE** for a healthy home.

92%

of millennials believe that **GOOD IAQ** is extremely or very important.

Breathe easier in a cleaner house

The pandemic raised awareness of the importance of improving indoor air quality, says Greg Calderon, vice president of H-P Products.

"Clearly, it's important to talk first about the HVAC system and ventilation, but vacuuming is like a dirty little secret that no one mentions," says Calderon. "The problem is that traditional vacuuming cleans your floor but dirties your air by recirculating the particles the vacuum picks up."

Cooper chose a central vacuum system from H-P Products, which pipes everything the unit picks up into a container in the garage. It only needs to be emptied once or twice a year, says Calderon. "I have allergies and dogs, and the combo of those two things can definitely cause suffering, particularly through high allergy season," says Cooper. "I wanted to make sure I was doing everything possible to improve my air quality."

H-P's central vacuum system in Cooper's home has retractable hoses in every room, which "clean at the speed of light because they have a larger motor than a portable vacuum," says Calderon.

"Another reason I picked H-P's central vacuum is because of the convenience," says Cooper. "When I clean, I'm flying around the house, so I love the fact that I don't have to lug hoses around. They retract right into the wall."



IAQ is now seen by early-adopter and first-mover millennials

as a fundamental homeowner right, and is as important as location to some homebuyers.



Millennials are particularly aware of health and wellness, and they're looking for non-toxic products, antimicrobial surfaces, and proactive IAQ systems that will keep their homes healthy.



Clean house, healthy air. The retractable hose of the H-P Products central vacuum system offers a convenient way to keep allergens to a minimum in today's homes.

CREDIT: COURTESY OF H-P PRODUCTS



High-tech garage features

Tech innovations such as a security camera and smart home connectivity mean that LiftMaster's accessories do more than just open the garage at Cooper's house.

"I use the garage as flex space for hobbies and also to store important items, so I wanted to be able to check on the space when I'm home and away," says Cooper. "The LiftMaster camera allows me to do this from my phone. I want to feel safe and secure, and this is a simple solution for that."

The camera can be connected to the *myQ* smart home app so it can be operated remotely, says Melissa Foley, principal of strategic relations for Chamberlain Group, which manufactures LiftMaster garage accessories.

"You can get an alert if someone tries to open your garage door and you'll have video to share with the police if needed," says Foley. "The app can be connected to the Amazon Key In-Home Delivery service, which lets you get packages delivered to your garage. Or, you can remotely open your garage for deliveries."

LiftMaster anticipates adding indoor air quality innovations in the future. "People often store pesticides, chemicals and paint in their garage, but they also sometimes use the space for hobbies and exercise," says Foley. "We're designing sensors to test the air for allergens, dust and carbon monoxide so that homeowners will know when they need to ventilate the space."

For now, sensors monitor the temperature in the garage and can be set to open the door to increase air flow. "A really cool thing LiftMaster offers is the ability to raise the garage door a little every hour so the space gets a fresh air exchange," says Cooper.

Whether Cooper is working at home or traveling, she has the peace of mind that comes with knowing the systems in her house seamlessly and smoothly function to maintain her comfort and safety. **GB**

Front-line defense.

LiftMaster's garage door opener system includes a security camera and smart home connectivity. The system can send alerts to a smartphone and allows remote access for deliveries.

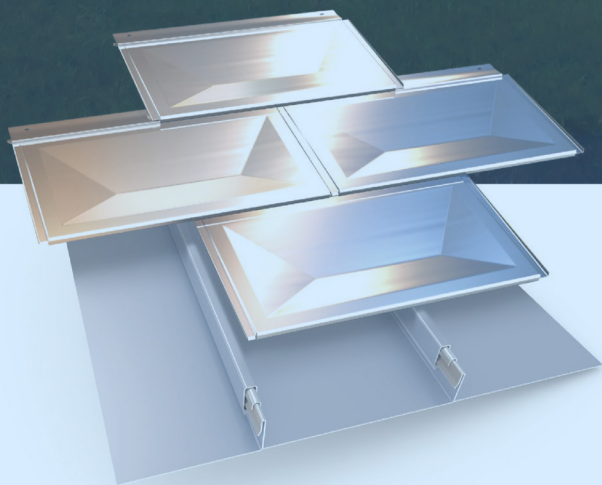
COURTESY OF LIFTMASTER

Be Different



"I'm always looking to do something different. When I saw the cupped metal tiles, I said, 'Wow, I want to use this on my residence!'"

