SPECIAL REPORT

What Does Green Really Mean?

Rising energy costs, climate change, and a new social conscience are complicating the way we build

BY SCOTT GIBSON

David Gottfried is putting his money where his mouth is. The Berkeley, Calif., building consultant and founder of the U.S. Green Building Council (www.usgbc.org) is downsizing, swapping his 2600-sq.-ft. house for one half its size. His two children will share a single bedroom with bunk beds.

He's leaving behind a home office, playground equipment in the yard, and a dedicated guest room. Gottfried doesn't view it as much of a sacrifice. Instead, it's completely logical for someone who has been beating the drum for smaller, more energy-efficient houses that waste fewer resources and keep their owners healthy and comfortable.

That, basically, is what the green-building movement is about. And in an industry that is painfully slow to change, green building seems to be gaining momentum with surprising speed. By the end of 2007, the National Association of Home Builders (NAHB) expects that more than half its members will be calling themselves green builders.

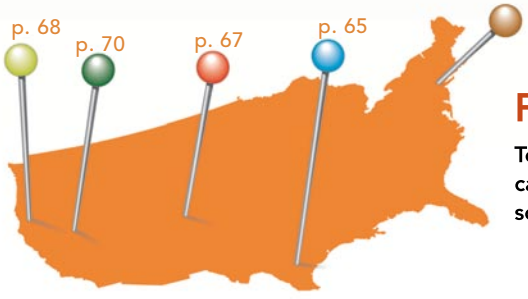
A combination of public and private initiatives is part of the reason. "And beyond all that," Gottfried says, "there's the market.

"Consumers are starting to get interested, and the bigger picture encompasses climate change, overburdened landfills, increasing energy costs, water scarcity, and diminishing air quality. Connect all those dots, and you can see a huge potential, not just in the U.S. but globally."

Just what is "green" building?

Dozens of local and regional programs across the country set minimum standards for winning a green label. NAHB has a set of voluntary guidelines, and the Green Building Council is in the process of rolling out a residential version of its successful program for commercial buildings. On the other hand, some states have no formal green-building initiatives, while others have allowed their green-building organizations to lapse.

Given this patchwork of sometimes conflicting guidelines, a "green" label has no sin-



FIVE HOUSES PROVIDE A GREEN SNAPSHOT

To illustrate the range of green practices going on around the country, we have included case studies from various regions. Each has its own unique design features and shows some of the diversity being used by architects and builders who are going green.

