All-Around

Pairing a proven net-zero strategy with conscious material choices

BY STEVE BACZEK

I see two paths to being green. (I don't like that term, but lack of a better one forces me to use it.) Path 1 is designing a typical code-built house and then applying a degree of recycled materials and site-generated energy in an attempt to make up for building-performance inadequacies. Path 2, my preference, is to integrate performance strategies with scrutinized building practices to develop a house where all the decisions are in harmony with each other. While energy efficiency is always a concern, conceptually I don't solve for it. I concentrate on durability, comfort, and health, making sure to align them with environmental responsibility, particularly in terms of material choices—and then energy efficiency comes along for the ride. The result is a comfortable, healthy home that is durable enough to last a long time, that will remain a high-performance home for decades, and that will have a minimal impact on the environment.

I recently had a great opportunity to design a home in this way with Don and Amy Bowen. If you ask them to describe their lifestyle, you'll hear words such as *simple, environmentally thoughtful, minimalist, uncluttered,* and *free*—which is to say free from a burdened conscience, the trappings of high energy bills, and arduous home maintenance. They live this way in part to have the time and money to pursue their favorite leisure-time activities, but mostly because they are passionate about the fight against climate change.

Photo: Rob Yagid

Efficient

With that philosophy in mind, Don and Amy came to me. Their goals were clear: First, the house had to generate at least as much energy as it consumed. Second, all materials had to be considered for their environmental impact, including both their recycled content and their recyclability. Local materials were to be given the highest priority, and domestically manufactured materials were to be chosen before products from abroad. Third, the house had to strive for a nearly maintenance-free exterior.

The Bowens' passion for this house was personal. They were not interested in a plaque, so I didn't design the house to meet LEED or Passive House or any other standard. Despite that, it is easy to see the influence that the LEED and Passive House standards had on the design. Meeting net-zero energy is a relatively easy concept to succeed at in theory: You build a house, determine the loads, and then design a PV system to balance them out. Although many find it as simple as that, my scrutiny extends a bit further. Developing a net-zero-energy home based only on the economics of energy used/purchased/generated is missing half of the equation. The home's performance should be elevated in an effort to reduce the burden of site-generated energy.

With the generating power of PV panels on the rise and their cost constantly being reduced, net-zero energy is becoming fairly easy

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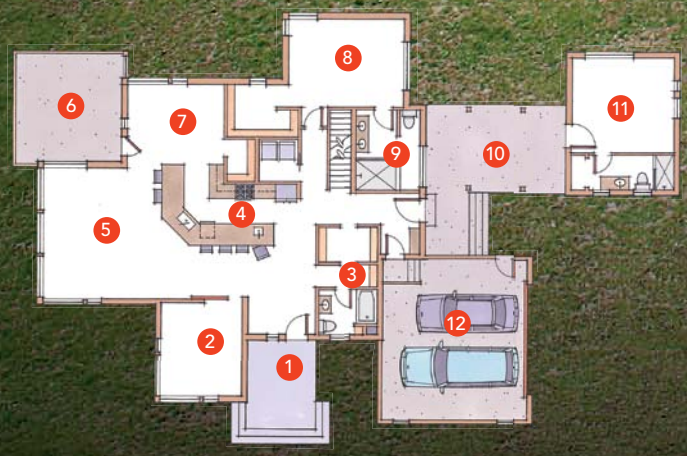
A FORTRESS OF EFFICIENCY

POWERED BY PV The house creates enough energy through its 14.6kw PV system for the house, the studio, and the Bowens' two electric cars. The PV panels are set at 20°, which helps to prevent them from shading each other. The 3.5kw battery system stores excess energy for times when there's no other energy input. The low-slope roof provides a large field for the PV system. Its pitch is a hip-style configuration achieved with tapered pieces (¼ in. per ft.) of rigid polyiso insulation.

