by Virginia Hughes

Building Green

Costs for environmentally conscious construction have come down, and that's good for green builders and for the environment

In April 2003, in the southwest Los Angeles suburb of Torrance, Calif., Toyota Motor Sales unveiled its new "South Campus" headquarters. The five, gleaming, three-story steel structures—together comprising 624,000 square feet of office space across 38 acres, and connected by a two-story glass atrium—had something in common with the company's best-selling Prius hybrid car: they were built "green."

Each building's rooftop holds a huge array of solar panels, providing 536 kilowatts of electricity—enough to power 500 homes, or 20 percent of the electricity needed for the entire complex. The campus uses recycled water for cooling, landscape irrigation and basic plumbing—saving 5 million gallons of potable water every year. It also boasts double-paned glass windows to reduce heat loss and recycled concrete to pave its roads.

Energy savings, water reuse, sustainable materials—these are the founding principles of green building, the movement borne out of the energy crisis of the 1970s that is now one of the most rapidly expanding industries in the developed world.

PHOTO COURTESY OF THE U.S. GREEN BUILDING COUNCIL

But another green force was at play when Toyota designed its South Campus: money. "We're achieving a very strong financial return from our green building complex," Tracey Doi, group vice president and chief financial officer of Toyota Motor Sales USA, told reporters at the time. The company's shareholders insisted that the new building generate at least a 10 percent return on investment. As it turned out, it well exceeded that requirement.

The buildings cost $90 per square foot—an average price for a campus that size. Unlike average buildings, however, the campus' green backbone saves the company $400,000 a year in electric bills and $12,000 a year in reduced water use. During construction, the company estimates it saved $35,000 by reducing and reusing waste that otherwise would have gone to landfills.

This incredible cost savings is what's primarily driving many companies to green their new construction projects. In November 2007, a survey conducted by the nonprofit U.S. Green Building Council (USGBC) of 150 "green" buildings found that the median cost increase to build green is just 1.6 percent—a premium that is well made up for in long-term energy efficiency, reduced maintenance costs and environmental protections, they contend.

The study was released at the same time as the council's annual conference in Boston, which was attended by 28,000 people from 85 countries—a 25 percent increase from the previous year.

The precise number of green building construction projects can only be traced back to 2000, when the USGBC rolled out comprehensive standards—called the Leadership

With a green roof, water-efficient landscaping and natural ventilation, the Sidwell Friends Middle School building (previous page) in Washington, D.C., is the first K-12 school in the United States to have a LEED Platinum rating (the highest of the four LEED rating categories). Fifty percent of the energy the school purchases for both of its campuses is wind energy. Toyota's South Campus sales headquarters in Torrance, Calif., currently remains the largest U.S. green building complex, left and below.

in Energy and Environmental Design (or LEED) Green Building Rating System—that would officially certify a new building as sustainable.

The USGBC started small, with only a handful of enthusiastic members. Now the USGBC is a world leader, with nearly 17,000 members, including corporations, governmental agencies and nonprofits. More than 60,000 architects and engineers from around the world are LEED-certified, meaning that they completed a LEED training course and passed a qualifying exam.

"It really took off in 2006," says civil engineer Jerry Yudelson, one of the original LEED trainers and author of *Green Building A to Z*. That was a big year, he says, for two reasons: first, Hurricane Katrina showed the vulnerability of buildings to energy price increases. Second, Al Gore's global-warming documentary, *An Inconvenient Truth*, was released. "That's really when people said, 'We better get serious about this stuff,'" Yudelson says.

A Spinach House

One of the world's "greenest" building designs is a house made of spinach.

The design plans—predominantly silver, white and green—emit a soft shimmer that hints of something from the future. Lush and unmanicured green bushes are planted inside some of the white sidewalk squares leading to the house. A gray, reconstituted concrete roof covers a wide-open, entirely unadorned front porch. The porch leads to the front door, and behind that rises the most striking feature: a tall, rounded, ultra-reflective column. This column is covered in a spinach-protein skin that absorbs heat from the sun and turns it into enough energy to power the home, neighboring houses and even the streetlights lining the block.

