

# Building Green Within Everyone's Reach

BY KIM MASTER

**G**reen building is fraught with mythology: “It is too expensive;” “I can’t get the products where I live so why bother?” “I don’t want to live in some weird straw-bale house;” “Solar is ugly;” “Nobody I know has ever done it;” “I’m not an old hippie and don’t want to live that way.” Other people assume falsely that green building is too good to be true—that it is all greenwashing and a marketing ploy on the part of the industry to dupe us once again.

Yes, some building elements do cost more. But many cost less! Green building is simply applied common sense. It’s a more systematic way of thinking about buildings. Looking at the big picture rather than just the bricks and mortar adds a new perspective to how all the pieces fit together and the consequences, both near and far, of the decisions we make at the design stage of a project and the products we use to build it.

Green building need not be too expensive. When it is part of the initial process of setting goals for the remodeling project it becomes matter of fact—the homeowner, the builder, and the architect just make it happen. Many builders have found that the real cost is in the learning curve, not in the implementation of the building process. The products are becoming more available and more affordable all the time as major manufacturers develop new lines to meet the “green” demand. Paints are a classic case in point; paints that are now low in volatile organic compounds (VOCs) are now featured in product lines of all major manufacturers. Keep in mind that green building doesn’t have to look any different from conventional buildings; it is how it’s built, not what it looks like.



**The home office in David Johnston's house**

Green building actually makes and saves money. And this is not just long-term energy saving costs; the costs to implement green features (“first costs”) is often less than remodeling by conventional standards. In the long term, green building can increase the resale value of your home. There are also financing options available for people who remodel with energy efficient features that can save hundreds of dollars.

Another way to look at the cost of green is what is it worth to you to reduce the possibility that your children will develop asthma or other respiratory problems?



**David Johnston's green building rehab project**

How valuable is the health of your family? Is comfort on cold winter nights—thanks to energy efficient windows and increased insulation—important to you? There are many subtle savings and preventative measures that can't be put into a bottom line cost/benefit analysis. But no matter



how you look at it, green building is a smart, money-making investment. Green building is not about opening your wallet; it's about opening your mind!

### Green Residential Building

In 1993, David Johnston, President of What's Working, Inc., a company that offers "visionary solutions for green building," bought a "fixer upper" with a view. The house was built in 1973 and was rented for eight years before he bought it. Like any rental property, it showed the results of hard use and little maintenance.

"Photovoltaic (PV) panels that generate electricity from the sun have been my best and biggest upgrade," asserts Johnston. "At least once a month, especially in big snowstorms or thunderstorms, our power would go down, stopping my home-based business in its tracks. So in 1999 when the U.S. Department of Energy had a rebate for PV systems, I jumped on the opportunity." Interest rates had come down and he was able to refinance the house, allowing him to take enough money out of equity to pay for the PV system

**"Green building is a smart, moneymaking investment."**

## Green Mortgages

There are many ways to finance "green building" construction and home improvements. While many "green" initiatives are encouraged through state and federal agencies, some banks are starting to see the financial advantage to energy efficiency. Lenders often focus on the bottom line, and increasingly the bottom line—saving energy and reducing greenhouse gases—work together. A home that uses less energy allows the owner to have more money available to pay the mortgage. This simple fact can finance home improvements and allow a home buyer to afford a larger mortgage. Home buyers and home owners have fewer excuses to avoid energy efficiency improvements. After financing, some improvements will actually lower their overall monthly costs.

Many of these financing programs start with a Home Energy Rating System (HERS) report. For a fee from \$150–\$400, a home is evaluated for energy related features such as insulation

levels, window efficiency, window-wall-ratios, heating and cooling, and air leakage. The inspection will provide a 1 to 100 rating and estimated annual energy costs. The HERS report will also evaluate home improvements on a cost vs. payback basis. Often qualifications for funding are based on improvements that must be cost-effective. The benefits must exceed the costs.

Energy Efficient Mortgage (EEM) programs are available from government and conventional sources. Research should start at the U.S. Department of Housing and Urban Development (HUD) and the Federal Housing Authority (FHA), which focus on first time home buyers and residents in disadvantaged neighborhoods. The Environmental Protection Agency (EPA) and the U.S. Department of Energy have an Energy Star program that offers borrowers incentives for Energy Star certified homes. Fannie Mae and Freddie Mac also have EEM packages for home buyers and home improvement.

