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Focus

## The Full Gain of Net-Zero

by [Jeff Gavin](#)  
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### Achieving energy-efficiency perfection

In the drive for energy-efficient buildings, perfection is net-zero energy. Such tightly constructed buildings also produce their own energy, ultimately offsetting the energy they expend. Some produce more than they use and can sell the excess back to the utility. Today, there are a handful of such buildings serving as examples of what could be done. Some communities and states are even setting target dates (15 to 30 years) when new construction must meet net-zero.

Net-zero is an end game to the efficiency movement. As targets are set (some voluntary, some not) efficiency goals ratchet up from 30 to 50 percent or more. With a 60- to 70-percent gain, the addition of an alternative energy source can allow a building owner to reach 100 percent efficiency, or net-zero.

Chip Plummer, president of the H&H Group Inc., Madison, Wis., served as the primary subcontractor for the new Aldo Leopold Legacy Center, a conservation center in Baraboo, Wis. The center is the highest Leadership in Energy and Environmental Design (LEED)-rated building in the United States for new construction. As a net-zero-energy building, it meets all of its energy needs on-site and uses 70 percent less energy than a National Electrical Code-compliant building. The center's roof-mounted solar array is projected to meet 110 percent of the building's energy needs on an annual basis.

H&H Group is composed of six companies offering mechanical and electrical contracting services, as well as solar energy, for southern Wisconsin.



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"We added solar seven years ago," Plummer said. "No one was doing it in our area. Representatives from the Leopold Center brought us into the project based on their familiarity with our solar division's work and reputation for partnering with the local utility."

With an array of divisions at its disposal, H&H Group approached net-zero using a number of strategies. Those included daylighting controls, motion sensors, compact fluorescents, a grid-tied photovoltaic (PV) system, a geothermal radiant floor system and an air chamber forced air system (600 feet of 24-in. diameter earth tubes placed 10 feet underground). Akin to storm water drainage pipes, the tubes ventilate the building using the ambient temperature of the earth.

"The [heating, ventilating and air conditioning] HVAC uses much less energy as a result of the air chamber/geothermal configuration," Plummer said. "The fixtures have light meters and sensors to control the lighting and heating to further minimize energy use. In fact, the PV-generated power offsets any of the center's electrical and heating cost."

Plummer considers this project a showcase for his firm.

"The owner put a lot of trust in us," he said. "[Its] goals and objectives were our roadmap as we strategized and assessed how to accomplish this feat. It required real dedication by the entire building team."

### A community sets a goal

Austin, Texas, will require all its community's new homes to be net-zero-energy capable or able to operate completely off the grid by 2015. John Umphress is the conservation program specialist for Austin Energy Green Building/Distributed Energy Services. He's helping the city meet its ambitious goal.

"All the processes and knowledge for net-zero building are known," Umphress said. "We have a pretty good idea how to get there. It's more a case of putting the requirements together and phasing them in. Many new homes today are near-zero energy. The building community needs to understand this isn't out of reach."

Austin is well on its way due to its strict energy-efficiency codes mandated by the state. Texas builders must better the residential requirements of the 2006 International Energy Conservation Code (IECC). Though Austin is leading with its net-zero goals, Dallas and other Texas cities are setting their own green-construction standards. California's Energy Commission has recommended similar net-zero-energy goals by 2020 for the entire state.

"The Potential Impact of Zero Energy Homes" is a 2006 report developed by the National Association of Home Builders (NAHB) Research Center in Upper Marlboro, Md.; the Department of Energy (DOE); and the National Renewable Energy Laboratory. It examines possibilities for zero-energy homes (ZEH) in the new home market and the impact on reducing future U.S. energy consumption through 2050.



**The Aldo Leopold Legacy Center's roof-mounted solar array is projected to meet 110 percent of the building's energy needs on an annual basis.**



**H&H Group Inc. approached its Aldo Leopold Center net-zero-energy project using a number of strategies, including an air chamber forced air system (earth tubes).**

In the report, Thomas Kenney, P.E., vice president, engineering and research for the NAHB Research Center, asserts the ZEH concept "will begin to diffuse into the U.S. housing market as early as 2012."

With today's housing market, does 2012 still make sense?

"Yes," Kenney said, "due to continued federal research and development programs to lower the cost of advanced energy-efficient building technologies and solar thermal and electric equipment. We also surveyed builders asking how they were accommodating the soft housing market. They shared that energy efficiency was either the first or second expectation of homeowners. In response, some builders are rethinking their product portfolios."

Kenney cited Centex Homes as one example. Its "Energy Advantage" homes are marketed to showcase their better thermal envelope, Energy Star appliances and features such as a dashboard power meter that shows homeowners the amount of energy they are using.

### The challenge of commercial buildings

Launched in August 2008, the DOE's Net-Zero Energy Commercial Building Initiative (CBI) aims to achieve marketable net-zero-energy commercial buildings by 2025. CBI works with researchers at DOE national laboratories as well as with public and private partners. The residential program, "Building America," has set a goal of marketable net-zero homes by 2020.

"You can technically do net-zero with commercial buildings, but cost-effectiveness is the challenge," said Dru Crawley, team leader for Commercial Buildings, Building Technologies Program, DOE. "Solutions for better efficiency and needed information on occupied buildings energy use to maintain net zero are needed. Also, some programs, such as Energy Star, don't cover a lot of products that commercial buildings might use. There is a world of equipment to discover and types of buildings to consider."

For example, Crawley explained that while office buildings pose their distinct energy-usage challenges, restaurants present a different set of concerns with their energy-intensive kitchens. The DOE initiative is planning pilot projects across multiple climate zones.

"We have national account partners, such as Best Buy and Intercontinental Hotels, who have agreed to build one property at 50 percent energy reduction from their existing structures once the economy allows. They will also retrofit one building each for maximum energy savings. We also have technology demos for partners to try out possible energy-efficient products. Maybe it's a new HVAC system or LED lighting. As a third party, we can help analyze their use and performance."

### Preparing for net-zero

If you are ready for green-building projects, you are ready for net-zero. That assumes being familiar with the latest energy-efficient technologies and alternative energy sources from solar to wind and beyond. But there are other skills to master.

"Measurement and verification (M&V) may become more standard in net-zero projects," DOE's Crawley said. "Prove what you promise. Integrated building construction practices will be common, too. That might include building information modeling. Familiarize yourself."

"Trust that costs will come down, efficiencies will rise and payback for alternative energy strategies will shorten," said H&H Group's Plummer. "Most of our solar clients are comfortable with a payback of 10 years or so. Solar also helps bring in electrical business."

David Ruggiero, LEED AP and account manager of ICF International, a professional services firm based in Fairfax, Va., administered the Zero Energy Challenge, which encouraged builders and developers to design and construct net-zero-energy homes in Massachusetts. The winning project, a 1,400-square-foot home in Amherst, achieved a Home Energy Rating System (HERS) of -8 through quadruple the insulation required by code, use of compact fluorescents, a DC-powered refrigerator, a solar thermal system and a PV rooftop array.

"The benefits of reaching net-zero are compelling and, I think, persuadable," Ruggiero said. "The economics make more sense when you consider the utility bill for the life of the home or office. You need to educate the owner and maybe the bank. Train people, including your staff, to think a little differently."

**GAVIN** is the owner of Gavo Communications, a marketing services firm serving the construction, landscaping and related design industries. He can be reached at [gavo7@comcast.net](mailto:gavo7@comcast.net).