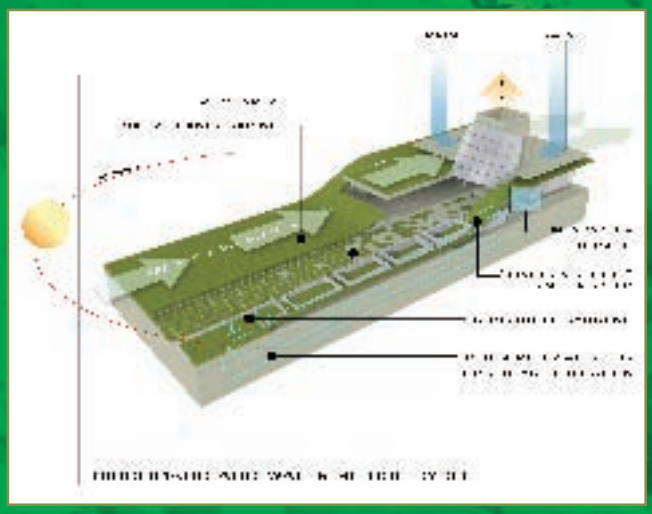
In 2004, a team of young Seattle architects submitted the revolutionary design to "C2C-Home"—an international competition of the most innovative "green" home designs. They bagged the first prize of $5,000, beating more than 625 entrants from 41 countries.

"It was a real challenge to envision what might be 20 years down the road, but at the same time be practical enough that it could be built today," says Michael Coates, the leader of the team. "The fundamental principle of the design was simple: to stop being 'less bad,' and to actually start being good in the way that we build."

The C2C-Home competition was sponsored by a nonprofit group out of Roanoke, Va., called Cradle To Cradle. The mission of the group is based on the thesis of the influential book of the same name. Written in 2002 by William McDonough, an architect, and Michael Braungart, a chemist, *Cradle to Cradle* calls for a new industrial revolution in which people live and businesses flourish without producing any waste.

"In reading that book, you understand that buildings need to stop being machines of consumption and actually start being producers of energy," says Coates. "They need to start giving back."

To create their forward-looking house design, Coates and his colleagues looked backward, to the time when most people lived in wooden shacks built around a central fireplace. "Everyone was aware of how much energy they were using because they could literally count the logs," he says. "Today, the fireplace has been relegated to a line on a real estate appraiser's checklist. We're not in touch with the energy source at all."



Everything about their design is sustainable. The living spinach panels allow it to operate entirely on solar energy. Water is conserved, too. Inside the shiny core, wastewater—including storm water from the vegetated roof system, sewage water and "grey water" from laundry, dish washing and bathing—is collected, filtered through a septic tank and finally released to irrigate the outdoor vegetable gardens. All of the building materials are produced without emitting much carbon into the atmosphere. And to offset the carbon produced in transporting goods to the building site, the design included plans to plant trees in the community.

Though three years have passed since this design was given the top prize, the structure has yet to be built.

"They didn't get the support in their community financially that they were hoping to," Coates says. In late 2006, he presented a model of it at the "Massive Change" exhibit at the Museum of Contemporary Art in Chicago. The ensuing press attention gave Coates and the C2C-Home leaders a "renewed vigor" for seeing the building in the real world.

"We're working together now to apply for grants and find funding for it," he says. "The intent is to make it the C2C-Home headquarters, to use it as their offices, as a demonstration home, as a training area and as inspiration."

PHOTO COURTESY OF THE AMERICAN INSTITUTE OF ARCHITECTS/BARRY HALKIN

Sidwell Friends Middle School's library allows sunlight to permeate the room. Virtually all interior spaces receive some daylight. Elsewhere in the school, thermal comfort is enhanced and energy use is reduced through the use of ceiling fans, which allow air-conditioning temperatures to be comfortably set 5 degrees warmer than usual.

More than 1,700 projects are now LEED-certified (and almost 14,000 are in the certification pipeline), in 69 countries, making up 3.9 billion square feet of building space. (See "By the Numbers," page 15.) By 2010, LEED's 10th anniversary, the global value of the green building industry is projected to reach $60 billion, according to McGraw-Hill Construction Research and Analytics.

If the movement wants to sustain this growth, however, it will need to overcome the largest hurdle to building green: the perception that it costs more money. When green building first began around 2000, the projects did cost more money—especially for specific components, like photovoltaic panels, and for sourcing local, sustainable materials. But now that architects and construction crews have many green buildings under their belts, they know how to find these materials quickly and can work together with manufacturers to lower costs.