-Tom Deignan, Homeowner



Private Residence, PA Contractor: Mount Vernon Roofing Architect: 3GHC Architects
GC: Amicus Construction Photo: hortonphotoinc.com

Precision Series Tiles cupped
Metal Wall System in Bright Annealed

Snap-Clad
Metal Roof System in Weathered Zinc



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HOUSING 2.0

The Secret to Client Loyalty? Overdeliver.

A product's success depends
on meeting or exceeding
customer expectations through
five critical user experiences.



BY SAM RASHKIN

This is Sam Rashkin's second in a series of articles based on his second book, "Housing 2.0: A Disruption Survival Guide." It is intended as a roadmap for high-performance builders to become the most successful in the industry.

IT WAS 2008 AND THE INDUSTRY I LOVE, HOUSING, was confronted with another downturn. Yes, downturns are inevitable, but this one was devastating. In fact, the bottom had virtually fallen out, with an 85 percent reduction in housing starts in many of the nation's largest markets (e.g., Arizona, California, Florida, Nevada and Georgia). They call the 2007 to 2009 period "The Great Recession" for good reason.

I was national director for ENERGY STAR Certified Home during this period, and we were in the midst of moving the housing industry from Version 1 to Version 2 specifications. This was the first significant program change in a decade. The key new mandatory building science requirement was the Thermal Bypass Checklist, which identifies comprehensive air barriers throughout the home. I had just finished a series of West Coast 1-day training courses on the new specifications and



Secret benefactor.

Four out of five existing homes purchased are ones where the name of the home building company is rarely known, partly due to lack of builder name recognition among buyers.

CREDIT: KATE_SEPT2004/ISTOCK

boarded my return flight home exhausted. And then I bolted up in my seat.

After months observing residential projects across the country, an urgency for the housing industry to deliver a total user experience consumed me. It was a sudden moment of clarity that high-performance alone would not have a meaningful impact on the success of the builders I had come to know and care about. In other words, our massive effort to transform home builders to one more critical building science best practice would ultimately have minimal impact on their business outcomes.

I realized the success of any product depended on meeting or exceeding customer expectations for five critical user experiences:

- **COMPANY:** Shared values.
- **DESIGN:** Product appearance.
- **PERFORMANCE:** Product functionality.
- **QUALITY:** Product fit, details, and durability.
- **SALES:** Support and service.

Although this framework represents a personal assessment, subsequent research validated a new user experience imperative. However, my generic product user experience framework had to be tweaked for housing. Decades of observations suggest consumers know very little about home building companies until it's time

to buy. This is the result of two factors unique to the industry.

First, research suggests people only purchase homes about three times during their lifetimes. Moreover, more than 80 percent of homes purchased are existing homes where the name of the home building company is rarely known, typically not a prominent factor in the decision process, and not involved in the transaction. Of course, this begs the question: Why is the home builder company not prominently featured on an existing home? We will put this aside for now and discuss it in a later article on owning customers for life.

Second, there is a general lack of brand recognition for most home builders. This is because they are often small regional companies and are not well-known outside their communities. The large national builders, meanwhile, often have too much variation in their product among geographically dispersed divisions to have a strong, consistent corporate brand promise.

Given such infrequent life moments where consumers are engaged with a housing industry not grounded in strong brand awareness, home buyers usually do not begin the process with significant "Company" expectations. Thus, the "Company" experience doesn't translate to homebuying as it does to most other products. Instead, it becomes part of the sales process where an individual builder has to earn home buyers' trust that their company delivers great product value and service. This will also be discussed in a later article.

