WHAT IS GREEN?

Determining a building product's true environmental impact is not always easy

by Alex Wilson

Readers of *The Journal of Light Construction* are no strangers to the green building movement. There are now several dozen residential green building programs around the country with thousands of homes built in the past few years to their standards. Many of you participate in those programs, or have launched your own green marketing efforts.

Energy Star Homes, which focuses on energy efficiency, has seen a dramatic surge in participation, with over 100,000 homes built through the program. Even the National Association of Home Builders — far from a fringe environmental advocacy group — has taken an active interest in green building, with the formation of a green building subcommittee and the passage of a green building policy last May.

A key aspect of green home building is the selection of green building products — materials that carry a minimal environmental impact. But just what makes a given product "green"? How do you evaluate the relative greenness of different products? How do you find green products? How do you distinguish the truly green from the greenwash?

We at BuildingGreen, Inc., and *Environmental Building News* have been researching and writing about green

building products for more than ten years. We've come up with specific criteria for evaluating building products and identifying those we consider green — a process we use in screening products for our *GreenSpec* directory. Here's what we've come up with.

Defining Green

Evaluating building products for their "greenness" involves something called "life-cycle assessment" (LCA). This is an emerging science that considers a product's environmental burdens throughout its life cycle — from resource extraction, through manufacturing and use, and ultimately to disposal or recycling into a new product. Because most building materials are in use for a long time, the *use phase* of a material's LCA is particularly important.

To complicate matters in LCA work, we consider lots of different types of impacts. We consider impacts on the resource base — harvesting timber, for example, or extracting mineral ores. We consider air pollution and water pollution emissions during manufacture and shipping, one measure of which is the "embodied energy" of a material. We consider what effect a product may have on the operation of a building — for example, the product's impact on the energy use of the building or the maintenance requirements (and *those* environmental impacts). And we consider what the impacts of a material might be on the people working or living with it — indoor air quality concerns.

The problem is that with so many different types of impacts, when we compare one product with another, we are often comparing apples to oranges. The challenge in evaluating green building materials is in balancing all the considerations.

Plastic lumber made from recycled HDPE grocery bags and cellulose insulation made from ground-up newspapers are good examples of post-consumer recycled content

Distant dream. The Holy Grail of the green building movement would be a database in which the life-cycle environmental impacts of different materials were fully quantified and *weighted* so that a builder or designer could easily see which material was better from an environmental standpoint. Though efforts are afoot along those lines — for example, the BEES software that has been developed by the National Institute of Standards and Technology (NIST) — we are not even close to fully realizing that goal. We are a long way from having a truly objective way to compare the greenness of building materials, but we can still make informed decisions about selection.

Let's take a more detailed look at some of the criteria that can be used to define building products as green. Through this process, you should get a sense of the tremendous variety of green building products and the many characteristics that can be used in identifying them.

Products Made With Salvaged, Recycled, or Agricultural Waste Content

The raw materials used to produce a building product — and the source of those materials — are key determinants of green.

Salvaged products. Whenever we can *reuse* a product instead of producing a new one from raw materials — even if those raw materials are from recycled sources — we save on resource use and energy. Many salvaged materials used in buildings (bricks, millwork, framing lumber, plumbing fixtures, and period hardware) are sold on a local or regional basis by salvage yards, but some are marketed nationally.

Products with recycled content. Recycled content is an important feature of many green products. From an environmental standpoint, *post-consumer* is preferable to *post-industrial* recycled content. "Post-consumer" means that some portion of the raw materials used in manufacturing the product was diverted from the waste stream. Plastic lumber made from recycled HDPE grocery bags and cellulose insulation made from ground-up newspapers are good examples. "Post-industrial" refers to raw materials that were waste products from industry but had never actually been in use. Iron-ore slag used in mineral wool insulation, fly ash used in concrete, and PVC scrap used to make shingles are examples of post-industrial recycled materials.

Products made from agricultural waste material. Some green building products are made from agricultural waste products. Approximately 140

million tons of straw are produced annually in North America from the harvesting of wheat, barley, rice, and other grains. In the past, most of that straw was burned in the fields, but pollution-control regulations increasingly ban that practice; using the material to produce building products is a great alternative. When it's chopped up, mixed with a binder, and compressed into panels, straw produces a superb particleboard product.

Products That Conserve Natural Resources

Aside from salvaged or recycled content, there are a number of other ways that products can contribute to the conservation of natural resources. These include products that serve a particular function while using less material than the standard solution, products that are especially durable or low-maintenance, wood products that carry Forest Stewardship Council certification, and products made from rapidly renewable resources.

Products that reduce material use. Products meeting this criterion may not be distinctly green on their own but are green because of resource efficiency benefits that they make possible. For example, drywall clips allow the elimination of corner studs, engineered stair stringers reduce lumber waste, pier foundation systems minimize concrete use, and concrete pigments can turn concrete slabs into attractive finished floors, eliminating the need for conventional finish flooring.

Products with exceptional durability or low maintenance requirements. These products are environmentally attractive because they need to be replaced less frequently, or they require less maintenance. Fiber-cement siding and fiberglass windows, for example, can be considered green because they last longer and require less maintenance than standard products.

