Better Than

This practical and healthy home confronts the challenges of location, extreme weather, climate change, and the looming clean-water crisis with noteworthy simplicity

BY BRIAN PONTOLILO

According to the National Centers for Environmental Information, 2015 was the warmest year since 1880, the year when global temperatures began to be recorded. But climate change is fickle, and during the winter of 2015, many in the northeastern United States were muttering the new cliche, "So much for global warming!" Instead of experiencing the warm winter much of the western United States was having, the northeastern states were bundling up against the polar vortex, the extremely cold pocket of air that typically hovers above the Arctic but occasionally reaches deeper into North America.

That winter, Margate, N.J., had its third-coldest February since 1895. Frigid temperatures caused Kirsten and Joe Levin's heat pump to fail. "I don't remember how long it was before we realized the heat wasn't working," says Kirsten, "but it took a while." Once they figured out that the temperature in their new house had dropped a few degrees, Kirsten plugged in a pair of small electric space heaters that she had used to help heat the uninsulated cottage that formerly occupied the property. "We were fine," she says. "It's amazing how well the new house holds heat."

It's said that a certified Passive House can be heated with a couple of hair dryers, but Kirsten and Joe's home is not a Passive House. It is certified by the New Jersey Climate Choice Home program, which means that it meets New Jersey Energy Star requirements. But for the team at ZeroEnergy Design (ZED) responsible for designing it, such certifications are a means to financial incentives—namely, rebates—not a goal in and of themselves or necessarily a performance standard.

Architect Stephanie Horowitz, engineer Jordan Goldman, and business-development director Adam Prince started ZED with a simple commitment: to design houses and other buildings that use 50% less energy than those built to code. Yet Kirsten and Joe's home has much more to offer than a tight, well-insulated envelope: It fits well into its eclectic neighborhood, it is sited to maximize opportunities for light and outdoor space, it conserves water, it is designed and built to stand up to coastal storms and flooding, it has finish materials and mechanical systems that support its owners' physical health,

A PERFECT FIT

Surrounded by a variety of mostly traditional home styles, this barn-inspired exterior blends right in. The front porch splits the elevation and softens the transition from grade to the raised first floor. A wood trellis wraps the house to shade both the front porch and the south-facing first-floor windows.

Average

A CLEAN KITCHEN
The kitchen appliances are energy and water efficient. The range hood and no-VOC, easy-to-clean surfaces keep indoor-air quality high. The modern style is sparse and crisp, and the European tilt/turn windows let in ample light and the ocean breeze.

COOKTOP AND OVEN
Thermador 30-in.
Masterpiece Series

RANGE HOOD
Best Eclisse with recirculation kit

DISHWASHER
Thermador 24-in.
panel-ready Topaz

KITCHEN LIGHTING
LED track lighting

REFRIGERATOR
Thermador 30-in. custom
two-door with bottom freezer

KITCHEN COUNTERS
Stainless steel

and it has a floor plan that supports the family's lifestyle.

With four bedrooms and three baths in 2600 sq. ft., this home is similar to the average new American home described by the U.S. Census Bureau and the National Association of Home Builders. A look at the construction methods used to build this house shows that it is within reach of most experienced builders. But it is hardly average.

A house within reach

American houses consumed about 18,946 trillion Btus of energy in 2015, making them the third-largest user, following industry and transportation, according to the U.S. Energy Information Administration.

It's not clear how much our homes contribute to greenhouse-gas emissions and to climate change. The most recent data available from the Department of Energy is from 2009-2010. Outdated as it is, this data indicates that residential buildings contribute around 20% of total U.S. greenhouse-gas emissions. This includes fossil fuels used on-site (e.g., natural gas for cooking and heating) as well as electricity.

Speaking about the work of ZED, Stephanie is quick to proclaim, "Energy motivates us!" She and Jordan describe their approach to energy efficiency as a three-step process. First, design and build the house to conserve as much energy as possible. The building envelope—foundation, floors, walls, and roof—is the main focus here. Second, design and install the most-efficient mechanical systems needed to heat and cool the house and to maintain fresh and healthy indoor-air quality. Finally, add renewables. With photovoltaic (PV) costs currently as low as $3 per watt installed after incentives, Jordan advises clients to add all the PV they can afford.

At Jordan's recommendation, Kirsten and Joe installed a 5kw PV system on their home, which qualified them for a state rebate. Between conservation measures and renewables, this home is using about 73% less energy than the average code-built home. That puts net-zero energy easily within reach should Kirsten and Joe decide at any point to make an additional investment in PV.