Initial costs are an obvious obstacle in developing countries, too, whose growing populations are perhaps most in need of technologies that capitalize on efficiency and shared resources.

"The holy grail of all this is to do really high-performance buildings and not spend any more money," Yudelson says.

History

The seeds of the USGBC were sown in 1993 by three guys in a Washington, D.C., bar.

The three guys were David Gottfried, a real estate developer; Mike Italiano, a lawyer; and Rick Fedrizzi, who for 25 years had been an executive at Carrier, a major heating and air-conditioning company. "They were very different from your usual group of greenies," jokes civil engineer Yudelson. "They said, 'Why not just form this thing and start getting people talking about green building?'"

Murmurs of eco-building had begun in the 1970s, when Arab oil exporters stopped trading with countries that supported Israel, drastically cutting the Western world's supply. This led President Carter, in a famous 1977 television address, to advise Americans that "conservation is the quickest, cheapest, most practical source of energy." The idea cropped up again in 1984 when, in response to NASA's call for designs for human settlements on the moon and Mars, Iranian architect Nader Khalili created the "Super Adobe" home, a giant beehive-like structure made of sandbags and other locally available materials.

But the real genesis of the modern green movement came in 1992. That's when the city of Hannover, Germany, asked architect William McDonough to develop a set of sustainable design principles—later coined the "Hannover Principles"—for the 2000 World's Fair. Those principles were released in June, at the United Nations Conference on Environment and Development, termed "Earth Summit," in Rio de Janeiro. The Earth Summit, attended by 108 heads of state, resulted in a 300-page plan for achieving sustainable development in the 21st century. Suddenly, green issues were making international headlines.

It was these events that led Fedrizzi, Gottfried and Italiano

to form the USGBC. From 1993 to 1997, they focused on gauging interest, building membership and laying the foundation for what would become the LEED.

"To promote green building you need some kind of metric that describes what that means," says Michelle Moore, senior vice president of policy and public affairs at the USGBC. "So it was part of their position to have a green building rating system from the very earliest day."

In the mid-1990s, the U.S. Department of Energy provided the USGBC with financial assistance to further develop the LEED guidelines. The guidelines were beta-tested on 50 projects over 1998 and 1999, and in 2000, updated guidelines were made available to builders across the world.

In 2004, Canada began its own Green Building Council, which now includes more than 1,300 member organizations. Sixteen countries—including Australia, India, Taiwan and Vietnam—now have their own Green Building Councils, which all belong to the World Green Building Council.

"What we've seen is a real blossoming of green building councils around the globe," Moore says.

So What is a Green Building?

LEED guidelines give a performance standard—specific efficiency goals to reach above and beyond what's dictated by the local building codes—but they don't dictate how to meet those goals, leaving green architects a lot of room for creativity.

Perhaps the two most important principles of green building are energy conservation and waste reduction. Green buildings typically use at least 30 percent less energy than standard buildings, usually with renewable sources like solar power. Increasingly, green buildings also are buying more of their power from off-site wind farms.

To cut back on waste, green builders can measure more thoroughly and plan ahead to reduce construction waste by up to 50 percent. Green buildings also will typically use salvaged materials, materials made from recycled content, such as fly ash from coal-fired power plants, and "rapidly renewable" materials that can be regenerated within 10 years, such as bamboo or cork.

Energy conservation and waste reduction are perhaps the "no-brainers" of green building. But there are several more subtle elements that are just as crucial to achieving sustainability.

Some of the most innovative green engineering ideas, for instance, come in making efficient use of water. Take, for example, the American Embassy in Sofia, Bulgaria, built in 2004 for $78.5 million. Inside the 184,000-square-foot building, water-efficient sink fixtures and a sophisticated irrigation system save 136,000 gallons of water per year, using 21 percent less than a conventional building. What's more, the system uses electrical pulses instead of harsh chemicals to treat the water.