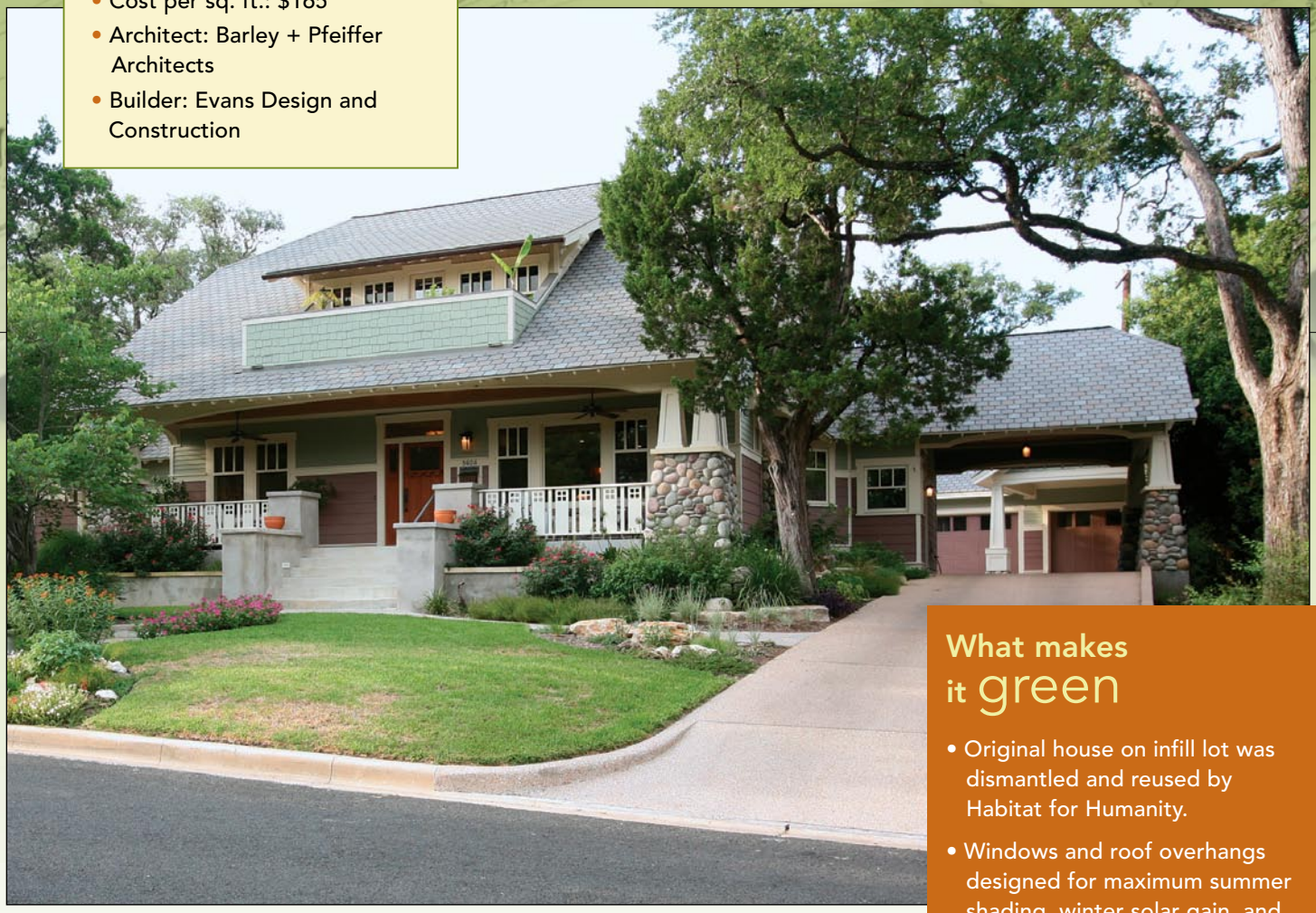
Drawing: Chuck Lockhart. Blueprint photo: Krysta S. Doerfler. Photo facing page: Connie Moberly.

DETAILS

- Size and layout: 3527 sq. ft.; 4 bedrooms, 3½ baths
- Location: Austin, Texas
- Cost per sq. ft.: $165
- Architect: Barley + Pfeiffer Architects
- Builder: Evans Design and Construction

1 A BUNGALOW FINDS SHADE IN TEXAS

Classic style and detailing can come in an energy-efficient package



What makes it green

- Original house on infill lot was dismantled and reused by Habitat for Humanity.
- Windows and roof overhangs designed for maximum summer shading, winter solar gain, and ample natural light.
- Reduced cooling load, thanks to a vented, radiant-barrier roof insulated with open-cell foam.
- Floor trusses, engineered structural beams, finger-jointed studs.
- Wood/plastic composite exterior trim, fiber-cement siding.
- Programmable thermostats, sealed sheet-metal ducts.
- Cooling-tower-enhanced air-conditioning achieves higher efficiency than conventional equipment.
- Positive pressurization of house reduces air infiltration.

gle meaning. Still, several common themes run through most established programs:

- **Site work that minimizes the environmental impact of the house during and after construction.**
- **Energy efficiency.**
- **Water efficiency.**
- **Use of recycled materials and materials whose production can be sustained without harming people or the environment.**
- **Healthful indoor-air quality.**

Depending on the region's climate and other local conditions, different programs might assign different values to each of these categories. Or they might weigh additional factors, such as a house's proximity to public transportation or basic community services so that occupants don't have to drive a car to work or to the grocery store.

Yet plenty of room exists for differences of opinion. Some building products, for example, might be considered green because they are durable and help a house to last longer. But they might have to be shipped long distances, consuming lots of energy in the process, or they might produce hazardous by-products when they are manufactured or when they are thrown away or incinerated.

"There are a number of things that get sustainable stamps, but then you look at where it's supplied from," says Keith Moskow, an architect in Boston. "If you're supplying a

job from Oregon and they're shipping across country, you start to wonder, 'Wait a second. Big picture, does that make sense?' "

In a country with an appetite for big houses, square footage is another fundamental issue to be settled. Can a 5000-sq.-ft. house built to the strictest possible green standards but only for two people ever really be green? It depends on whom you ask.

