Inexpensive Strategies for Green Building

Yes, recycled lumber and plantation-grown lumber cost more, but designing smaller houses, orienting them for solar gain and minimizing job-site waste don't

BY ALEX WILSON

Many designers and builders think of green building as just another add-on option for potential home buyers to consider: "So do you want the master-bath bump-out with spa ($4,800), the three-car garage ($10,500) and our exclusive 'green' package (just $3,500)?"

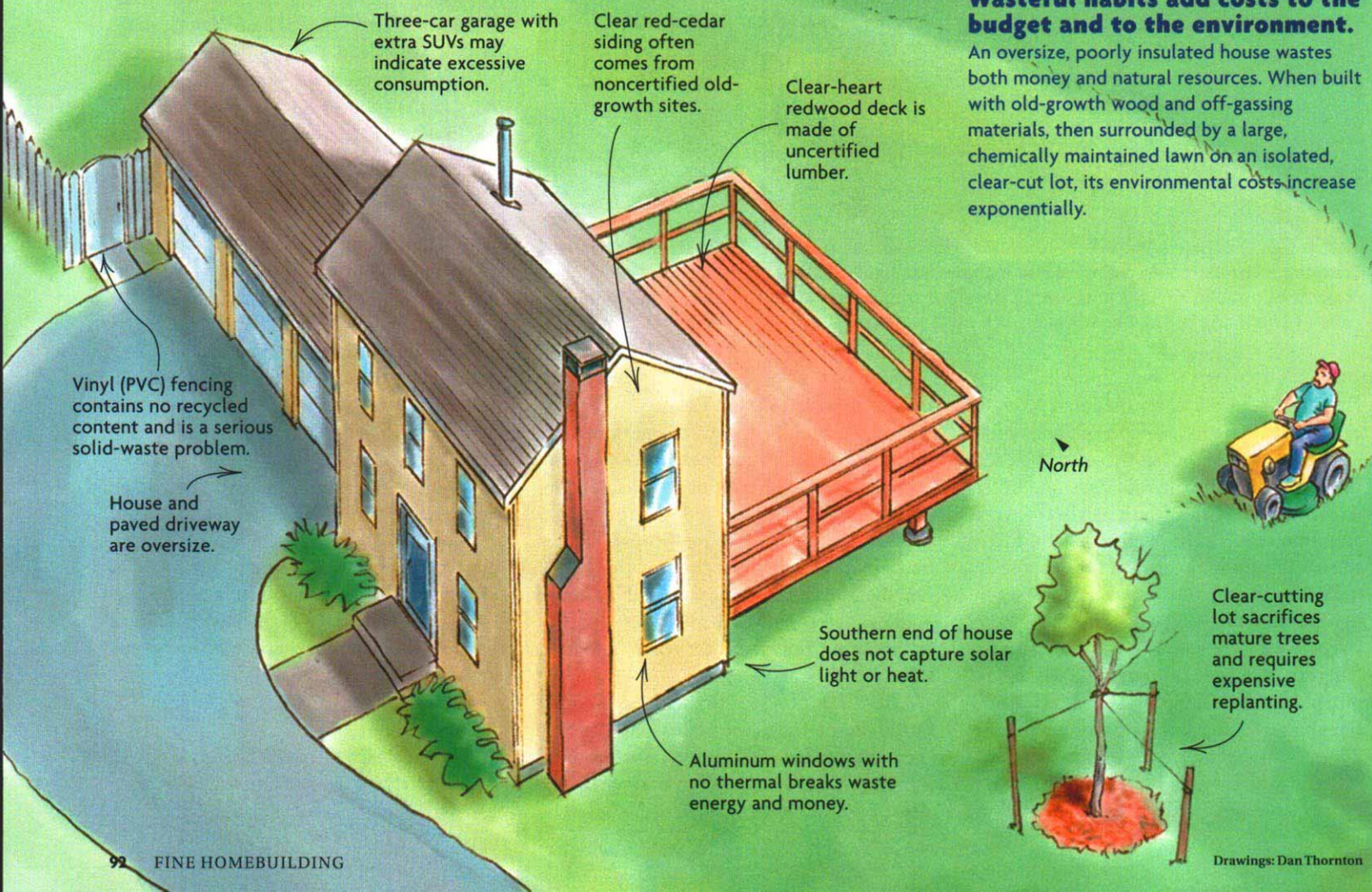
Owners then mix and match these options, trading off conflicting priorities, to stay within their budget. "We'll go with the master-bath option, but stick with the two-car garage; and how much of that green package can you provide for $2,500?"