Another fundamental component of green building is the appropriate use of the building site. The site shouldn't be on or near a wetland, for instance, or prime agricultural land. If possible, it should be near public transportation so that people don't have to rely on cars. Once the site is chosen, builders

PHOTO COURTESY OF THE U.S. GREEN BUILDING COUNCIL

The first green American Embassy in Sofia, Bulgaria, serves as a prototype for its advanced 'green building' technologies and design features.

should make great efforts to use local renewable materials. These ideas were used to beautiful effect by the designers of the Sidwell Friends Middle School in Washington, D.C., rebuilt in 2007 for $28 million. The school is next to a metro station. All cars are parked underground, giving room for more than 80 species of native plants in place of an asphalt parking lot. The flooring was made partly of pilings salvaged from the Baltimore harbor.

Finally, a green building should provide a green atmosphere for its future inhabitants. The Computer Science and Engineering Building of York University in Ontario, Canada, for instance, provides fresh-air ventilation through the hundreds of windows—which occupants can open and close themselves—in its central atrium. Since the building's construction in 2001, the builders say there has been a "noticeable decrease in the number of complaints regarding air and environment quality."

How To Green Your Home

Non-green buildings—which make up the vast majority of the market—put an enormous strain on the environment every year. In the United States, buildings represent 39 percent of primary energy use, 70 percent of electricity consumption and 39 percent of all carbon emissions, according to the Department of Energy. Buildings use 12.2 percent of all potable water, or 15 trillion gallons per year, according to the U.S. Geological Service. And every year, the American building industry generates more than 136 million tons of construction and demolition waste, according to the Environmental Protection Agency (EPA).

Here are some tips for greening your current home (and, in the process, saving quite a bit on energy bills):

- Plant shade trees around your home to naturally insulate it in the winter and cool it down in the summer.
- Replace single-pane windows with high-performance windows.
- Install high-efficiency heating systems, water heaters, dishwashers, washing machines, refrigerators, toilets, faucets and shower heads. Install insulation with recycled materials, and insulate existing ductwork, to keep heat or cool air from escaping.
- If you live in a sunny climate, consider a solar water heating system or photovoltaic system.
- Switch your light bulbs to compact fluorescent light bulbs (CFLs). They cost a bit more upfront ($6 to $7 each in the United States), but last longer and use much less energy, saving you $30 or more in electricity costs over each bulb's lifetime. The average U.S. household has 45 light bulbs; replacing that number of 75-watt incandescent bulbs with CFLs would save $180 per year.
- If you redecorate, use paints that are low in VOCs (volatile organic compounds), which have many adverse health effects, according to the EPA.

Good Business Sense

Making tenants happier is one of the major byproducts of building green—and one of its biggest selling points.

