The American dream it is not.  
But if Americans imagine that we can continue to blanket former cornfields vast distances from urban centers with 5,000-square-foot “McMansions”—homes that individually consume enough electricity and natural gas to power small villages in developing nations—then Americans are dreaming.

Designing past the political  
A native of Germany who has lived in the United States only shortly, Ulrike Passe has no intention of getting caught in the crossfire of the culture wars between Europe and America that have only escalated over military adventures in Middle Eastern oilfields. Instead, the assistant professor of architecture in Iowa State’s College of Design offers an olive branch, an alternative dream not just of sustainable homes but sustainable communities as well.

“It came very naturally to me to be involved in green design, green technologies, green policy,” the young assistant professor muses from her office on an early summer morning when thoughts of Iowa’s harsh winters couldn’t be farther from the mind.

“The Green Movement had already begun in Germany...
when I was a teenager,” Passe continues. “A lot of that was anti-nuclear—and then Chernobyl happened, which gave people a mainstream appreciation of the risks.”

In an age of growing demand and dwindling supplies, the politics of oil and nuclear energy are never far from the debate. But for 10 days next summer, 20 college and university teams from across the globe will offer a vision that looks beyond the contention associated with non-sustainable energy sources to instead tap the inexhaustible power of the sun.

Passe heads the Iowa State team that seeks to design, build, and operate Interlock House, an attractive and energy-efficient solar-powered dwelling in the U.S. Department of Energy’s fourth Solar Decathlon since inaugurating the biennial competition in 2002.

As befits its name, entrants in the decathlon will be judged in 10 areas, including architecture, engineering, market viability, communications, comfort, appliances, hot water, lighting, energy balance, and transportation. Houses must generally be designed to reflect climatic conditions at their schools of origin, and teams are encouraged to use recycled materials and local resources to the extent possible. The Iowa State team plans on using soy-based glues, plastics, and even insulation.

The power of ‘passive’ engineering

Passe is joined by colleagues from across the Iowa State campus, including students and faculty in engineering, design, architecture, agriculture, communications, chemistry, and a host of other disciplines. That broad level of inclusion is not a luxury, she stresses, but an absolute necessity.

“Green design is not an engineering issue by itself, it’s not a business issue by itself, it’s not an architecture issue by itself—it can only be done as an interdisciplinary effort,” Passe says. “So we went across campus and were amazed at the number of people who were interested.”

Two of those colleagues are Professor Ron Nelson of the mechanical engineering department and his graduate student, Tim Lentz, who coordinates engineering for the project from the student side. Though engineers by training, both strongly
support Passe’s interdisciplinary focus, in fact acknowledging the leading role of the designer/architect in the overall project.

“Architects and engineers must work closer together as energy becomes more important,” Nelson agrees. Beyond the need for collegiality, Nelson’s concession underscores the basic nature of solar technology itself. Before enlisting the advanced photovoltaic technologies developed by researchers such as Vik Dalal and Sumit Chaudhary (see stories, pp. 12, 16), solar installations must first exploit the “passive” technologies of green design: window placement, insulation, ventilation, landscaping, and a host of other decisions impacting heating and cooling can dramatically affect the number and types of photovoltaic cells needed to generate electricity.

The reductions in energy usage afforded by such decisions, Nelson says, can be dramatic. “You could easily cut your energy use in half,” he says. “I’ve seen homes insulated so well that the heat of the occupants alone can substitute for a furnace in the winter.”

Passe agrees. “Photovoltaic cells and thermal water heaters are things you add to the building, things you integrate,” she observes. “But they’re in addition to what the building already can do on its own. One house I designed in Germany, the owner turns off his furnace two months before his neighbors—just because of the way the house is built.”

A net producer of energy

Once these fundamental design parameters are established, second- and third-level solar technologies will be folded into the mix in the form of thermal collectors and off-the-shelf solar panels—the cutting-edge photovoltaics being developed by Dalal and Chaudhary won’t be available for the competition. Yet, along with the design elements of Passe and her architects, these readily available technologies will demonstrate the possibilities available to consumers today.
For instance, notes Nelson, besides levels of insulation not typical in most modern construction, the Interlock House’s thermal collectors will heat water that circulates beneath the floors to warm the house’s occupants. Such techniques, he stresses, are nearly five times more efficient than using electricity from solar cells to heat living spaces.

Yet the ultimate objective of the competition is to build a house that not only is desirable from a design perspective, but that actually produces more energy than it consumes. As the only elements capable of producing electricity, therefore, solar cells loom large in design considerations for the house. Beyond optimizing thermal properties in order to conserve electricity for other uses, then, project engineers must also configure conventional solar arrays in a manner that maximizes the conversion of solar energy into power.

To balance the demands of design and efficiency, Lentz is developing a passive tracking system that allows photovoltaic cells to follow the sun for maximum UV absorption. The aim of the new technology, he says, is not so much to increase electrical production but instead to permit the use of fewer cells to produce the same levels of energy, a desirable option for those put off by the large arrays of static panels often seen in solar installations.

“Usually tracking is active or on a very large scale, where you have an entire solar panel following the sun over the course of a day,” Lentz observes. “These will be smaller—six inches, maybe—with a single row of cells that track the sunlight. It’s a mass balance system, with a fluid that heats up and tilts the panel from one side to the other, with no external electricity needed to control them.”

A new vision of community

Adopting selected aspects of green technologies such as those in the Interlock House and Solar Decathlon is a relatively simple proposition: given the inexorable rise in fossil energy prices, not to mention the environmental costs of burning carbon, few would quibble with adopting solar as it becomes economically competitive.

The cultural issues are another question, however. Passe’s vision of green design is more holistic than selective, more communitarian than individualistic. It’s a vision that cannot be reduced to discrete technological fixes or even the broader category of design, but instead values design and technology as elements that sustain local communities within balanced, integrative “eco”-systems—i.e., both economically and ecologically, including social ecology as well.

“It doesn’t stop with the building,” Passe insists. “It only starts with the building, and then goes on to infrastructure and community development.”

And while green design may have been first embraced in Europe, Passe’s philosophy increasingly reflects more than a European perspective, as green design principles merge into the American mainstream through programs such as LEED (Leadership in Energy and Environmental Design) certification. Tim Lentz, for instance, is one American engineer who does not mince words about the Interlock House’s broader agenda.

“Part of the point of our design is to discourage suburbanization—the huge back yards that people don’t even use that contribute to sprawl,” Lentz states bluntly. “Our house is meant to be an ‘infill’ situation to keep that sprawl from going outward, to maintain neighborhoods and make them more densified.”

"Green design asks, what do you really need to be happy?"

Rethinking how we live

Whether such a vision can take root—let alone sustain itself—in the land of the five-bed-three-bath-four-car-garage middle-class “estate” remains to be seen. The members of the Interlock House team have no desire to promote “sustainable overconsumption,” after all, and the ultimate irony would be for the success of “green design” viewed narrowly in economic terms to serve as an excuse for Americans to continue on a path toward ecological disaster.

Gazing out the window of Passe’s office over the gently rolling Iowa State campus on a warm summer’s day, ecological disaster seems even more remote than the prospect of millions of modestly sized American homes powered by the sun in close-knit communities. For Passe, though, the fundamental question is more personal than any grander social scheme.

“Green design asks, what do you really need to be happy?” she reflects. “To be comfortable? Do you really need 5,000 square feet?”

She smiles and adds, “One has to rethink how one lives.”

"Green design asks, what do you really need
to be happy?"