While quite common today, this à la carte approach largely misses the point of green building. Limiting green building to a collection of add-ons almost guarantees that the finished product will fail to be as green as possible, no matter what the budget.

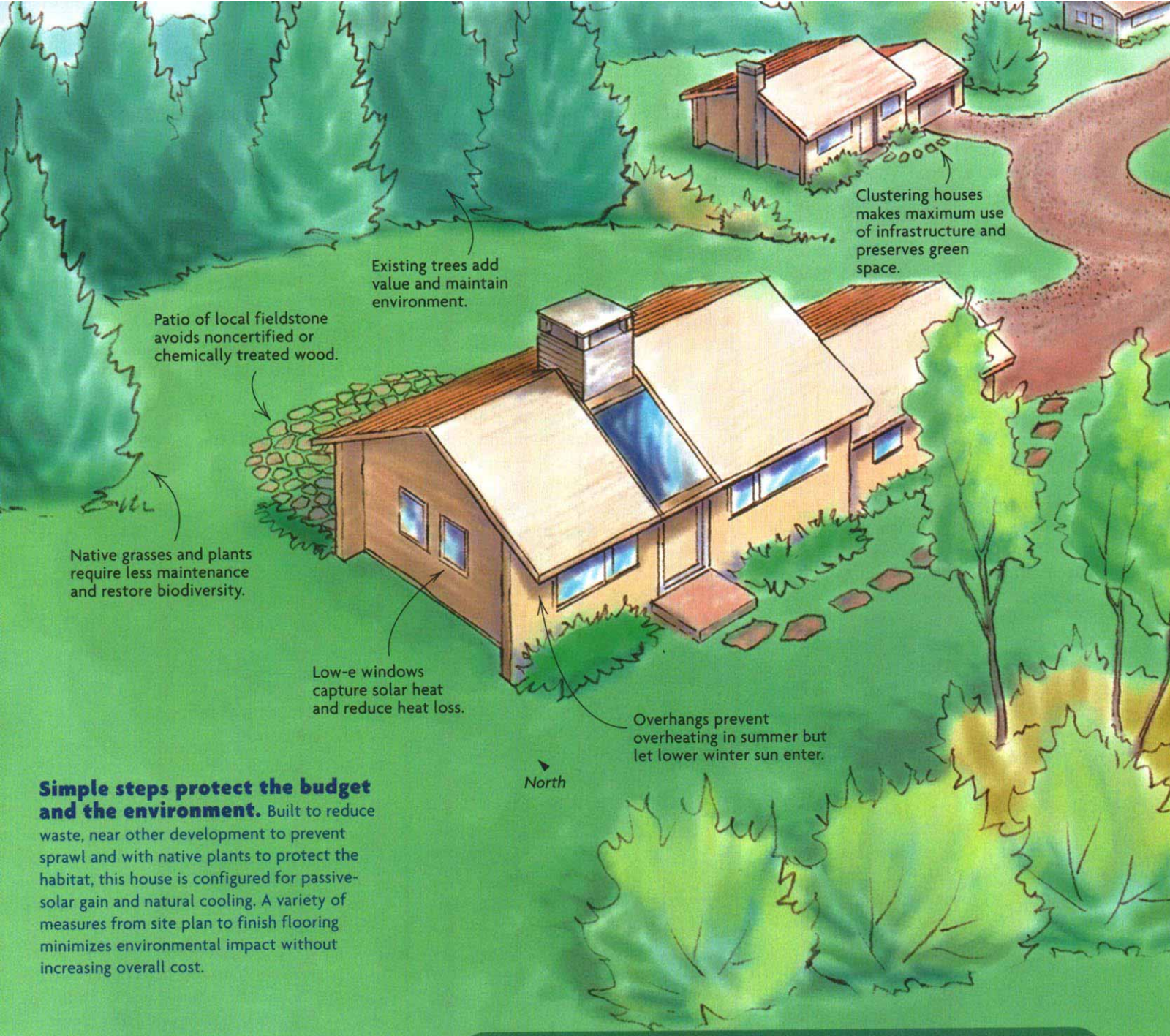
I suggest a different approach. Instead of beginning with a collection of high-profile (and often expensive) green features to add to a house, let's integrate from the start ten basic strategies that dramatically increase sustainability but add little or no cost. Some even reduce costs. Even strategies that do increase purchase price slightly may reduce the total cost of ownership (due to the lower utility bills or reduced maintenance costs) while providing a greener product (sidebar facing page).