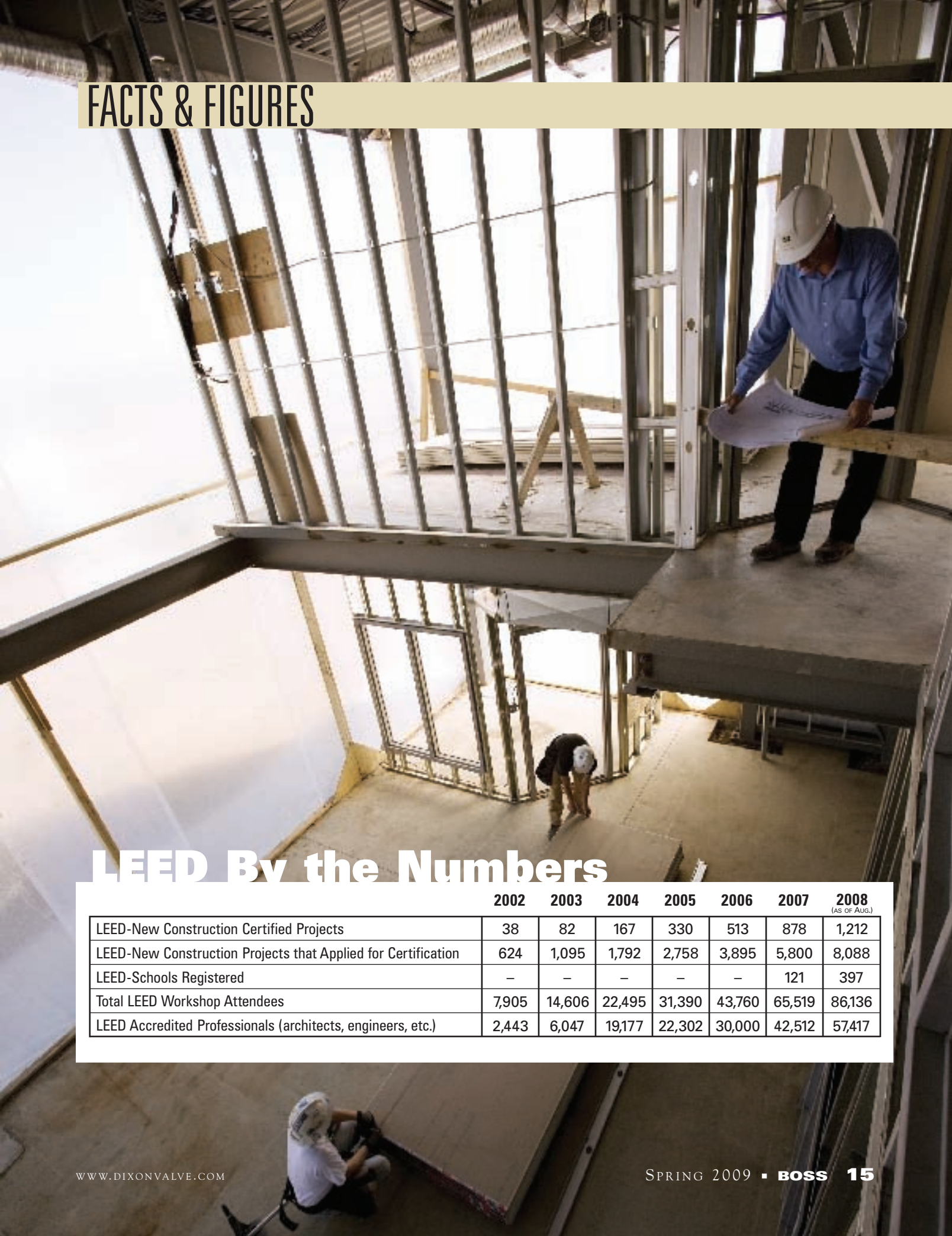
"Major corporations are basically in the talent business, they're all about getting and keeping good employees," says Yudelson. He says that "going green" is particularly important for the 30- to 40-year-old work force that employers desperately want to attract. "I call it the pillow talk issue. The spouse says, 'Why are you going to work for these people?' And the other spouse can say, 'Because they're green.'"

Now that LEED is off and running, USGBC has focused its efforts on expanding green building by making this business argument.

"Today we're affecting about 10 percent of all new commercial construction, but 99 percent of all buildings that are already in operation today are in large part energy hogs," Moore says. "So our biggest strategy is just demonstrating the business case, showing people that by doing the right thing—building a building that's going to produce dramatically less CO2 emissions, be much more energy-efficient, be healthier and respect the natural resources around which it's built—that that's going to be something that's beneficial for the bottom line."

Green building owners save an average of 30 to 50 percent on electric and water bills. In March 2008, CoStar Group, an independent research firm, analyzed the resale values of 355 LEED-certified buildings and 945 buildings certified by ENERGY STAR, an older and less stringent green certification system. The researchers found that compared to conventional buildings, those LEED-certified buildings had 4.1 percent higher rental occupancy and commanded $171 more per square foot on resale value. The ENERGY STAR buildings analyzed had 3.6 percent higher occupancy and a $61 per square foot premium on resale value.

"Economics drives everything," Yudelson says. "We've basically proven the business case for green buildings; now it's only a matter of getting people lined up to figure out how they can do it in their own situations."



LEED By the Numbers

	2002	2003	2004	2005	2006	2007	2008 (as of Aug.)
LEED-New Construction Certified Projects	38	82	167	330	513	878	1,212
LEED-New Construction Projects that Applied for Certification	624	1,095	1,792	2,758	3,895	5,800	8,088
LEED-Schools Registered	–	–	–	–	–	121	397
Total LEED Workshop Attendees	7,905	14,606	22,495	31,390	43,760	65,519	86,136
LEED Accredited Professionals (architects, engineers, etc.)	2,443	6,047	19,177	22,302	30,000	42,512	57,417