Check with local banks as well. In Vermont, Chittendon bank offers a 1% discount

on their standard home equity loan rate when the loan is used to make energy efficient improvements to a residence. Working with Efficiency Vermont, Chittendon is packaging business loans for energy efficiency as well, calling it the **UE<sup>2</sup> Loan Program** (Upgrade for Energy Efficiency.) Other banks are just beginning to understand the financial side of "green buildings." Call your local bank and see what they offer.

When considering a "green building" or energy home improvements, do the research for your area. The Northeast states are among the best in the country for state initiatives. Look to local utility companies as well. With state mandates on renewable energy, many utilities are looking for ways to increase their "green-ness" (see Green Tags.) While some home owners may be motivated to "do the right thing" regardless of cost, anyone can get involved and save money in the process.

— Greg Aubin

Many hotels now feature energy-efficient lighting and other green features such as the Azure Dining Room and this quiet seating area at the Lenox Hotel in Boston



and simultaneously save money on his monthly payment.

The 1.2 kilowatt system is enough to power his office. In an emergency, the system also powers the hot water baseboard heating, lights and the refrigerator. Johnston exclaims, “I don’t believe in pay-back periods for energy equipment, but I do believe in never being powerless again.”

Even if it’s not broken, Johnston tries to replace old technology with new technology whenever possible. So he’s installed Heat Mirror™ windows, often called “super windows,” that have a film of plastic suspended between two panes of glass that make them super energy-efficient—they’re almost twice as effective as conventional windows. “The windows work like a charm,” according to Johnston, “making the house more comfortable and reducing our heating bill significantly.”

In addition, with the push of a button, Johnston’s Metlund “on-demand hot water pump” circulates water in pipes until it reaches a predetermined temperature at his bathroom faucet. “I no longer waste water waiting for the shower to heat up; rather, the pump shuts off and the water is instantly hot.”

The savings Johnston enjoys from his PV system and other “mini-green renovations” are just a small part of the

gratification; peace of mind is priceless. The PV system has kicked in many times, allowing him to be productive in his office even during “down times.” Reduced water usage protects the limited neighborhood water system. Importantly, “greening my vintage home has been a fulfilling way to connect to my environment and to support my community.”

### Green Commercial Building

Tedd Saunders, owner of the Saunders Hotel Group in Boston, is also a very dedicated green building proponent. The Saunders Hotel Group owns the Lenox Hotel, located at 61 Exeter Street in Boston. Other Saunders projects include the Copley Square Hotel and the Comfort Inn and Suites Boston/Airport. The Lenox Hotel is a green business and is becoming greener every day. “This is an ongoing project,” says Tedd, the family’s third generation hotelier. “We spend about \$275,000 yearly on studies evaluating new products and training. We are a TQM [Total Quality Management] operation.”

Saunders’ Lenox Hotel and Comfort Inn have been awarded the EPA’s Energy Star Building Label for exceptional energy performance. In March of this year, the Saunders Hotel Group won the prestigious EPA Energy Star Partner Of The



Year. “We are extremely proud,” Tedd says. These hotels do more than study how to save energy on paper; they actually save energy in the real world. The hotel combines energy conservation, solid waste and water management with eco-friendly products. They also support those efforts with a commitment to educate their customers.

What made the Lenox Hotel “green”? First, to increase the building’s energy efficiency, bricks and windows were replaced and insulation was added. The replacement brick chosen was historic old brick; the brick material that was no longer needed was recycled. The windows that were removed were literally de-manufactured and recycled. The hotel’s new windows are low emissivity (low-e) and highly efficient. Energy is conserved with super efficient heat pumps in guest rooms, providing both heating and cooling. Tightening the building’s skin allowed downsizing of the heat pumps as well, further saving money. Forty-eight hundred energy efficient light bulbs were recently installed in all three hotels, including low energy,

five to seven watt, and candelabra bulbs.