Green homes are often fairly expensive, but they don't need to be. You can usually implement the following strategies with little or no net increase in the house's overall price. You can certainly go a lot farther, installing solar panels on the roof, recycled-glass tiles in the bathrooms and certified-wood cabinets in the kitchen—and I hope you will

Wasteful habits add costs to the budget and to the environment. An oversize, poorly insulated house wastes both money and natural resources. When built with old-growth wood and off-gassing materials, then surrounded by a large, chemically maintained lawn on an isolated, clear-cut lot, its environmental costs increase exponentially.



Drawings: Dan Thornton



Simple steps protect the budget and the environment. Built to reduce waste, near other development to prevent sprawl and with native plants to protect the habitat, this house is configured for passive-solar gain and natural cooling. A variety of measures from site plan to finish flooring minimizes environmental impact without increasing overall cost.

What exactly is green building?

The phrase "green building" has been thrown around a lot in the past few years. As used here, it means designing and building a home in a way that reduces the environmental impacts of both building and operating it. A green home is one that:

- **Is no bigger than it needs to be.**
- **Uses materials efficiently.**
- **Does not harm—and may even help—the immediate environment.**
- **Does not waste much energy or water.**
- **Will last a long time and require only low-impact maintenance.**
- **Will be healthy to live in.**

There are many ways to design and build a green home; don't expect one list of measures to fit every situation. The details of any green design depend on the needs and priorities of the homeowner, the building site, the local climate, regional resource issues and, of course, the budget.

—A. W.

consider these options—but you don't have to spend any more to build a green home.

1. Make houses no larger than necessary

Since 1950, the average U. S. house size has more than doubled while the average family size has dropped 25%. Put another way, the average house in 1950 provided 290 sq. ft. per family member; the average house today provides more than 800 sq. ft., a 2.8-fold increase. Scaling back not only reduces the environmental impacts of building and operating that house, but it also saves money.

Depending on how much we reduce overall house size, we may save money even while spending more per square foot on better-quality finishes, extra amenities and perhaps even some of those more-expensive green features. Building smaller isn't easy, though. It takes a good designer to create a small house that functions well and doesn't feel cramped. Sarah Susanka's book, *The Not So Big House* (The Taunton Press, 1998), provides a superb, beautifully illustrated overview of creating smaller houses that work.

2. Use integrated energy design

Integrated energy design pays for better energy performance by downsizing heating and cooling equipment. This low-cost strategy is crucial to designing a green home (drawing pp. 92-93). Say you spend an extra $5,000 increasing insulation levels to R-24 in the walls and R-50 in the roof, upgrading to high-efficiency windows with multiple low-E coatings and configuring the house to benefit from passive-solar heating and natural cooling. These changes allow you to heat the entire house with a single high-efficiency, vented gas space heater ($1,500) and two radiant-electric panels ($500), and to maintain comfort in summer with a single room air conditioner ($500) and two paddle fans ($500). The building-envelope design and this heating and cooling equipment allow you to eliminate the central heat and air units, ducting and controls ($8,000). The total direct costs of these two approaches balance out, and you get a far greener home that costs much less to operate.