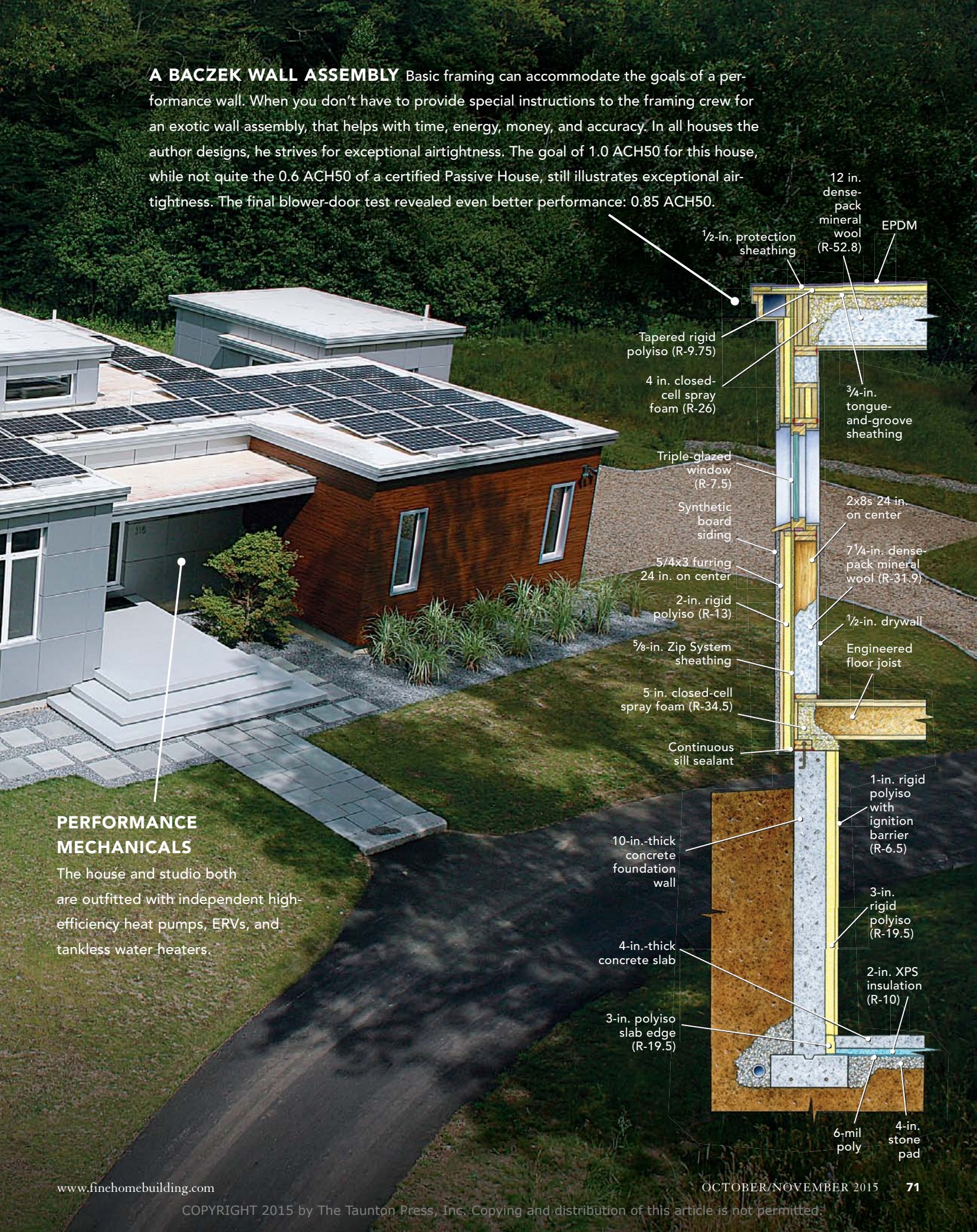
DURABLE ENVELOPE The Bowens wanted a low-maintenance building, so the cladding materials were chosen for their longevity. At the same time, their high recycled content reduces their environmental impact. Firestone Una-Clad aluminum trim coil, made from over 50% postindustrial material, was used for the fascia and soffits. The cladding is a combination of Reynobond, a composite material comprised of aluminum sheets thermobonded to a polyethylene core, and EcoClad XP, a highly durable, nontoxic material made from bamboo and recycled paper bonded together with a corn- and cashew-based resin.