Some differences are inevitable, and despite ample grounds for confusion, builders, architects, and consultants often describe green building simply as good building.

"A lot of it isn't just fancy products," says Gottfried. "It's the good design fundamentals that we used to have. When we used to build in a hot area, we made homes that were solid with good thermal mass. We had awnings and overhangs and front porches that were shaded. We had cross-ventilation. There are so many things you can do without even looking at mechanical systems for cooling. We used to know all those things."

A tight building envelope and low energy consumption are key goals

Most climate scientists now believe that the carbon dioxide released into the atmosphere when fossil fuels are burned is contributing to global climate change. At the same time, buildings consume a lot of energy—$305 billion worth in the United States in 2003 alone—even while resources are finite.

For both of those reasons, reducing the amount of energy that dwellings consume is among the most important goals of green building. A number of programs use the federal government's Energy Star rating system as a starting point. Some builders and designers, however, look for much more dramatic savings. They employ photovoltaic panels, wind generators, and active solar systems to produce zero-energy houses, those that make as much energy as they consume.

Cutting energy consumption usually involves a number of strategies, from building a superinsulated, airtight building envelope to selecting the most-efficient windows, heating system, and appliances. There is no single approach.

Alex Wilson, executive editor of *Environmental Building News* (www.buildinggreen.com), has been reporting on the green-building movement for two decades. He suggests that the best approach is to bring in a variety of experts at the start of a building project. In his new book on green building, *Your Green Home* (New Society Publishers, 2006; $17.95), Wilson explains this "integrated design" approach with the justification that long-term savings will more than offset any initial added expense.

By way of example, he suggests that investing in superinsulated walls and high-performance windows and incorporating passive-solar design could make it possible

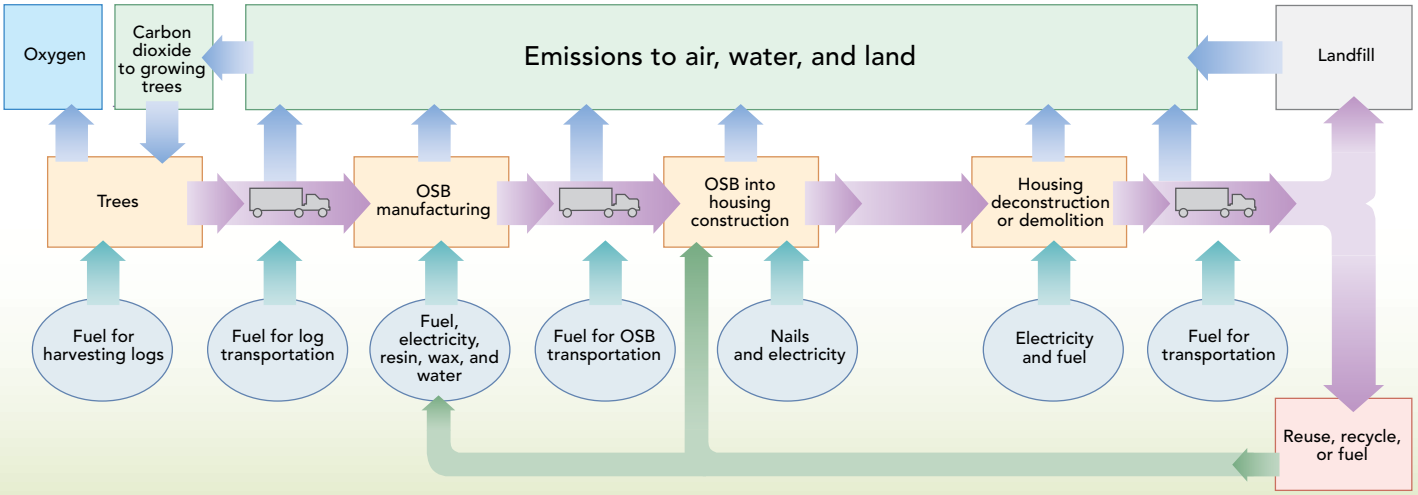
2 A GREEN

DETAILS

- Size and layout (Cypress model): 2845 sq. ft.; 5 bedrooms, 3 baths
- Location: Loveland, Colo.
- Cost per sq. ft.: $98
- Architect/builder: Aspen Homes of Colorado

MEASURING A PRODUCT'S GREEN VALUE IS NOT EASY

How green is oriented strand board? A life-cycle analysis or assessment, represented in the flowchart below, shows how complicated the green equation can be when you factor in the energy and resources that are consumed throughout OSB's service life. For example, OSB gets greener when manufacturing energy comes from renewable resources and when a load of panels doesn't need to travel far from plant to job site.