Additionally, water management is a priority for Saunders, who encouraged a closed loop cooling system that is used for making ice and for air conditioning. The old “once through” water-cooled system wasted a great deal of water as it passed through the heat exchanger only once. In the laundry, an ozone generator eliminates the need for chlorine and hot water. The Comfort Inn & Suites/Airport has a pool that is fitted with an ion system that saves 90% of the chlorine that it would otherwise consume. In-room showers are now fitted with high quality showerheads that use less water and last longer. Toilets are low flush devices and all sinks have aerators. The sink aerators were a \$200 investment for the entire hotel. These aerators are expected to save \$2,000 in energy and water in the first year. That is a savings of a factor of ten that continues year after year.

“We chose Aveda Bath Products,” Tedd says, “because their soaps, shampoos, and personal care products are environmentally friendly.” Saunders has a commitment to environmentally friendly products. Eco-

**“Our cost is in the minus numbers after renewable credits.”**

— MALCOLM BROWN OF HULL WIND

friendly products include paints, cleaners, and air fresheners that are low, or contain no volatile organic compounds (VOCs). Even the carpets and other cleaning materials are environmentally friendly. Carpets are cleaned with bicarbonate of soda and chandeliers with ultrasonic sound. The dining room floor is made of cork, a fast growing wood that avoids the need to cut old growth forests and is soft to walk on. Tedd likens using renewable products to eating rock crab rather than lobster, “The crab can grow back its claw, unlike the lobster.”

Education is taken seriously. The hotel has an education channel on its in-house

**The Hull Turbine beautifully visible from Boston**



television. Books are provided in every room. Tedd’s own book *The Bottom Line of Green is Black* is paired with *The Consumers Guide to Effective Environmental Choices* by the Union of Concerned Scientists.

The overall program was begun in the 1990’s as a “comprehensive environmental initiative.” The Lenox Hotel has won numerous awards including: The President’s Environmental & Conservation Challenge, National Trust for Historic Preservation, National Wildlife Federation, and Green Globe.

**Community Wind Project**

One company can make an impact. One community can also make an impact. The future of green energy can be seen at the Hull Municipal Light Plant in Hull, Massachusetts in the form of a green electric power generating station. It is now feasible for a town to generate some of its own electricity.

The impetus for the original wind turbine was the townspeople. Hull’s original turbine, circa 1985, was installed next to the high school and could power 16 homes. This turbine was then relocated to the

**Malcolm Brown stands in front of the wind turbine in Hull, Massachusetts**



town’s landfill on Windmill Point, which juts into Boston Harbor. In 2002, a newer, larger replacement turbine was installed. This new turbine is able to power 260 homes. “The replacement turbine is very neighborhood friendly,” Malcolm Brown

# INSULATION

## Thermal Performance is Just the Beginning

Insulation remains a critically important component of any green building—whether residential or commercial. No matter the type of insulation used, if it is used appropriately, its environmental benefits over a building's life will almost certainly far outweigh any negatives—and dwarf any environmental differences among the available materials. What follows is a brief survey of insulation materials.

**Fiberglass** The most prevalent type of insulation in North America, fiberglass is produced from silica sand with various additives, including boron. Most U.S. fiberglass insulation has a minimum 20–30% recycled content. Fiberglass insulation is manufactured with binders (typically phenol-formaldehyde) that hold the glass fibers together.

**Cellulose** Cellulose insulation is made primarily from post-consumer recycled newspaper, with up to 20% ammonium sulfate and/or borate flame retardants. While cellulose insulation used to be one of the highest-value uses of old newspaper, today dozens of de-inking plants in North America turn old newspaper into new newsprint, a better alternative than insulation's downcycling.

**Plastic foam insulation** Plastic foam insulation materials, including extruded polystyrene (XPS), expanded polystyrene (EPS), polyisocyanurate, and the various types of spray polyurethane insulation, are all produced primarily from petrochemicals. Both natural gas and petroleum are common feedstocks, and both have significant environmental impacts associated with their extraction, refining, and transport. All foam plastic insulation materials rely on flame-retardants to meet fire-resistance standards.