Durability is in the details

On the day of a full moon in October 2012, Superstorm Sandy struck the New Jersey shore. Nearly 350,000 homes were damaged or destroyed by the severe wind and by the state's second-highest recorded floods. In Margate, an island town within the bull's-eye of Sandy's landfall, the foundation for Kirsten and Joe's home recently had been poured. This home, like many others across the country, is in a risky area to build.

For extra flood protection, Stephanie and Jordan raised the foundation 4 ft. above grade, a foot higher than the building department required at the time. Going higher would have made it difficult to fit the two-story home into the neighborhood's overall height limitation for buildings. The raised foundation allows water to flood beneath the house and to drain via water vents. It's detailed as an unconditioned crawlspace.

The first floor is framed with I-joists and is air-sealed and insulated with a combination of rigid foam and water-based spray foam. The 2x6 stick-frame walls are filled with dense-pack cellulose. The roof is framed with 12-in. I-joists, also filled with cellulose. ZIP System sheathing provides the air barrier for most of the building.

The entire exterior—walls and roof—is covered with 4 in. of rigid polyisocyanurate foam. To Jordan, this approach to insulating the envelope is about durability as well as efficiency. "Exterior insulation keeps the wood framing warm and dry over the life of the house," he says. "If moisture gets into the wall cavity, it can dry to the inside because there is no interior vapor barrier."

Though some American manufacturers now offer triple-glazed, high-performance windows, ZED prefers European products—in this case, from Schüco (schueco.com). Jordan says that they are more cost-effective than the domestic offerings and have a modern style that many homeowners are looking for. Beyond thermal performance, these windows provide thermal comfort by keeping the mean radiant temperature, or the average temperature of all interior surfaces, consistent. Because they are not available in impact-resistant glass, the house has a fabric shutter system that can be deployed when strong winds are imminent.

Detailing the envelope and installing the windows were the trickiest parts of the project for Chris Alexander, the builder, who had not put up a high-performance house before this. "We had a lot of meetings and 60-something pages of plans," he says. "We usually have eight." About the permitting and inspection process, Chris reports, "The building inspector was thrilled that a house like this was being built around here."

Everything is inextricably linked

Not only does it make sense to use electric mechanicals and appliances in a home that produces electricity on its roof, but burning fossil fuels on-site is contrary to another of ZED's ethics: to provide healthy indoor air for clients. Combustion appliances are on the EPA's list of indoor pollutants, and a significant factor in poor indoor-air quality, according to the agency, is inadequate ventilation.

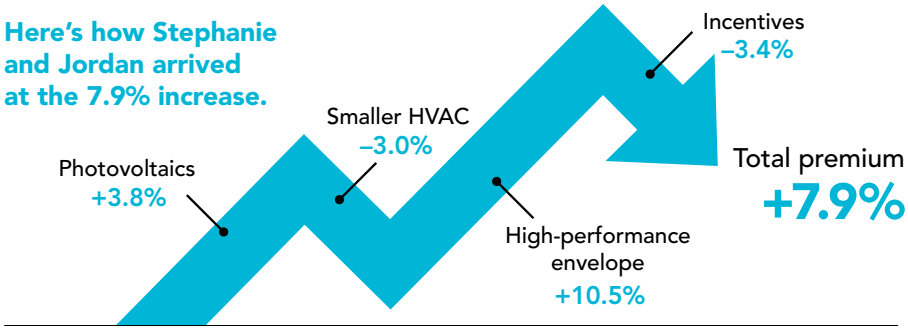
"It's all inextricably linked," says Stephanie. "When you address air infiltration, for example, you're addressing energy efficiency, thermal comfort, and indoor-air quality." In this case, ZED's approach to airflow was to build an extremely tight house (0.47 ACH50) and to provide plenty of fresh air with a Venmar energy-recovery ventilator and a balanced ventilation system. Fresh air is continuously supplied to bedrooms and living spaces. Stale air is continually exhausted from the kitchen and baths, each of which has a boost switch to make sure that enough air is being exhausted when the rooms are in use.

Electric heating and cooling are supplied by a Mitsubishi minisplit heat pump. The house has a heat-pump water heater and an induction cooktop as well. The electric

How much does a better home cost?

The answer, say Stephanie Horowitz and Jordan Goldman of ZeroEnergy Design (ZED), is typically about 5% to 8% more than a similarly finished code-built house. The home featured here cost $275 per sq. ft. of conditioned space, a premium of about 7.9%. This house is on the higher end of the price-increase continuum for a few reasons: It doesn't have the inexpensive space of a basement to lower the cost per square foot, and it's a bit smaller than the average new house. (All else being equal, larger houses have a lower cost per square foot.) A larger, fancier house with a basement typically will be at the 5% end of the range, sometimes even lower. Also, the budget for a high-performance house is allocated differently from that of a more average house. For example, more money is spent on the building envelope, which here includes European windows and doors. The result of such spending is that the house requires a much smaller heating and cooling system.