The well-known real estate industry sales mantra "location, location, location" suggests that the community experience unique to housing may be the most important when buying a home. And this makes sense, since you can always upgrade a home, but the neighborhood amenities and culture that profoundly impact everyday life and future value are completely out of each resident's control. Thus, "Community" replaced "Company" when developing the housing user experience benchmarking tool introduced in my first book, "Retooling the U.S. Housing Industry." See Figure 1 below.

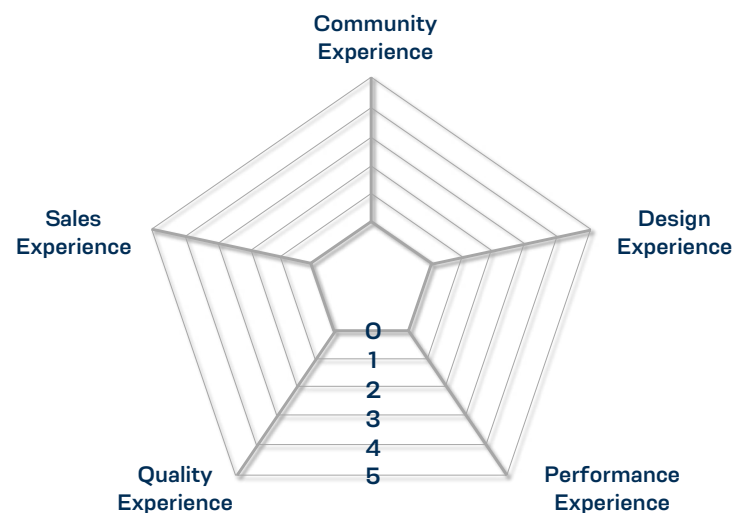


Figure 1

If housing is the ultimate consumer product, it could be surmised that the industry is best positioned to maximize profits by meeting and exceeding user experience expectations. And since home buyers are getting exponentially more informed, it also stands to reason that home builders cannot deliver a “3-star or less” user experience without significant negative impact on their

ability to attract new customers and charge higher prices. Thus, home builders need to score well on all key user experiences.

This epiphany was a wake-up call. The home using experience I was using experience I was personally observing on projects representing 10,000s of homes was substantially sub-optimized from widely available best practices. My user experience benchmarking profile for the industry at large, based on decades of extensive engagement, see Figure 2. Admittedly, I am a tough judge. But I let the low user experience scores reflect a belief there is a huge opportunity for improvement and better business outcomes. It is always best to be positive.

Starting with this average benchmarking score for a typical home builder, all that would be accomplished successfully promoting ENERGY STAR Certified Home certification across the nation is a small bump in the “Performance Experience” as shown in Figure 3.

However, observations from other industries suggest devastating outcomes where businesses fail on just one key user experience. Consider these examples:

- **COMPANY EXPERIENCE** failure: When Volkswagen did not accurately report diesel emissions and created huge litigation expenses and a crisis of confidence in their brand.
- **DESIGN EXPERIENCE** failure: Where Toyota’s first uninspired *Prius* had weak sales compared to impressive growth following the introduction of a much more unique and compelling design appropriate to this truly transformational vehicle.