1 Entry
2 Office
3 Powder room
4 Kitchen
5 Great room
6 Porch
7 Dining area
8 Master bedroom
9 Master bath
10 Deck
11 Studio
12 Garage

Photo: Rob Yagid. Floor-plan drawing: Martha Garstang Hill.
Drawing facing page: Don Mannes.

A BACZEK WALL ASSEMBLY Basic framing can accommodate the goals of a performance wall. When you don't have to provide special instructions to the framing crew for an exotic wall assembly, that helps with time, energy, money, and accuracy. In all houses the author designs, he strives for exceptional airtightness. The goal of 1.0 ACH50 for this house, while not quite the 0.6 ACH50 of a certified Passive House, still illustrates exceptional airtightness. The final blower-door test revealed even better performance: 0.85 ACH50.



PERFORMANCE MECHANICALS

The house and studio both are outfitted with independent high-efficiency heat pumps, ERVs, and tankless water heaters.

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to achieve. That also means it's becoming easier to build a lower-performance house and throw a truckload of PV panels on the roof. While I could meet net-zero energy by building that way, I would not satisfy my basic tenets of shelter, in which comfort, health, and durability play the primary and decisive role in determining the right amount to invest in the home's performance.

Working with Don, who served as general contractor, I developed a Passive House–inspired design that guided us to a high-performance ideal. With the 10/20/40/60/5 insulating rule (R-10 underslab, R-20 basement wall, R-40 above-grade wall, R-60 roof, and R-5 windows) as a guide, I set out to design the building assemblies. The airtightness goal was the high-performance minimum of 1.0 ACH50, which is only slightly above the Passive House standard of 0.6 ACH50.

For health reasons and because we planned to use site-generated solar, we eliminated all combustibles and agreed to an energy-recovery ventilator (ERV) as part of our mechanical ventilation. For durability reasons, we eliminated thermal bridging and used a cladding system and rain-screen concepts to provide sound water management. Our assemblies were in pretty close alignment with the insulating rule, although because of certain framing-material choices, the R-values for the above-grade walls and the roof deviated somewhat. We also decided to elevate the R-value of the windows. The Bowens wanted a modern-looking house and the above-average amount of glazing that is part of that style. More windows mean less efficiency, however, so the R-5 window value needed to be elevated 150%. The final 10/26/45/88/7.5 design proved to be the best and most cost-effective assembly for lowering the home's energy load.

Net-zero energy—a unique challenge every time

The site was purchased in part because of its exposure. It is a large open lot with a tree-filled perimeter. The Bowens wanted from the start to have a low-slope roof, which proved advantageous for integrating a 14.6kw PV system ballasted with blocks to prevent penetrations in the roof. The house is set about 10° off due south to provide the desired views both to and from the house, but that doesn't hamper the PV system's overall production. With a low-slope design, the entire roof can have PV panels as long as none are shading any adjacent panels. This does mean giving up some of the roof area, but what remains still exceeds what would be achieved on half of a gable roof.

The house creates enough energy not only for itself but also for two electric cars. Coupling the PV system with a 3.5kw battery-storage system means that excess energy can be stored for times when there is no other energy input, such as in the evening or during power outages of up to 12 hours. Should the need arise for more storage capacity, extra battery units can be added to the existing system.