Although the principles of integrated energy design are fairly straightforward, implementing them effectively takes a lot of skill and experience. The key is working with a good energy designer who can use computer-design tools to model building performance. Several builders I know have been using Energy-10 design software, a modeling tool developed by the National Renewable Energy Laboratory and distributed by the Sustainable Buildings Industry Council (www.sbicouncil.org; 202-628-7400). Energy-10 allows them to simulate how various alternatives (different insulation levels, glazings, window configurations, etc.) will affect the building's energy performance. As with all prediction software, the output is only as good as the input; the designer must understand building science to evaluate the software's predictions. Paying for such expertise at the design stage saves resources and money at all later stages.

3. Use materials more efficiently

Designing and building a house to standard dimensions—wall lengths in multiples of 2 ft. or 4 ft., ceilings at 8 ft.—saves money both by reducing cut-off waste and by reducing landfill disposal costs. Optimum-value engineering, or advanced framing, allows you to use less framing lumber without sacrificing structural integrity (drawing facing page).

Joseph Lstiburek, P. E., of Building Science Corporation in Westborough, Massachusetts, consults for some of the largest production homebuilders in the country. Lstiburek has seen dramatic savings result from advanced framing. The lumber package costs about the same with advanced framing (even though less lumber is used, more expensive 2x6s are substituted for 2x4s), but labor costs less—after a learning curve. "The real financial benefit of advanced framing," he claims, "is reduced callbacks from drywall cracking."

Town and Country Homes in Chicago, which builds about 1,000 homes per year, is now saving $75,000 to $100,000 a year just through reduced drywall callbacks. With two-stud corners and drywall clips supporting drywall, corners are far less prone to cracking. Prior to switching to advanced framing, the company had a 75% to 85% callback rate for drywall cracking; that has now dropped to less than 20%.

4. Use structural materials as finish materials

Houses can be thought of as being built in layers: a structural layer (wood-frame walls and plywood subfloors, for example) supports an interior finish layer (drywall, hardwood flooring) and an exterior finish layer (siding and shingles). Combining structure and finish in one material can save both resources and money. For example, textured and pigmented concrete floors are attractive enough to serve as the finished floor and add thermal mass. Structural posts, beams, rafters and collar ties can be left exposed. Timber-framing carries this strategy to great lengths (photo p. 96) but is usually not a low-cost building approach. Applied less comprehensively, though—for instance, using timber-frame ceiling joists with exposed tongue-and-groove flooring above—this strategy can save money while saving materials. Autoclaved cellular concrete blocks are another example. This low-cost material uses a fiber-reinforced stucco over blocks laid with thinset mortar. The stucco can serve as the wall finish on both interior and exterior.

5. Build a patio instead of a deck

Raised decks are either environmentally damaging or expensive—or both. Pressure-treated wood (usually chromated copper arsenate treatment, or CCA) carries significant environmental risk during disposal, while the naturally rot-resistant woods used for