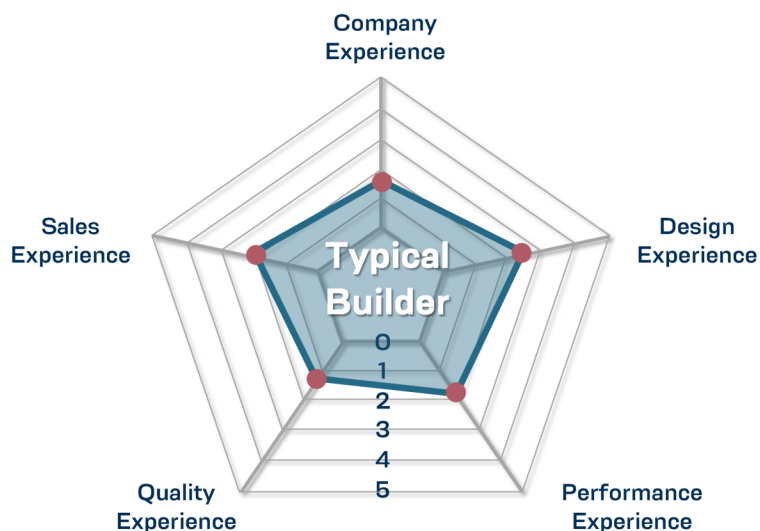


Figure 2: Housing user experience optimization scores for typical builder

HOUSING 2.0 SPONSOR SPOTLIGHT

The Housing 2.0 program is a comprehensive training and education program designed to teach building professionals how to prepare themselves for the massive transformation that the housing sector is experiencing. The program is helping building professionals design and construct higher-performance, healthier, more-sustainable homes, optimizing the total housing user experience with an estimated 30 to 70 percent hard cost savings/added value.

THE PROGRAM IS GENEROUSLY BROUGHT TO YOU BY THE FOLLOWING PARTNERS:

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se.com/us/en/home

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na.panasonic.com/us/home-and-building-solutions

- **PERFORMANCE EXPERIENCE**

failure: When Samsung Note 7 smart phones had problems spontaneously catching on fire and had a long battle winning back customer confidence.

- **QUALITY EXPERIENCE**

failure: When more than 1,100 people were sickened by tainted food served by Chipotle that has led to a prolonged period to regain substantial sales lost.

- **SALES EXPERIENCE**

failure: When Wells Fargo bank got caught and incurred huge litigation costs overselling investments to meet quotas rather than serve their customers' best financial interests.

All of these failures and their huge impact on business bottom line outcomes demonstrate how critical it is to meet or exceed expectations for all key user experiences. Thus, even though I had the privilege to lead a national program successfully marching towards 2 million-plus ENERGY STAR Certified Homes, my larger goals for moving the industry to great housing were not close to being met.

This awareness has led me to a comprehensive framework for consistently optimizing the housing user experience. Like any new concept, this user experience optimization framework needed to be put through an effective vetting process. This led to more than five years of workshops with hundreds of housing