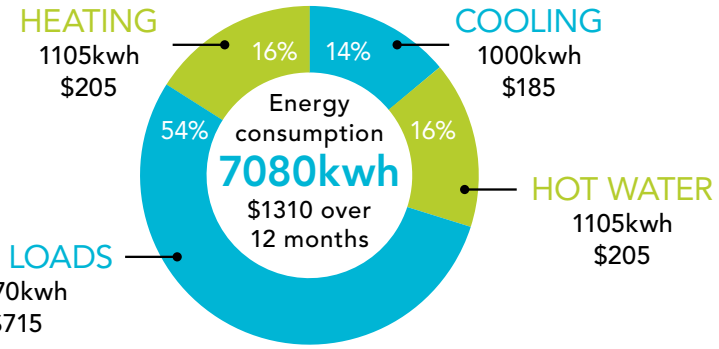
Here's how Stephanie and Jordan arrived at the 7.9% increase.



There is a return on investment in the form of significantly lower utility bills. The ZED team estimates a payback period of nine to 14 years, depending on future energy costs. Yet Stephanie says, "We do not try to justify the improvements we make, relative to code construction, on an economic basis. There are too many benefits that cannot be monetized, such as thermal comfort, altruism, resilience, durability, and sound attenuation."

Over the last 12 months, this house used $1310 worth of electricity (7080kwh). By Jordan's calculations, a code-compliant house would have used $4800 worth of gas and electricity (assuming gas heat and hot water for the code-built house). So this house operated with a 73% reduction in utility bills, almost $3500 in annual savings.

Here's where the house is using its energy over the course of a year.



A MODERN INTERIOR

The interior is clean and uncluttered, with purposefully designed built-in storage. Large windows offer views and daylight, and shades provide privacy when needed. The white-oak flooring from Vermont Plank Flooring brings warmth to the otherwise bright, white interior.

mechanicals and appliances don't introduce any pollutants to the house, nor do any of the zero-VOC adhesives, surfaces, finishes, and furniture. These efforts earned the EPA's Indoor AirPLUS certification for the house.

Just as the systems of a house are inseparable, so are our national infrastructure and resources. The looming water crisis and what we can do about it in our homes is a fitting example. According to the U.S. Geological Survey, the average family of four uses between 320 gal. and 400 gal. of water a day in their home. Production of electricity, however, is the largest consumer of freshwater worldwide. Kirsten and Joe's home conserves water first by producing its own electricity. But it also collects rainwater from the roof for landscape irrigation and has only water-efficient fixtures and appliances inside.

Average size but hardly average

Kirsten and Joe had been living in an uninsulated, split-level "money pit" on this property before they found ZED and decided to build a new home. Though they could have put a bigger house on the property, they were committed to building only what they needed. Kirsten had kept an idea file and knew she would like a "modern barn" aesthetic outside with a modern interior.

The home's orientation along the northern side of the lot maximizes solar gain during the winter, and the driveway acts as a buffer between Kirsten and Joe's home and a neighboring home. Cost-saving is inherent to the home's simple shape. Splitting the elevation between grade and the first floor with the deck minimizes the visual impact of raising the house and means no handrail is needed. The planters and trellis add a clean modern edge. In a neighborhood with no prevailing architectural style, the exterior is unlikely to offend anyone's design sensibilities.

Stephanie's challenge was to design an interior that reflects the way Kirsten, Joe, and

Floor-plan drawings: Martha Garstang Hill

SPECS

Bedrooms: 4, plus multipurpose room

Bathrooms: 3

Size: 2600 sq. ft.

Cost: $275 per sq. ft.