First cost vs. life-cycle cost

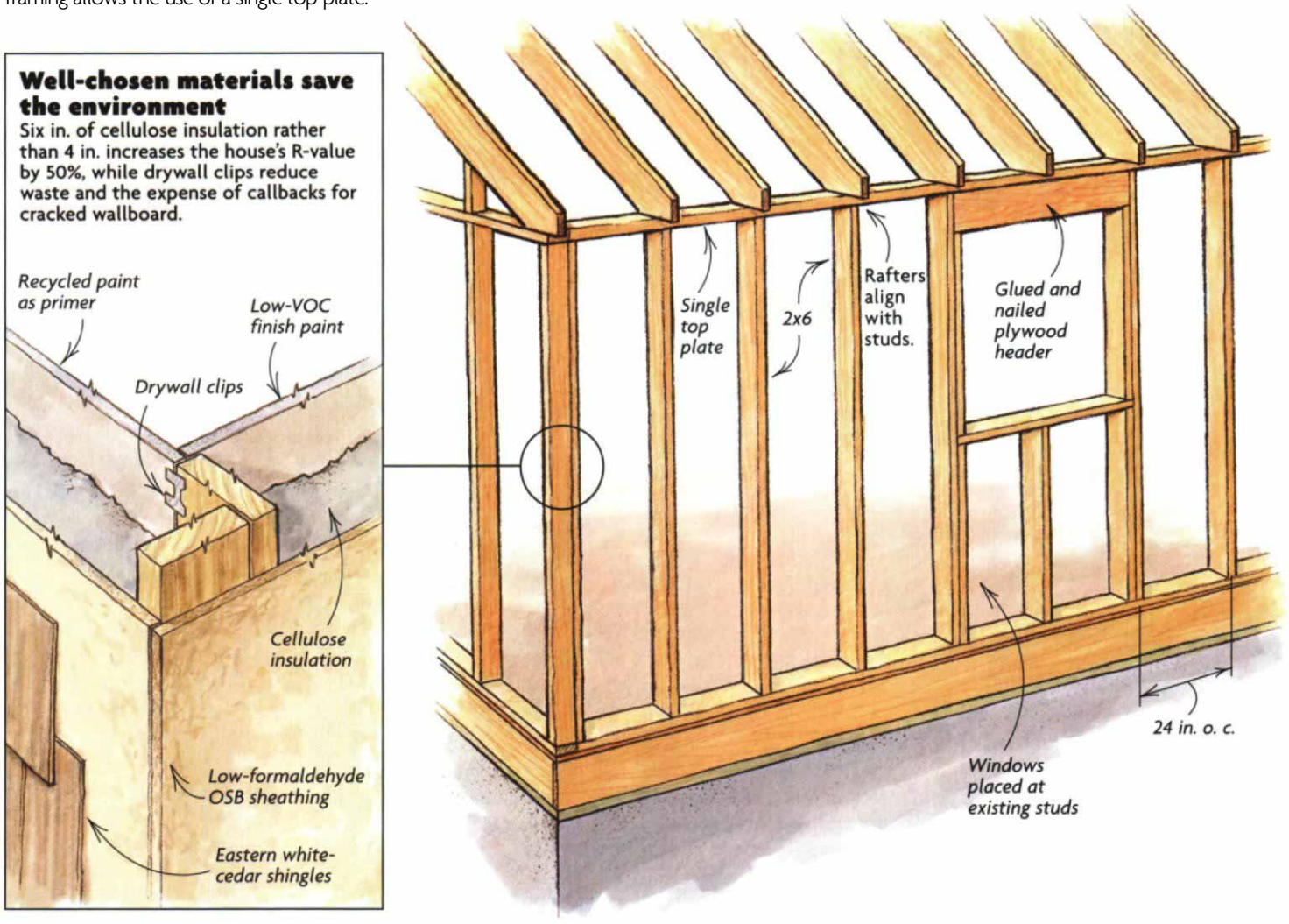
Building a green home without spending more is certainly possible, but sometimes it makes sense to spend more up front for savings down the road. For example, energy improvements to the building envelope (insulation, glazings, passive-solar design) can often be paid for through reduced cost of mechanical equipment. But even if the savings don't pay for the entire extra up-front costs, it still probably makes sense to carry out those measures; life-cycle costs will be a lot lower. The same argument holds true for a more expensive siding material that will last 50 years instead of 20 years, or for installing longer overhangs that protect siding from rain and splash back.

Life-cycle cost analysis looks at the total costs of a product or system over its life: initial purchase, energy use, maintenance and replacement. The idea of payback for an investment—the time it takes to repay the extra up-front cost—is a common way to express this. Return on investment is another. Comprehensive life-cycle cost analysis will factor in the discount rate, an assumption for how quickly money in the bank will increase in value if you saved your money instead of investing it in the product.

—A. W.

ADVANCED FRAMING SAVES MATERIALS

Keeping wall lengths to increments of 2 ft. avoids small stud bays that complicate framing, while 2x6 studs 24 in. o. c. with two-stud corners minimize wasted materials and maximize insulation. Aligning rafters and studs for in-line framing allows the use of a single top plate.



decks, including redwood and the tropical ipé, are not readily available from independently certified forests. (The Forest Stewardship Council—www.fscus.org; 877-372-5646—lists guidelines that should be considered standard for well-managed forests.) The environmentally attractive decking material—recycled plastic lumber or recycled wood-plastic composite lumber—has a higher first cost than pressure-treated lumber, but costs less to maintain and has a long life.