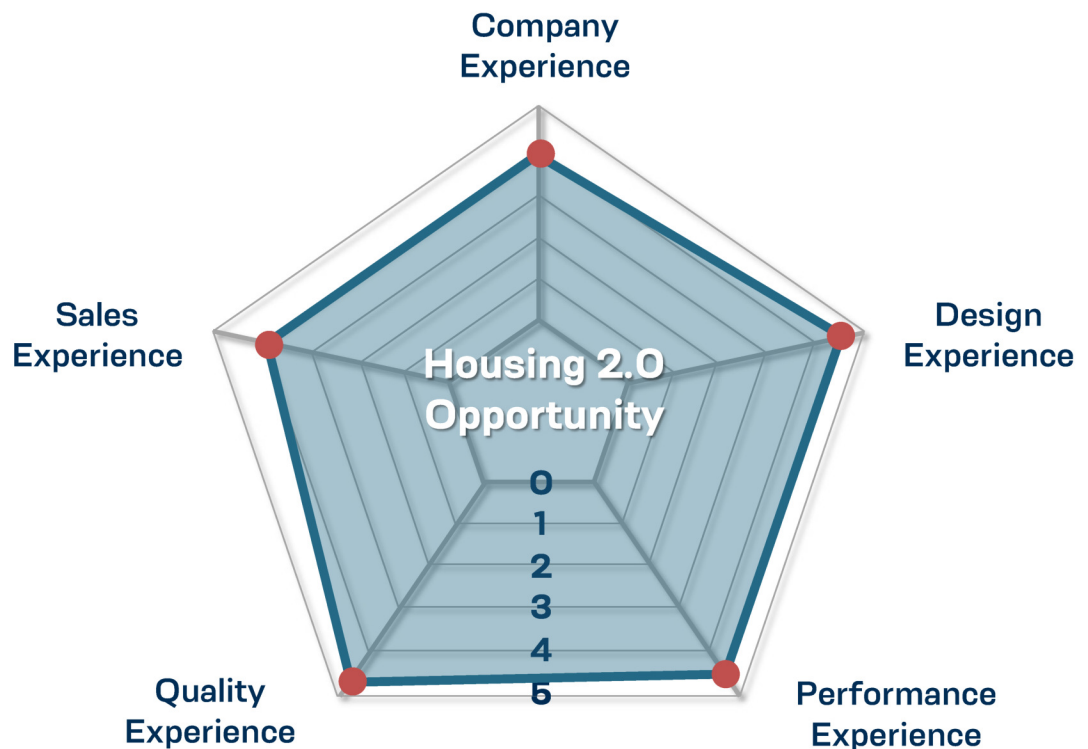


Figure 4: Housing user experience optimization opportunity with Housing 2.0

industry executives based on my first book, “Retooling the U.S. Housing Industry.” This engagement effectively served as a personal research project that has led to my substantially revised and updated second book, “Housing 2.0: A Disruption Survival Guide.”

And like most endeavors, it is a journey that never ends. The guidance provided is intended to help high-performance housing professionals get on their own personal optimization path that hopefully looks like the benchmarking scores shown in the figure above.

Observe that the goals shown are not perfect 5s; they never should be. It is good form to always leave room for continuous improvement. Most importantly, substantially improved business metrics can be expected as leaders in housing user experience distance themselves from laggards. I invite you all to start your own journey and be part of the [Housing 2.0 program](#). **GB**

Sam Rashkin’s two-decade career as a licensed architect includes serving on national steering committees for the U.S. Green Building Council (USGBC)’s LEED for Homes, Green Builder Media’s Green Builder Guidelines, the Environmental Protection Agency (EPA)’s WaterSense label, and EPA’s Indoor airPLUS label. He has partnered with Green Builder Media to develop the [Housing 2.0 program](#), which empowers building professionals to design and construct higher-performance, healthier and more-sustainable homes at a fraction of the cost.

The Housing 2.0 program is sponsored by Mitsubishi Electric, ZIP System™, Panasonic, and Schneider Electric.

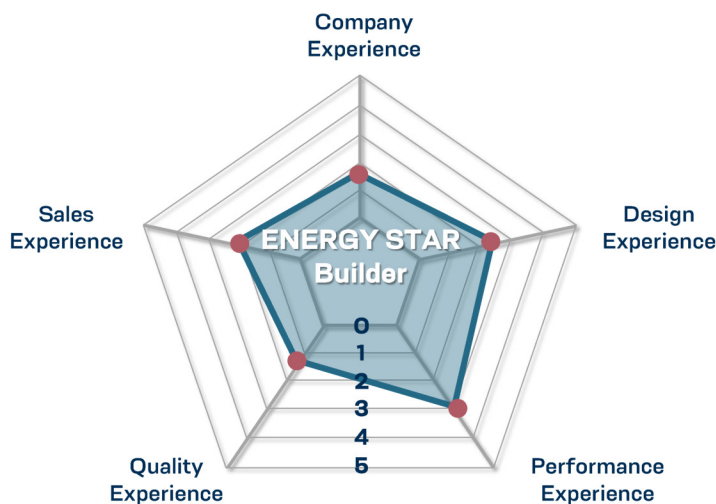
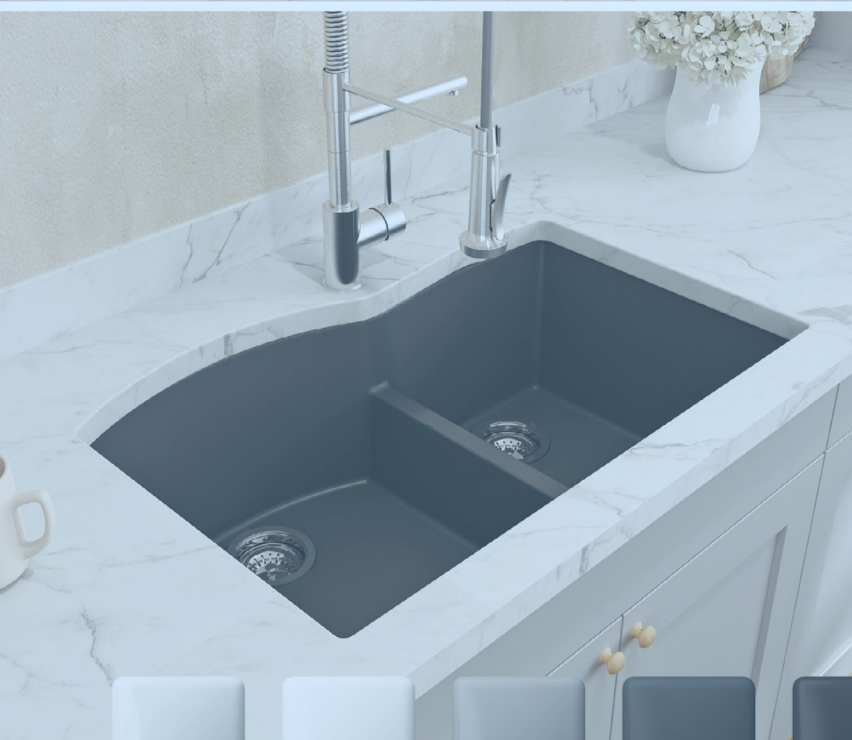