Drawing: Chuck Lockhart; concept: Jim Wilson, CORRIM Inc. Photos: Courtesy of Aspen Homes.

DEVELOPMENT TAKES ROOT IN COLORADO

Economical spec housing that comes with a written energy guarantee

"I think of a green-built home the same way I think about cars. We don't manufacture the same car we did 25 years ago, so why would we build homes the same way we did 25 years ago? A green-built home will have lower utility bills, be more comfortable for the homeowner, and use fewer resources during construction. Everyone wins when you build green."
—Rob Sabin, Aspen Homes

What makes it green

- Centrally located, high-efficiency furnace with energy-recovery ventilation and whole-house filtered-air system.
- High-performance windows, tankless water heater, and Energy Star appliances.
- Low-VOC paints and water-based finishes.
- Extensive air-sealing and passive radon mitigation.
- Carpets made from recycled plastic; wood composite decking.
- Wood and cardboard construction waste recycled; off-road construction equipment runs on biodiesel fuel.

to skip a central-heating system altogether, even in areas with a real winter.

"We need to shift our economies to a non-fossil-fuel base," says Robert Riversong, a Vermont builder and a longtime advocate of green building. Conventional residential construction, he says, suffers from the same energy imbalance as modern agriculture: The system invests 10 calories of petrochemical energy to produce a single calorie of food energy. In other words, it doesn't make much sense.

Protecting the site and conserving water are also central themes

Conservation and stewardship are recurring themes that run through green-building practices, and this sensibility extends naturally to two other areas: the amount of water that households consume and the building site itself.

Good building practices would locate a house away from any environmentally sensitive areas. Infill lots are especially attractive to green builders because they reduce the impact of building on prime land and because they tend to keep occupants within walking distance of neighborhood stores and other services.

Other site objectives in green-building programs often include:

- **Disturbing the smallest possible area of the site.**
- **Limiting the amount of grass.**
- **Using trees to provide shade.**
- **Using permeable paving materials to minimize water runoff.**
- **Orienting the house so that it takes the best possible advantage of passive-solar heating potential.**

Water conservation is an especially important goal in some parts of the country, notably the far West, where drought is becoming a way of life. NAHB says that mean per-capita indoor daily water use is now about 64 gallons but could be lowered to less than 45 gallons in a green home. Conservation measures might include rainwater collection, "gray-water" systems that reuse water from showering and washing dishes or clothes, high-efficiency

3 A GREEN PREFAB CAN GO ANYWHERE

The Glidehouse is a prototype for a new family of well-designed factory-made houses

"On hot days, we keep the house cool by opening the windows and doors to create a cross-breeze. When it's cold outside, we simply open the sunshades to let the sunlight in and warm the rooms. This alone has substantially decreased the amount of money we spend on utility bills." —Michelle Kaufmann, architect

DETAILS

- Size and layout: 1566 sq. ft.; 3 bedrooms, 2½ baths
- Location: Northern California
- Cost per sq. ft.: $250
- Architect: Michelle Kaufmann Designs
- Builder: Cullen Woodworking (other Glidehouse models are built by various factories)

irrigation systems, low-flow fixtures, and plumbing that minimizes hot-water waste.

Water is precious in Frisco, Texas, a city of 88,000 located 25 miles north of Dallas. Frisco's mandatory green-building guidelines include a number of water-conservation measures, such as a "drought-tolerant" landscaping option, mulching, and zoned irrigation systems. If a house doesn't pass, the builder doesn't get a certificate of occupancy.

Keeping indoor air healthful and choosing "green" materials

Energy-efficient houses are sealed tightly. But tightly sealed houses can trap a variety of contaminants, including the chemicals found in adhesives, carpets, furniture, and building materials. The contaminants can end up creating some pretty lousy indoor-air quality. That, in turn, can be a contributor to health problems such as asthma and allergies.