Recycled and resourceful material choices

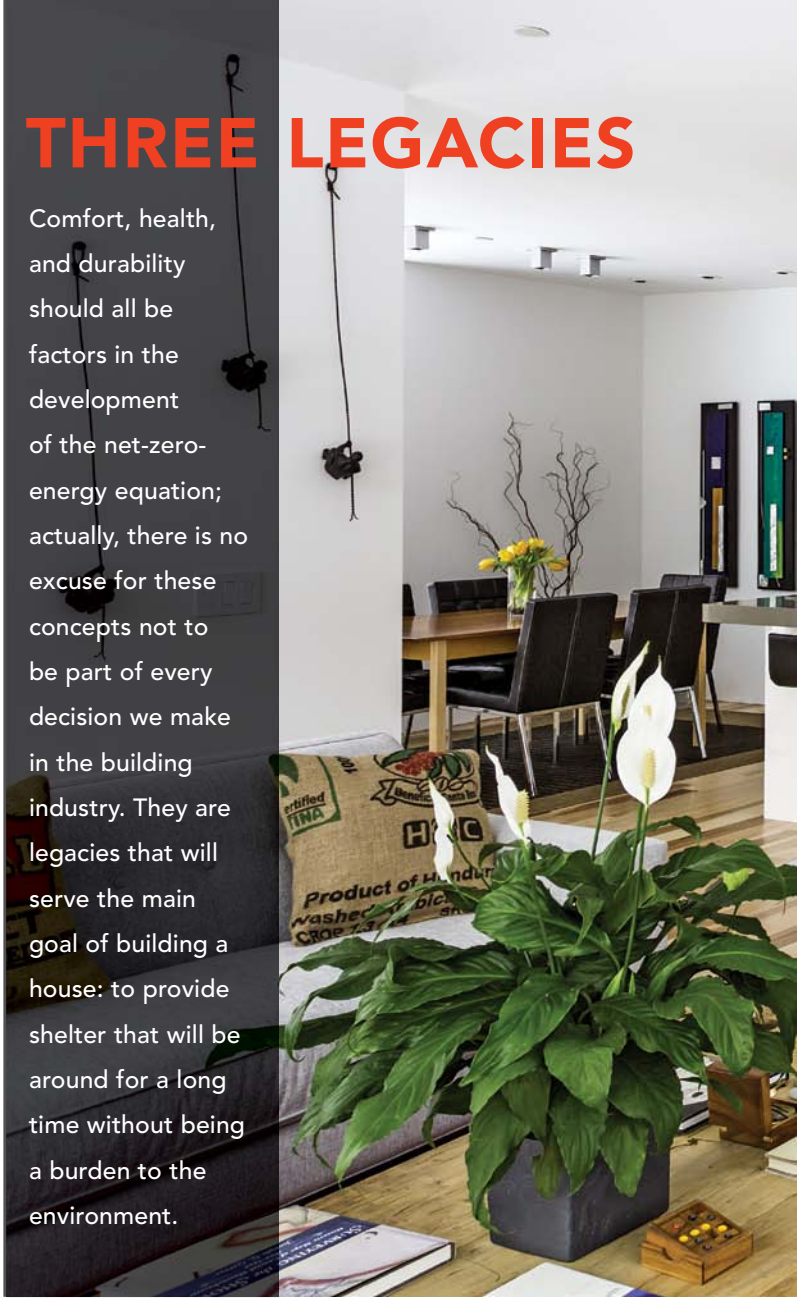
Environmental impact drove all of our decisions. We balanced the presence of recycled content and the recyclability of the home's materials with the durability of those products; if a product has a life twice as long as an alternative, its environmental impact is halved. Flooring is locally sourced or reclaimed. Countertops are largely made up of recycled glass, and water fixtures are low-flow models. Because the Bowens did not want to provide any scheduled maintenance, the cladding materials were chosen for their longevity, and as it turns out, the metal panels and the plank siding have a high recycled content.

Always concentrating on durability, comfort, and health, I aligned environmental responsibility with each concept to ensure that our decisions kept us on the path to shelter that's built to last, which is still the greatest measure of green, whether I like the term or not. □

Steve Baczek is an architect in Reading, Mass.

THREE LEGACIES

Comfort, health, and durability should all be factors in the development of the net-zero-energy equation; actually, there is no excuse for these concepts not to be part of every decision we make in the building industry. They are legacies that will serve the main goal of building a house: to provide shelter that will be around for a long time without being a burden to the environment.



SPECS

Bedrooms: 1, plus studio
Bathrooms: 3
Size: 2034 sq. ft., plus 320-sq.-ft. studio
Cost: $265 per sq. ft.
Completed: 2015
Location: Hamilton, Mass.
Architect: Steve Baczek
General contractor: Don Bowen

Top photo: David Fell, courtesy of Steve Baczek, Architect.
Bottom photos: left, Aaron Fagan; right, Rob Yagid.

Conscious choices. *The kitchen features an EcoStone recycled-glass countertop and reclaimed beams from a barn in Falmouth, Maine. The flooring, which extends into the master bedroom, is locally harvested hickory finished with a water-based, no-VOC sealer. The glazing throughout the house is triple-pane Yaro windows (below).*