Certified wood products. Third-party forest certification, based on standards developed by the Forest Stewardship Council (FSC), is the best way

Green Products vs. Green Building

It's important to consider the distinction between green building products and green building. One could build a green home with few materials specifically defined as green. A really compact, highly energy-efficient house on an in-fill site close to public transit, for example, would likely be defined as green even if all of the materials in the house were conventional — no recycled-content decking or linoleum flooring or certified wood.

Conversely, green products can be used in dumb ways that result in buildings that are far from environmentally responsible. One could use nothing but recycled-content products but fail to pay attention to energy efficiency or where the house is built. Or one could ignore moisture control and end up with a mold farm that makes the homeowners sick. That certainly isn't green.

Green building involves more than just the selection of green products. It involves such issues as siting the home wisely, minimizing dependence on automobiles, protecting the ecosystem around the home, designing the home to benefit from passive solar energy, providing an energy-efficient building shell, and incorporating building science principles to ensure that the house will be safe and last a long time.

That said, however, substituting green products for conventional products can make the difference between a good home and a great one from an environmental standpoint.

to ensure that wood products come from well-managed forests. Wood products must go through a chain-of-custody certification process to carry an FSC stamp. While there are now other forest certification systems, including the Sustainable Forestry Initiative (SFI) — which has been strengthened significantly in the past several years — the FSC standards are still the most rigorous and the most frequently specified in the green building movement.

Rapidly renewable products. Some products are considered green because the raw materials used in producing them are replenished quickly. Natural linoleum flooring is made from linseed oil (an agricultural crop). Cork, which comes from the bark of certain oak trees, is harvested sustainably on an eight- to ten-year cycle. A new class of concrete form-release oils made from plant oils is both nontoxic and fully biodegradable. Jute, sisal, and coir are examples of natural fibers that are used in everything from wall coverings to erosion-control geotextiles. Because sunlight is generally the primary energy that produces those raw materials (via photosynthesis), they are often less energy intensive to produce than the conventional products they replace.

Products That Are Green Because of What Isn't There

Some building products are considered green because they are alternatives to conventional products that are considered hazardous.

Alternatives to conventional preservative-treated wood. CCA-treated wood, which contains both arsenic and chromium, poses a health hazard and a significant environmental risk during disposal; pentachlorophenol (penta) and creosote are considered carcinogens. Alternatives to those chemicals, such as ACQ, copper azole (Wolmanized Natural Select), and borates can thus be considered green.

Alternatives to ozone-depleting substances. Ozone-depleting substances are being eliminated through international agreement. As of this year, for example, polyisocyanurate insulation is no longer made with ozone-depleting HCFC-141b as the blowing agent. But in a few categories, the majority of products still contain or use HCFCs, including certain categories of foam insulation (extruded polystyrene and high-density spray polyurethane) and compression-cycle hvac equipment. A product can be considered green if it serves as an alternative to one of those widely used products.

Alternatives to PVC. Polyvinyl chloride (PVC), or vinyl, products contain up to 40% chlorine by weight, and if an accidental fire or improper incineration occurs, hazardous chlorinated hydrocarbons, such as dioxins, can be generated. The plasticizers used to make many PVC products soft are also considered hazardous. The debate about the relative risks of PVC has been quite heated over the past five years, with Greenpeace and other environmental groups decrying PVC as dangerous, while the plastics industry touts such products as green because of their durability and low maintenance requirements. In the green building field, the use of PVC is generally discouraged, so some products may be considered green because they are non-PVC in an application served primarily by PVC products.

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Alternatives to mercury and other components considered hazardous. Fluorescent lamps with low mercury levels can be considered green, as can certain non-mercury lighting technologies, such as LEDs (light-emitting diodes). The absorber surfaces of solar collectors can similarly be considered green if they are made without chromium.

Natural or minimally processed products. Products that are natural or minimally processed can be green because of low energy use and low risk of chemical releases during manufacture. These can include wood products, agricultural or nonagricultural plant products, and mineral products such as natural stone and slate shingles.

Products that reduce or eliminate pesticide treatments. Periodic pesticide treatment around buildings can be a significant health and environmental hazard. The use of certain products can obviate the need for pesticide treatments, and such products are therefore considered green. Examples include physical termite barriers,

borate-treated building products, and bait systems that eliminate the need for broad-based pesticide application.

Products that reduce pollution or waste from operations. Alternative wastewater disposal systems reduce groundwater pollution by decomposing organic wastes more effectively. Porous paving products and green (vegetated) roofing systems result in less stormwater runoff and thereby reduce surface water pollution and sewage treatment plant loads. Masonry fireplaces and pellet stoves burn fuel more completely with fewer emissions than conventional fireplaces and wood stoves. Recycling bins and compost systems enable occupants to reduce their solid waste generation. All these products are green because they improve the environmental performance of building operations.