Walls: R-44

Roof: R-68

Windows: U-factor, 0.13 SHGC, 0.35

Completed: 2013

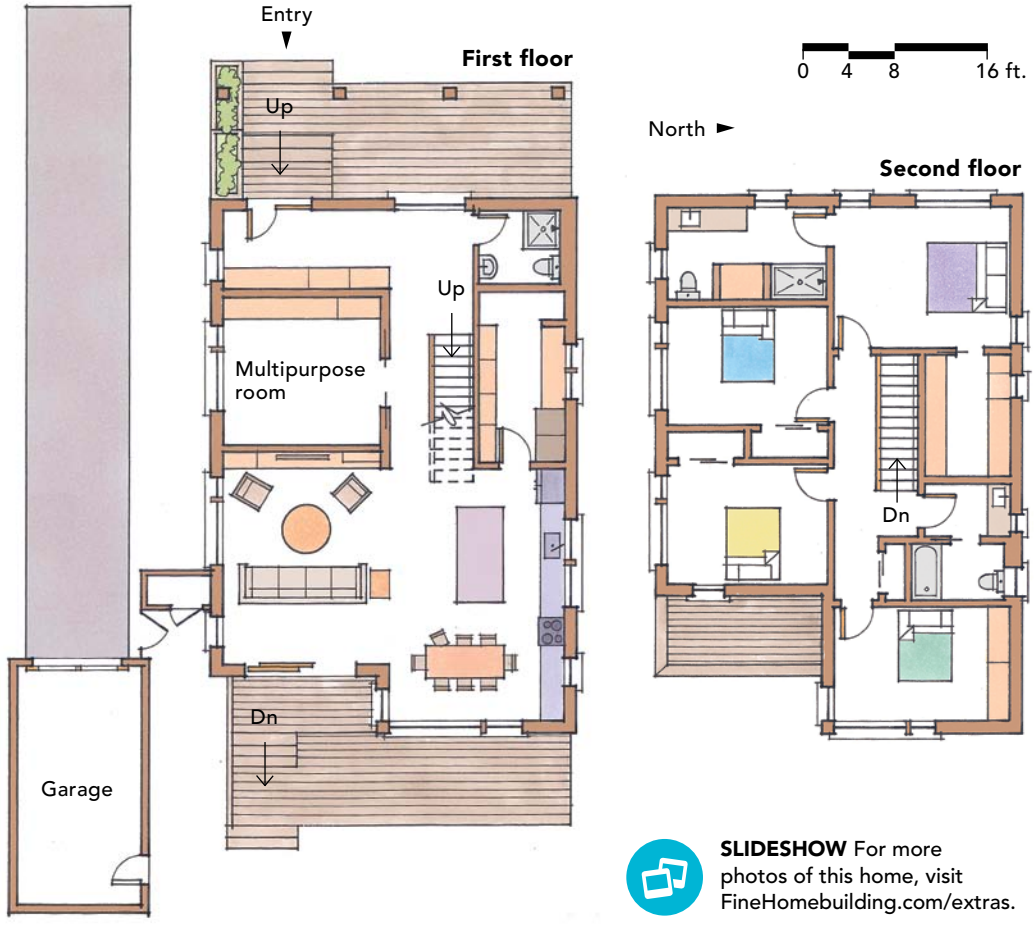
Location: Margate, N.J.

Architect: ZeroEnergy Design, zeroenergy.com

Builder: Chris Alexander, C. Alexander Building & Maintenance Co., calexanderllc.com

FIT FOR A FAMILY

Open plans have been the trend for many years. But too open is sometimes too much. Here, the entry is separated from the living areas and designed for function, as it serves as the family's main path into the house. While the kitchen and living room are open to one another, a multipurpose room on the first floor has pocket doors that can be closed for privacy.



SLIDESHOW For more photos of this home, visit FineHomebuilding.com/extras.

their three children would live in the house. The front entry, for example, was an important consideration in a home near the beach with street parking. Instead of opening into the great room or to a long view, which is so common today, the front entry opens to a bench and built-in storage cabinets. A full bathroom is only steps away.

The inside of the house is clean and modern. There is minimal trim, the stairs are open and sparse, the finishes are light in color, and generous storage keeps each room uncluttered. Natural-wood was used for the floors and stairs, as well as an accent in the kitchen cabinetry. And plenty of sunlight warms the home literally and in that blissful-Sunday-morning way.

Since the house was built, Margate has adopted the 2015 International Residential Code (IRC). In terms of energy performance and indoor-air quality, this home still far exceeds it. In the wake of Superstorm Sandy, some resiliency provisions, such as the height to which a home must be elevated above grade, have been increased by the township.

Yet legislation is unlikely to be the force that makes a significant impact on how we build. The International Code Council (ICC) updates the nation's most commonly used residential codes every three years, but the updates are rarely adopted. For example, only two states have adopted the 2015 code, and many have yet to adopt the 2012 code. California has an ambitious goal that all new homes built in the state will achieve net-zero energy use by 2020, but critics fear that simply adding renewable energy to average houses misses the most important aspect of high-performance homes: conservation.

With the dire forecast of climate change and more severe weather patterns predicted for the future, the likelihood of continued unpredictable fuel prices, and the knowledge and technology to build smarter and better than average, it's time to demand more of our homes. It's time to build more houses like this—houses that prove how easy it is to outperform the average. □

Brian Pontolilo is design editor. Photos by Eric Roth (ericrothphoto.com).