As with energy conservation, improving indoor-air quality amounts to a number of interconnected steps. The aim is to keep an adequate amount of fresh air coming into the house and to limit exposure to noxious chemicals.

Guidelines often recommend closed combustion appliances, which draw combustion air from outside a building; bathrooms equipped with ventilation fans that can be operated with automatic timers or humidity-sensing switches; kitchen ranges vented to the outside; and whole-house ventilation systems equipped with energy-recovery ventilation equipment that reduces energy loss.

But relying on mechanical equipment to keep air moving doesn't appeal to all green builders. Riversong, for instance, has been critical of one highly efficient house in Vermont (featured in *FHB* #161, pp. 74-79) because it's "a box that is hermetically sealed so that it cannot breathe without artificial respiration." He adds: "And, of course, artificial respiration works only when power is not disrupted, which happens with some regularity in rural Vermont." He'd prefer designs relying on passive ventilation.

Indoor-air quality can be improved by choosing building materials and furnishings that don't off-gas volatile organic compounds (VOCs) and by keeping the garage separated from living spaces to limit exposure to auto-emission toxins.

Choosing building materials that either can be produced sustainably or are good for buildings and occupants is a related, and sometimes contentious, part of green building.

Recycled, locally harvested, and salvaged materials all are favored, as well as simply using fewer materials to begin with (in other words, making houses only as big as they really need to be).

Any discussion of green materials, however, can become complicated. For example, structural insulated panels (SIPs) are effective thermal insulators, and their oriented-strand-board skins make good use of easily replenished wood. That's good. But they are

Top photo: John Swain Photography; small prefab photos: courtesy of Michelle Kaufmann Designs. Photo facing page, bottom: Paul Warchal.

What makes it green

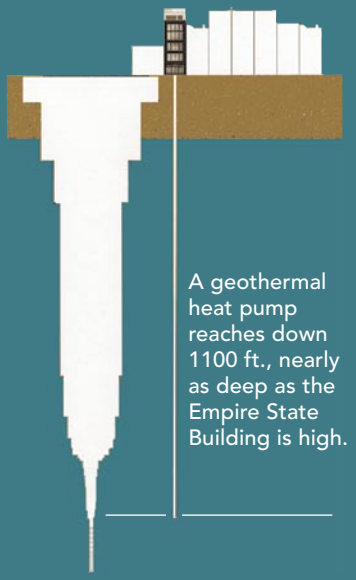
- Walls finished with nontoxic paints; reclaimed-wood or bamboo floors.
- Formaldehyde-free kitchen cabinets and energy-efficient appliances.
- On-demand water heaters, dual-flush toilets, and bathroom countertops made with recycled paper.
- Solar-friendly design with operable windows to maximize cross-ventilation in all major rooms.
- Off-site construction means efficient use of materials with little waste and less environmental impact on home site.

- Tight building envelope insulated with open-cell foam. All wood-to-wood framing joints are caulked.
- Mechanically ventilated with air-to-air heat-recovery ventilator and high-efficiency air filtration.

A TOWN HOUSE DIGS DEEP FOR HEAT IN NEW YORK CITY

4 Green goes metro, high end, and super energy-efficient

What makes it green



A geothermal heat pump reaches down 1100 ft., nearly as deep as the Empire State Building is high.

- Geothermal heat pump is 75% more efficient than conventional heating and cooling system.
- Nontoxic finishes; formaldehyde-free cabinetry and flooring.
- No vinyl products.
- Insulating concrete forms for concrete walls.
- High-efficiency air-ventilation system removes pollen, mold, and particulates.

DETAILS

- Size and layout: 6500 sq. ft. over seven levels; 4 bedrooms, 4 baths, plus ground-floor home office with powder room and pantry
- Location: New York City
- Cost per sq. ft.: Unavailable
- Architect: Studio Petrarca
- Builder: Wildman & Bernhardt

5 A MOUNTAIN RANCH SOAKS UP THE SUN IN NEVADA

Virtual energy independence happens even in a rigorous climate

"During last winter's blizzards, neighbors called wondering why Suzanne's power was on when theirs wasn't. The conversation would turn to energy bills, which for most homes at Job's Peak approach $1000-plus per month, while hers are nearly nothing on an annually averaged basis."