Figure 3: Housing user experience optimization scores for ENERGY STAR Builder

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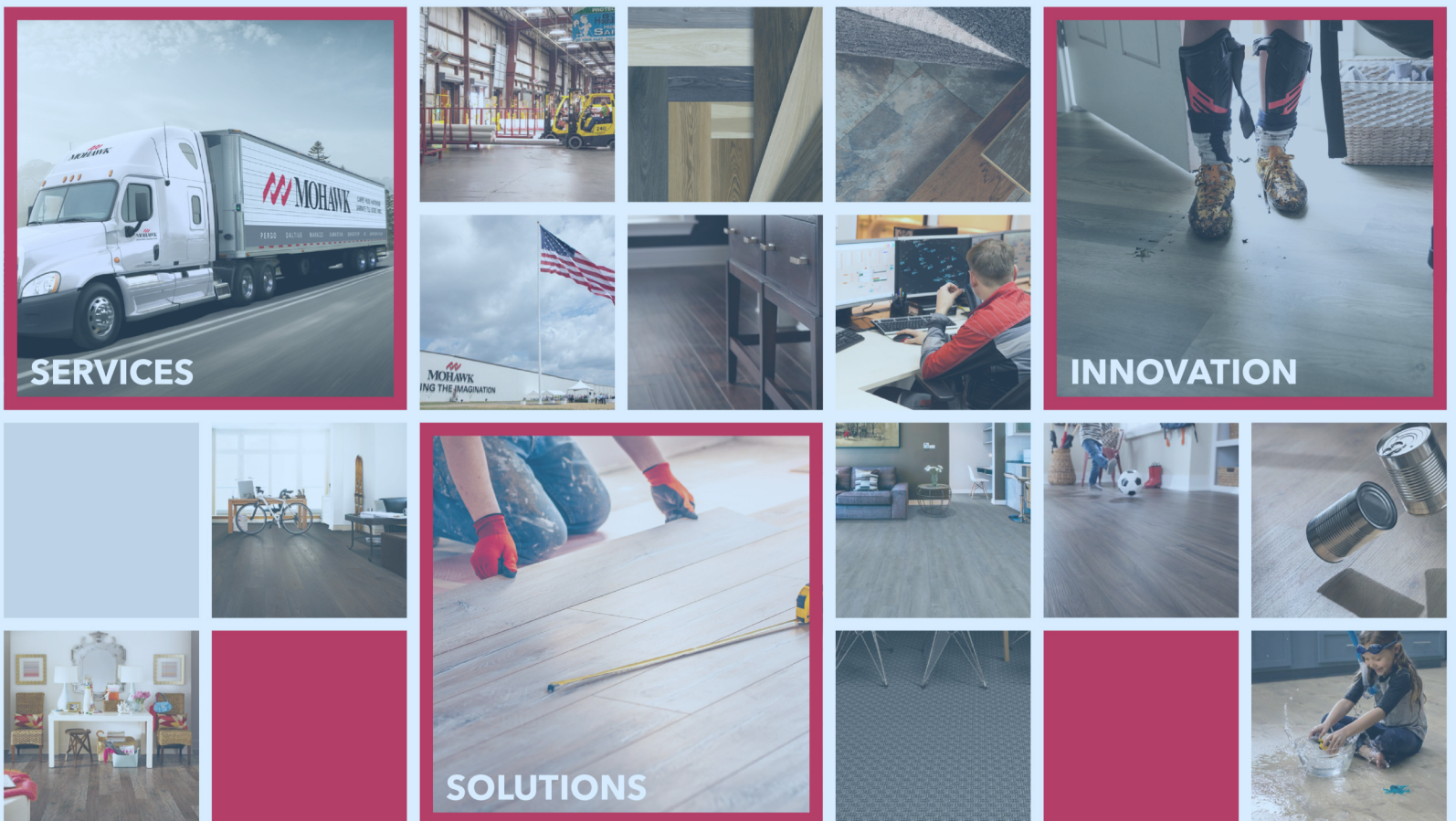
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A matter of timing? The move to ban natural gas in some cities is underway. Now the real question is “how soon?” and “who’s first?” CREDIT: ONURDONGEL/ISTOCK