Recycled polystyrene can be incorporated into polystyrene foam insulation fairly easily, since polystyrene is a thermoplastic. EPS has long been made with non-ozone-depleting pentane. Some manufacturers are using a low-pentane formulation that results in lower pentane emissions. (While not an ozone-depleting compound, pentane can generate ground-level smog.) The more distributed production of EPS, compared with XPS, may reduce shipping energy consumption to some extent. EPS and XPS differ in how the foam is expanded—and they use quite different blowing agents. XPS still relies on hydrochlorofluorocarbons (HCFCs.) Though the XPS industry led the charge in replacing chlorofluorocarbons (CFCs) with far-less-damaging HCFCs, it is today the only type of boardstock insulation that remains harmful to stratospheric ozone.

Polyisocyanurate insulation incorporates a relatively small amount (9–10%) of recycled content to comply with CPG minimums. A portion of the polyol used in polyiso is produced from recycled PET bottles. The polyiso industry is one of the largest users of recycled, mixed-color PET bottles, according to the Polyisocyanurate Insulation Manufacturers Association (PIMA). The foil facings on many polyiso boardstock products may also contain some recycled content. The biggest environmental news in foam boardstock insulation has been the elimination of HCFC-141b in polyiso. The industry completed the transition from that ozone-depleting compound to the blowing agent pentane at the end of 2002.

### Final Thoughts and Recommendations

Insulation is a key component of any green building. More important than the decision of what type of insulation to install is the decision of how much insulation should be installed. From an environmental standpoint, a thicker layer of a relatively non-green insulation material is almost always better than an inadequate thickness of the greenest insulation material available. This point cannot be over-emphasized. However, assuming that adequate R-values can be achieved, choosing a green insulation material over a non-green one can be a very good decision.

### Summary recommendations

- Provide the highest feasible insulation levels.
- With lower R-value materials, increase insulation thickness.
- Avoid extruded polystyrene due to the ozone-depletion potential of blowing agent.
- Except where moisture may be an issue, use polyiso instead of either XPS or EPS.
- With highly conductive framing systems, especially steel, minimize thermal bridging by wrapping the frame with a layer of rigid board insulation.
- Choose high recycled content insulation materials when doing so will not result in significant loss of R-value compared with other materials.
- Address air leakage and moisture resistance in insulation detailing. A good source of information on building science issues is [www.BuildingScience.com](http://www.BuildingScience.com).
- For chemically sensitive individuals, test potential insulation materials for reaction before installation.
- Choose an insulation contractor who recycles scrap insulation.

— Alex Wilson  
Building Green

# Adding Solar and Buying Green Electricity

**W**hile insulation and conservation are the cornerstones of green building design, there are other ways to make an impact. Some will even save you money. After you seal your house, insulate, use compact fluorescents and look for energy conserving habits and appliances, consider these options that can allow you to make an impact.

## Solar Domestic Hot Water

Investing in a solar domestic hot water (SDHW) system is the most cost effective investment in solar, with the exception of orienting your house to the south and ensuring south-facing windows. Since their introduction in the 70s, the industry has matured and you can purchase reliable products that are virtually maintenance-free. Homes with electric or propane gas water heaters generally have a fast return on your investment. Homes with natural gas water heating, due to the current low cost of natural gas, make it more difficult for solar to offer a good return on your investment. If you live in a sunny area, SDHW systems can provide up to 75% of your hot water needs. Expect to pay \$3,000–\$5,000, and look for financing incentives that can bring your net monthly costs down. Also, the tell-tale panels on your building tell friends, neighbors and customers that you are doing your part.

## Photovoltaics—Solar Electric Systems

Perhaps you have been considering a Photovoltaic (PV) system that generates electricity from the sun for your house or business. A surprising 69% of home PV systems are connected to the power grid, and most areas now have “net-metering” so you become an electricity supplier, getting full retail value for your contribution. In fact, you will pay 30–60 cents per kWh, 3–5 times the cost of retail energy. However, there are very good federal tax incentives, and many states also offer incentives to encourage the installation of PV systems that might make the investment come closer to paying dividends. Check with [www.dsireusa.org](http://www.dsireusa.org) for their database of incentives.

Keep in mind that you are buying a hedge that future energy costs will increase far beyond the rate of inflation. Someday, 30–60 cents per kWh may be competitive. Also, if electric generation from other fuels was forced to include external costs: carbon, pollution, waste disposal, even wars—the numbers get even better.