Fortunately, there's another green alternative: Stone patios last longer and do not release chemicals into the environment. Stone can usually be found locally, and the patio will need less maintenance and probably cost less to build (photo p. 97).

6. Use salvaged materials

Using salvaged building materials eliminates the environmental impacts associated with extracting raw materials and processing them into building products. Materials salvaged from buildings being torn down or renovated are sometimes (but certainly not always) less expensive than new materials. Note that low-cost salvaged materials can require labor to prepare—scraping mortar off old brick, removing nails, etc., so even buying salvaged materials inexpensively will not always reduce building costs. In fact, vintage salvaged and remilled lumber often costs significantly more than new lumber; but the quality, durability and often the resale value of the home are usually higher. With some species—cypress, longleafyellow pine and redwood, for example—the best wood available today is often from salvaged sources because we have depleted the old-growth trees that can produce such lumber.

Salvage yards often carry lower-cost salvaged materials. These materials may include wood that hasn't been remilled, brick, stone countertops, slate shingles, patio flagstone, hardwood flooring, claw-foot bathtubs and period millwork (doors, mantels, wainscoting, etc.). Even salvaged paint is available in some areas—filtered and remixed leftover acrylic paint works fine as primer. Most ofthese salvaged materials will cost less than comparable new products; sometimes, the savings are significant.

A few cautions: Avoid the temptation to install salvaged toilets or shower and sink hardware that uses far more water than new products. Similarly, salvaged windows lack energy efficiency. Finally, use care in buying salvaged wood, especially millwork, because ofpotential contamination with lead paint or pesticide residue. Lead-paint test kits are widely available and easy to use.

7. Reduce job-site waste

Construction-waste disposal never used to be a significant budget item in home construction, but it often is today. Reducing the

Photo not authorized for reproduction

Double duty. Recycled timbers and concrete floors conserve resources by serving as both structural and finish materials. The concrete floor also adds thermal mass.

amount of waste being hauled to the landfill can save hundreds of dollars per home. Waste-reduction strategies include storing and reusing lumber cutoffs, chipping up drywall scraps as a soil amendment and recycling cardboard, plastic packaging, steel scrap, asphalt shingles and nonreusable wood. A local municipal solid-waste office should be able to provide a list of recycling facilities. It takes time to separate, store and haul recyclable materials; but for a well-organized job site, the costs of dealing responsibly with waste should be less than the costs of simply landfilling it.

8. Cluster buildings or build near existing infrastructure

In a larger development or subdivision, clustering buildings reduces infrastructure costs: water and sewer lines, natural-gas lines, electricity, storm-water drainage systems and pavement. Clustering can also reduce permitting costs, for instance if measures to protect open space increase support for the project. Clustering offers at least two environmental benefits: It consumes less material and protects open space, farmland and wildlife corridors.

Creating tightly knit communities can also result in environmental benefits down the road—or rather not down the road—because residents may find that they like spending time in the neighborhood instead of driving somewhere else. Clustering houses while permanently protecting open space is one of our most important green opportunities.

When building individual houses, we can realize the same sorts of environmental and cost benefits by building where infrastructure already exists. In urban or suburban areas, consider in-fill lots; in rural areas, consider already developed sites instead of developing undisturbed land.

9. Protect existing trees and use native landscaping

Saving trees on a building site takes time and effort, but it repays handsomely. Planting a reasonably sized tree costs hundreds of dollars, while large existing trees add significant value to a home—on the order of $5,000 to $10,000, according to a survey by the National Association of Home Builders.

While you're saving trees, get rid of turf grass. Instead, consider native vegetation: Where you want grass, plant indigenous grasses. In appropriate regions, seed for tallgrass prairie vegetation or maintain a native woodland. Even if these landscape treatments don't save money initially, they will almost certainly reduce maintenance costs; outdoor water use often accounts for one-half of a homeowner's water bill. Meanwhile, native landscaping offers dramatic environmental benefits. For starters, native vegetation provides food and forage for wildlife, thus helping to restore biodiversity. Meanwhile, in many areas, chemical runoff from lawns is the No. 1 cause of water pollution; and, according to the EPA, a two-cycle gasoline lawn mower generates more carbon monoxide and other regulated air pollutants in one hour than driving a typical car 2,000 miles.