To Ban OR Not to Ban

BY MIKE COLLIGNON

THE TOPIC OF BANS is usually one that evokes a fair bit of emotion, especially in the U.S., with our Independence Day and Labor Day celebrations. The definition of “ban” is “to prohibit,” which can be viewed as an infringement on personal freedoms. However, a ban usually impacts not just an individual, but also a larger collective group. Banning books has been a way for some entity, group or government to prohibit certain thoughts and ideas from percolating throughout their society. Since the pandemic started, we’ve seen countries enact travel bans to stop the spread of a highly contagious virus. There was even a time when [a band named Guns N’ Roses was banned from a city](#) for

inciting a riot, although that ban was lifted 26 years later.

None of the aforementioned bans had anything to do with the building industry, but we are starting to see a new type of ban that is certainly making its mark on the design and construction of new buildings: a natural gas ban. That sounds somewhat Draconian, so perhaps you’re more familiar with the term “electrification.” And in some places, we’re seeing a counter to this movement: a ban on natural gas bans. How did we get here, and where are we going?

The first jurisdiction to enact a natural gas ban on new construction was Berkeley, California, but they are no longer alone. Other cities such as San Jose, Oakland, San Francisco and Seattle, and dozens of [other communities](#), have passed similar or partial prohibitions. These measures are being adopted as jurisdictions work to meet their respective climate action plans. Many of these plans have called for a state, city or county to achieve net-zero carbon emissions by some benchmark year, whether it be 2040, 2045, 2050, etc.

In the words of one Oakland council member, electrification is the equivalent of low-hanging fruit. “State energy policies and lower prices of renewables mean that substituting natural gas with electricity is one of the quickest, safest and least expensive pathways to eliminating greenhouse gas emissions from

buildings,” Councilman Dan Kalb says. According to a [study commissioned by the City of Oakland](#), 18 percent of the city’s greenhouse gas emissions came from natural gas combustion attributed to buildings.

In case you were thinking this is mostly a California thing, the mayor of Lincoln, Nebraska is leading an effort to reduce the city’s overall carbon emissions by 80 percent by 2050. Among strategies that could be enacted in the next six years: [transitioning all homes to electric-only heating and cooking appliances](#).

Meanwhile, other places are working to preserve the natural gas industry and the jobs associated with it. [That list](#) includes such states as Arizona, Texas, Oklahoma, Tennessee, Kansas, Indiana and Louisiana. Some legislators in these states believe they are keeping construction costs down for new buildings. Others cite the lack of a clean energy infrastructure in the near-term. However, when offered the possibility to add a provision that would protect homeowners from restrictive, anti-solar covenants from HOAs, one Indiana politician was reluctant because “[his constituents have concerns about aesthetics](#).”