Products That Reduce Environmental Impacts During Construction, Demolition, or Renovation

Some building products achieve their environmental benefits by avoiding pollution or other negative environmental impacts during construction, renovation, or demolition. While this is a fairly small category of products, it is nonetheless important. Erosion-control products, foundation products that eliminate the need for excavation, and exterior stains that result in lower VOC emissions into the atmosphere all reduce the impact of new construction. Low-mercury fluorescent lamps reduce environmental impacts during demolition and renovation. Access flooring systems and modular carpet tiles minimize environmental impacts during renovation, because they make reconfiguration of spaces much faster and reduce waste.

Products That Save Energy or Water

The ongoing use of energy in a building is often its most significant environmental impact — and one that usually far outweighs the impacts associated with building that structure. Water consumption is becoming a more and more important consideration in buildings as droughts become more common and more severe.

Building components that reduce heating and cooling loads. Examples include structural insulated panels (SIPs), insulating concrete forms (ICFs), and high-performance windows and glazings. As these energy-saving products gain market acceptance, the performance level needed for a product to be considered green can rise. For example, while insulated-glass windows with a low-e coating may have been enough to designate a window as green several years ago, today it may take multiple low-e coatings or other green features, such as more durable or recycled-content frame material.

Equipment that conserves energy. With energy-consuming equipment such as water heaters and refrigerators, it is fairly easy to identify green products — by setting a threshold for energy performance. Some green building programs identify products labeled by Energy Star as the standard for green. Other programs or directories may define tougher standards or include other criteria, such as durability, in addition to energy performance.

Renewable energy and fuel cell equipment. Equipment and products that enable us to use renewable energy instead of fossil fuels and conventional electricity are highly beneficial from an environmental standpoint and are generally considered green. Examples include solar water heaters, photovoltaic systems, and wind turbines. Fuel cells can also be considered green, even though fuel cells today nearly always use natural gas or another fossil fuel as the hydrogen source; they are considered green because emissions are lower than those of combustion-based equipment and because the use of fuel cells will help us move beyond fossil fuel dependence.

Fixtures and equipment that conserve water. Products that conserve water are often considered green, but there may be other considerations. All toilets and most showerheads, for example, now meet federal water efficiency standards, but not all of those products perform satisfactorily. A green designation may require independent evidence of superior performance.

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Products That Contribute to a Safe Indoor Environment

Buildings should be safe to live and work in, and product selection is a significant determinant of indoor environment quality. Green building products that help to ensure a healthful indoor environment can be separated into several categories:

Products that release insignificant levels of pollutants. Included here are zero- and low-VOC paints, caulks, and adhesives, as well as products with very low emissions, such as nonformaldehyde-manufactured wood products. Just how low the VOC level needs to be for a given product to be considered green may vary by program and directory.

Products that block the introduction, development, or spread of indoor contaminants. Certain materials and products can be considered green because they prevent the generation or introduction of pollutants — especially biological contaminants — into occupied space. Duct mastic, for example, can block the entry of mold-laden air or insulation fibers into a duct system. Rainscreen products can help buildings dry out after wetting occurs. Entryway "track-off" systems remove pollutants from the shoes of people entering. Coated ductboard — compared with standard rigid fiberglass ductboard — prevents fiber shedding and helps control mold growth. And linoleum helps to control microbial growth because of the continuing process of linoleic acid oxidation.

Products that remove indoor pollutants. Removing stale indoor air is an important air quality practice, so a wide range of ventilation products, filters, and radon mitigation equipment can be considered green. In some product categories, other considerations may be important. Noise may be a consideration for bathroom fans, for example, because they are more likely to be used by homeowners if they're quiet.

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Products that warn occupants of health hazards in the building. Carbon monoxide (CO) detectors and test kits for lead paint, VOCs, mold, and other potential hazards can help keep homes and workspaces safe, and so can be considered green. In some cases, performance criteria are also considered — some CO detectors are not effective, so evidence of good performance may be necessary for a green designation.

Products that improve light quality. There is a growing body of evidence that natural daylight is beneficial to our health and productivity. Products that enable us to bring daylight into a building, such as tubular skylights, can be considered green for that reason (in addition to their energy-saving benefits).

Finding Green Building Products

Selection of green building products as part of an overall green design strategy makes a great deal of sense. But finding such products can be difficult. Green building products may not be available in all building supply centers. Some are more expensive or are considered fringe products. To get your local supplier to carry green products may take some convincing. If you are committed to using FSC-certified lumber, for example, besides letting your supplier know that, you could help out by doing the research on product wholesalers your supplier could purchase from. Just a few customers asking for green products can make a huge difference — try it.

You may also find it challenging to identify which products are actually green — compared with those being marketed as green. "Greenwashing" is fairly common today, and few places exist where you can find independent verification of green claims. Specific labeling programs such as Energy Star, GreenGuard, and Green Seal can help, and there are a handful of green products directories, including our own: *GreenSpec*. Such directories can be a valuable resource.

Alex Wilson *is president of Brattleboro, Vt.-based BuildingGreen, Inc., which publishes* Environmental Building News *and* GreenSpec*, the leading national directory of green building products.* GreenSpec *carries no advertising and includes more than 1,650 products. It is available in a print edition or as part of BuildingGreen's premium web content. The fourth edition will be available in November. For more information, visit www.buildinggreen.com or call 800/861-0954.*