10. Allow storm-water infiltration

The conventional practice of channeling rainfall into storm sewers and dumping it in a nearby body of water is both environmentally damaging and expensive. Channeling storm water directly into surface waters contributes to downstream flooding, precludes natural filtration and chemical breakdown of pollutants, and prevents the recharging of underground aquifers. For a large subdivision, building storm sewers can cost hundreds of thousands of dollars. In some areas, storm-sewer connections are even required for individual houses. With planning, however, we can usually allow rainwater to soak into the ground right on site—what civil engineers call storm-water infiltration.

In the 1970s, developer Michael Corbett designed the 70-acre, 240-unit Village Homes subdivision in Davis, California, so that it could handle, without storm sewers, all the storm water likely to be generated in even the heaviest rainstorms. As it recharged aquifers and reduced downstream flooding risks, this strategy saved about $800 per house—$200,000 total. Interestingly, the local building department did not trust this natural storm-water management system and made Corbett post a $1 million bond to pay for retrofitting storm sewers after his scheme failed. Shortly after the project was completed, when a severe 100-year storm inundated Davis, the Village Homes subdivision handled not only all this rainfall, but also much of the runoff from adjacent

subdivisions whose storm-sewer systems failed. The city returned Corbett's bond.

Specific strategies for storm-water infiltration include the following:

· Minimize paving—keep driveways and access roads narrow, for example.

· Avoid contiguous impervious surfaces—where a paved sidewalk abuts the driveway, provide a crushed-stone connecting channel into which storm water can drain.

· Use porous paving for the driveway and parking surfaces—special mixes of asphalt, open-web concrete pavers filled with gravel or planted with grass, or special recycled-plastic honeycomb paving systems that can be filled with sand and planted with grass (the plastic grid prevents soil compression, thus protecting the grass).

· Collect and store rainwater from the roof—a rain barrel under the downspouts costs almost nothing, while a more sophisticated system with a large cistern and water-purification system will cost significantly more. Harvesting rainwater reduces consumption of municipal-water supplies and thus the homeowner's water bill.

Energy-efficient mortgages give homeowners more for their money

These ten strategies are a good start toward low-cost green building, No matter how well builders control costs, though, the homeowner still has to pay for it; and most homeowners need to take out mortgages to do so. Fortunately, many lenders now offer special mortgages for energy-efficient houses. An energy-efficient mortgage (EEM) recognizes that the owners of such houses will spend less on energy, and so can afford higher mortgage payments. Thus, owners at a given income level can afford a more expensive house. They can get more of a house—a nicer location, perhaps, or some of those green features that do cost more—without raising their total monthly housing costs (mortgage payments plus energy bills). In some markets, the mortgage-lending company Fannie Mae is currently testing other, much broader "green mortgages."

Building a green home doesn't have to cost a penny more than building a conventional home. What does cost more, though, is the investment of time required by the designer and builder to make a house green. It takes time and effort first to learn about and then to implement environmentally responsible design and construction practices. Don't expect to build the ultimate green home right away. Ease into green building by integrating a few new strategies into each home, gradually making it a key part of your design. Your clients will be pleased with the homes you create, and you can feel good about helping to make your children's and grandchildren's world a better place. □

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Let it rain. A fieldstone patio avoids the chemicals of treated wood decks and requires little maintenance.

Photo this page: Steve Silk

Green-building resources

BOOKS

Builder's Guide to Cold Climates: Details for Design and Construction by Joseph Lstiburek; The Taunton Press, 2000.

Building Greener Neighborhoods: Trees as Part of the Plan, 2nd edition, by National Association of Home Builders; Home Builder Press, 1995.

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Green Building Resource Guide by John Hermannsson; The Taunton Press, 1997

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Natural Home, Natural Home, LLC; www.naturalhomemagazine.com; (800) 340-5846
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