—David Arkin, architect

filled with foam insulation derived from petrochemicals. Not so good.

In the end, focusing too much on materials can overshadow more-important factors, such as energy conservation or indoor-air quality. A house built totally with recycled materials still can be an energy hog.

Who decides when it's green?

After its creation in 1993, the U.S. Green Building Council launched Leadership in Energy and Environmental Design (LEED), a green-building rating system for commercial buildings. It remains a centerpiece of the council's efforts and soon will be augmented by a similar residential program.

LEED buildings must meet a long list of requirements to attain one of four levels of certification. It has been highly successful for commercial space. Organizers working on the pilot program are hopeful it will have the same impact on residential construction.

The LEED program awards points for various performance levels, materials selection, energy use, and the like. One key feature is what's called third-party verification, meaning that the building must be vetted by a certified inspector with no ties to the builder.

Other green programs around the country allow the builder to use a checklist and declare the house green with no outside inspection. But to Gottfried and many others, third-party verification is essential.

"I would say it's critical," he says. "It's one thing to use a little checklist and say you did it. It's another thing to verify, third party, that you did it, that you back up your claims and document them."

Making misleading claims about green compliance (what the industry calls "greenwashing") might lead to credibility problems with a voluntary program as well as with green building in general, according to Wilson.

"The green-building proponents need to do some policing or some education to ensure that there isn't that confusion within the marketplace and the potential for problems with credibility," Wilson says.

Because programs vary so widely, buyers should ask questions about a green designation: What are the requirements for certification, for example, and were any of them checked by an outside inspector? Understanding what went into the designation can be a big help in deciding how much it really means.

"It's like nutrition when we look at food labels," Gottfried says. "The first thing is

Photos: Edward Caldwell

What makes it green

- Roof-integrated photovoltaic panels with battery backup.
- Gray-water system provides landscape irrigation.
- Extensive use of reclaimed wood, salvaged doors, and interior windows.
- Timber-frame/straw-bale construction, fiber-cement plank siding.
- Fly ash in concrete-floor slabs with water-based finish.
- Partially earth-sheltered with sod roof.
- Near-zero energy bills in 7500 heating degree day climate, achieved through net metering.

DETAILS

- Size and layout: 3445 sq. ft. including guest house; 3 bedrooms, 3 baths
- Location: Gardnerville, Nev.
- Cost per sq. ft.: $350
- Architect: Arkin-Tilt Architects
- Builder: Rick Walters, SAGE Design/Build

getting the key information in the key categories, and then understanding if it's 40% fat, it's bad for your health. That's where we are right now: trying to figure out the label, and what is good, what is excellent."

Does green building cost more?

Not everything about a green house is expensive, and some advocates say a green house does not necessarily cost any more than a conventional house. Others say there is a premium for green, with estimates ranging from 3% or 4% up to 10% to 15%. But advocates also say it's misleading to consider only the initial cost of green materials or techniques.

"We really try to look at what's called a lifecycle cost analysis," says Ed Young, chief estimator for Canyon Construction in Oakland, Calif. (sidebar p. 66).

Wilson's book uses a comparison of water heaters to illustrate the point. An indirect water heater (which taps heat from a boiler for domestic hot water) costs almost twice as much initially as a conventional electric heater ($600 vs. $350). But over 13 years, the average life span of the electric appliance, the indirect water heater saves more than $2500 in operating costs. The same is true for many other building components.

Young adds that the cost of green features translates into a small bump in the mortgage when amortized over the term of a 30-year loan. And the upgrades result in lower operating costs, a net gain for the buyer.

In time, Gottfried believes that a verified green house will be common, even required by lenders and governments. That would be better for both builders and homeowners because better houses mean fewer complaints, and better prospects for Planet Earth.

"It's about quality," he says. "It's an ethic. It hasn't spread everywhere yet. It will. It has to. Who doesn't want fresh air and clean water? Show me one person in the world." □

Scott Gibson is a contributing editor to *Fine Homebuilding*. Ashley Pedersen, an editorial intern at the magazine, contributed to the reporting for this article.

Online extra

For a list of green resources, including associations, publications, and links to certification programs, visit **www.finehomebuilding.com.**