Although you will not get rich on this investment, you will be the proud owner of a system that is quiet, has no moving parts and produces clean energy that is clearly better for the future of our planet. Most importantly, you own your own electric supply, and you are helping to build a decentralized clean energy system, one system at a time.

## Clean Electricity

If you don't want to invest in your own solar system, but want to use green electricity, you can do that today. Many utilities are offering green electricity options, or you can purchase Renewable Energy Certificates (RECs), sometimes called “green tags.” In both cases, you will pay a premium of \$100 to \$200 a year. This premium will be invested in utility-scale wind projects, biogas, biomass, or other clean energy projects, helping to build a clean energy future. For information on what you can buy in your area, check [www.green-e.org](http://www.green-e.org) and [www.greentagsusa.org](http://www.greentagsusa.org).

— Greg Aubin

tells us. Malcolm Brown has been one of the principals in the Hull Wind project since its inception.

Sighting wind turbines can be difficult. Using a landfill site is even more problematic because toxic materials can leak around concrete supports. New sealing technology has solved this problem. Now landfill excavations can extend to bedrock without leaks. Traditionally, in order to construct these towers, large areas of land had to be cleared. Malcolm explained that land clearing has been reduced from one acre to half an acre. No longer must assembled turbines be hoisted into position. By using newer turbines, wind power generators can be assembled “blade by blade.” By reducing the amount of cleared land needed, hilly sites, often the best locations, are easier to locate and pass public muster.

Has the project been a success? The turnkey cost was just under \$700,000, and the cost of the power it generates is 3½ cents per kilowatt-hour compared to 9 cents. “Our cost is in the minus numbers after renewable credits,” says Brown. The new turbine, now about three years old, is over 99.4 percent reliable. It would have been even better were it not for a 10-day outage to replace the generator and gearbox. Plans are in place to add another turbine to the site, more than doubling generating capacity.

Would a wind turbine work in your town? To find out, a meteorological tower would need to be erected in order to capture the data to generate a “wind rose”—a graph of wind intensity, duration, and direction. This data indicates whether a site is windy enough for power generation. It must be windy for much of the year. A regular 14.5 miles per hour wind is critical to the success of a project.

Is a site available? The site needs a good access road for heavy equipment. You will need a half acre of cleared land for delivery, set up, and assembly. Access to a three—phase, primary voltage distribution line (13,800v in Hull's case) is required to deliver power from generator to market.

Municipal electric projects can generate cost effective, renewable electricity on a

significant scale. Green commercial buildings can utilize conservation on a significant scale. Companies that build green sites may start off with a commitment to green policies, and then find that their commitment pays off.

Sometimes that commitment involves paying nothing for energy. The goal achieved by Keith Groff in New Jersey brings green building to the next level. Keith owns a Zero Energy Home (ZEH.) A home that has a zero-net energy bill at the end of the year requires a few steps:

Install R-23 insulation in the attic and between the floors and the basement. Install R-21 insulation in your eight inch thick walls. Have your windows facing south and east to collect passive solar heat. Install solar panels on the roof, which are angled to capture the maximum amount of solar energy. Your kitchen stove must be a high

efficiency gas fired range. Use compact florescent lighting. Install a high efficiency gas fired hot water heater that holds only ten gallons.

When power consumption is low, your home functions as a generator selling power to the local utility. This appears as a billing credit on your monthly statement. Keith's yearly energy costs, before credits, is about \$650. Cost after credits for power sold to his electric utility: zero dollars.

Collectively, Americans spend \$1 trillion annually on construction. If just a fraction of this money was focused on greener construction, we could restore a significant portion of the world's ecosystems while immediately creating a healthier indoor environment for our families. Moreover, according to a recent study by the Capital E group, Lawrence Berkeley Laboratory, and participating California state agencies,

commercial green buildings pay for themselves 10 times over as a result of the financial benefits associated with improved health productivity and lowered operation and maintenance costs.

Homeowners similarly enjoy improved comfort, better health, and lower utility and maintenance costs that result from building green. The bottom line: green building pays off.

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*David Johnston & Kim Master co-authored Green Remodeling: Changing the World One Room at a Time, a practical guide to new methods of sustainable design and building for homeowners and building professionals. David is the founder and Kim Master is a senior associate of What's Working, Inc.*





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