Whether a jurisdiction has started talking about a natural

According to a [study commissioned by the City of Oakland](#), 18 percent of the city’s greenhouse gas emissions came from natural gas combustion attributed to buildings.

gas ban or not, if they’re striving towards a significant reduction in carbon emissions in the next 10-30 years, they’re all going to be faced with the same decision. Are they going to require electrification or not? Given the type of power that is generated from solar and wind, it seems rather inevitable that natural gas, like coal, is on the way out the door.

Maybe it’s a blessing in disguise that only some cities and states are moving towards electrification. We know we have a labor shortage in the trades right now. If this transition was more widespread, the logistics might not be attainable. Instead, with some locations embracing this move and others...denying it, we’re bound to see a phased approach to implementation. That might also help with the current supply chain issues we’re facing across multiple industries. **GB**

Mike Collignon is the executive director and co-founder of the Green Builder® Coalition.

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The Green Builder® Coalition is a not-for-profit association dedicated to amplifying the voice of green builders and professionals, driving advocacy and education for more sustainable homebuilding practices. For more information, visit GreenBuilderCoalition.org



Net zero goal. Berkeley was the first city in California to ban natural gas in new construction, opening the door for other jurisdictions nationwide.

CREDIT: THOR SWIFT/LAWRENCE BERKELEY NATIONAL LABORATORY

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It's Time to Move From the Sidelines to Center Stage



Ron Jones
Co-Founder and President
Green Builder® Media
ron.jones@greenbuildermedia.com

IT HAS BECOME UNDENIABLY APPARENT that the shelter industry is due for a serious recalibration. Those of us in this sector must adjust our frame of reference and embrace greater responsibility for the outcomes of our actions. There has perhaps never been a more urgent need to honestly reassess the impact and performance of what, where and how we build.

This is a time when our country, and much of the rest of the world, is undergoing a series of painful self-examinations in order to come to grips with a host of social issues, looming environmental catastrophes, economic uncertainties and threats—internal and external—to our health, safety and security. We can't sit this one out.

As we witness the ever-increasing destruction resulting from Climate Change—as manifested in the intensification of violent storms and flooding, unprecedented obliteration of entire communities by massive wildfires, megadrought affecting multiple states and millions of residents, and the extinction of countless species on this planet—we need to take a step back and own up to the part we have played in getting to this point.

Inexplicably, we seem to willingly participate in a deadly game of chance each time we respond to another disaster by rebuilding the same old way, in the very same places, with the same marginal systems and materials. We somehow expect a different outcome the next time our number comes up.

It is generally accepted that buildings account for roughly 40 percent of energy use in the U.S. and a corresponding 40 percent of carbon emissions generated. Yet, the industry resists all attempts to move the needle in a positive direction, instead hiding behind the skirts of “affordability,” a code word

for profitability.

But it may not be possible to fly under the radar for much longer. The failed strategies and policies that have propped up the industry are coming home to roost. We are seeing increasing resistance to “business as usual” in a variety of ways.

For example, some insurance companies are refusing to renew policies for homes in areas with high risk of wildfires. Similarly, the National Flood Insurance Program is undergoing big changes that will significantly impact those who have traditionally relied upon its protection.

We are also learning of building moratoriums predicated on concerns about the availability of water and perhaps other resources and essential services. The industry will no doubt rail against these policies as no-growth strategies conjured up by “environmental extremists.” But who is willing to guarantee that these necessities will be sustainably available?

Look at the abysmal condition of our infrastructure across the nation. The daily news is full of stories about crumbling dams, roads and bridges, deteriorating water and wastewater systems, an increasingly vulnerable and suspect power grid, and the dangerous conditions surrounding pipelines across the continent.

We are left to ask ourselves whether we are going to continue to contribute to the problem, or become part of the solution. Shelter is as basic a necessity for people as food, safe water and breathable air. We can do better. We have the knowledge, the tools, the materials and the technologies. The question is, do we have the will? **GB**



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