Solar Decathlon 2002

Energy We Can Live With

Solar Decathlon 2002

Secretary of Energy, Spencer Abraham chats with a student engineer at FutureTruck 2001, one of several student competitions sponsored by the U.S. Department of Energy

Message from the Secretary of Energy

The U.S. Department of Energy is proud to sponsor the first-ever Solar Decathlon, a college and university competition that brings together our nation's brightest minds to demonstrate practical ways of producing and using energy efficiently in the home.

The Solar Decathlon consists of 10 contests that encompass all the ways in which we use energy in our daily lives—from livability and comfort to daily chores and home-based work to getting around town. Sunlight is the only source of energy that can be used to generate the thermal, electrical, and mechanical power needed to compete in the 10 contests. The best looking house that can produce the most energy and use that energy the most efficiently will win.

Energy efficiency and solar technologies are available for the home today, and they are affordable. At the same time, the designs of these homes are attractive and livable. The Solar Decathlon will prove that investment in renewable energy and energy-efficient technologies can reduce our dependence on foreign oil, improve human health, conserve natural resources, and create markets for American products around the world.

My thanks to BP Solar, The Home Depot, EDS, the American Institute of Architects and the National Renewable Energy Laboratory for helping make this important event possible. The U.S. Department of Energy, together with our sponsors, is committed to helping students and consumers make winning decisions about energy. Because when we power our lives with clean energy, we protect our own future. And when we protect our future, we are all winners.

My special thanks go to the solar decathletes. Their hard work and commitment to meeting the energy challenges we face represent the best this nation has to offer. I wish them all the best in the Solar Decathlon and in whatever worthwhile challenge they undertake next.

Spencer Abraham
Secretary

Solar Decathlon 2002

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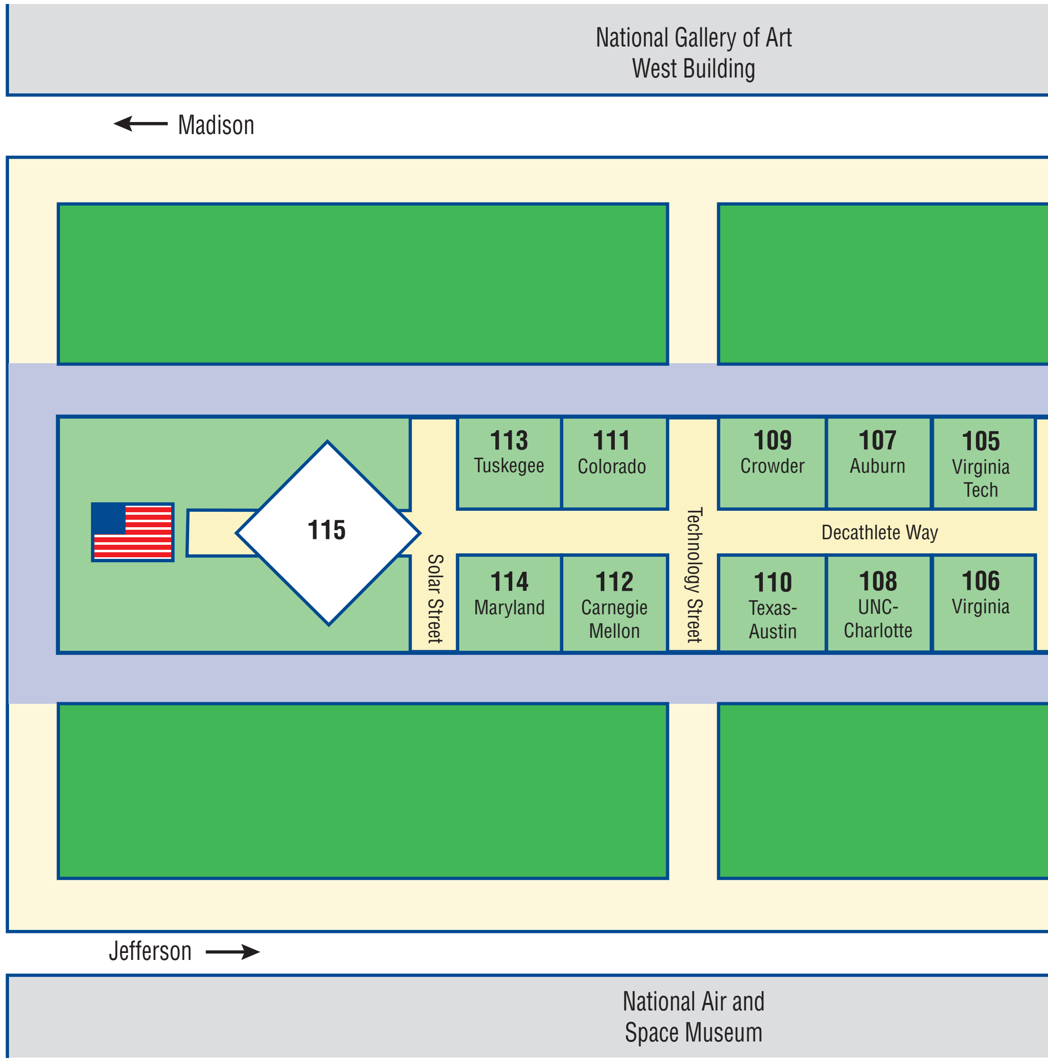
What is the Solar Decathlon?

The Solar Decathlon is a competition to design, build, and operate the most effective and attractive house powered solely by the sun. The U.S. Department of Energy (DOE) is proud to sponsor the international competition for college level students. The competition is designed to showcase "energy we can live with," meaning solar and energy efficiency technologies that are not only viable today, but are also unobtrusive features of homes that fit gracefully into our modern lifestyle.

Fourteen student teams from the United States, including Puerto Rico, will transport their competition homes to the National Mall in Washington, D.C., and will begin building a Solar Village on September 19. When construction is complete on September 26, the Solar Decathlon will begin. The competition will end on October 5, and a winner will be announced. During the event, only solar energy may be used to generate the power needed to compete in the 10 Solar Decathlon contests.

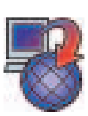
The Ten Contests

Each team can earn 1,100 points. The Design and Livability contest is worth 200 points; each of the others is worth 100 points.

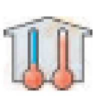


Design and Livability: Have design, innovation, aesthetics, and renewable energy technologies been successfully integrated into a pleasing domestic environment?

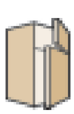
Design Presentation and Simulation: Do the pre-design drawings, scale models, and computer-generated models effectively illustrate the construction of the house and the simulation of its energy performance?



Graphics and Communication: How effective are the Web site, newsletters, and other outreach materials designed by the teams?



The Comfort Zone: Is the house designed to maintain interior comfort through natural ventilation, heating, cooling, and humidity controls while using a minimum amount of energy?



Refrigeration: During the competition, how consistently do the refrigerator and freezer maintain interior temperatures while minimizing energy use?

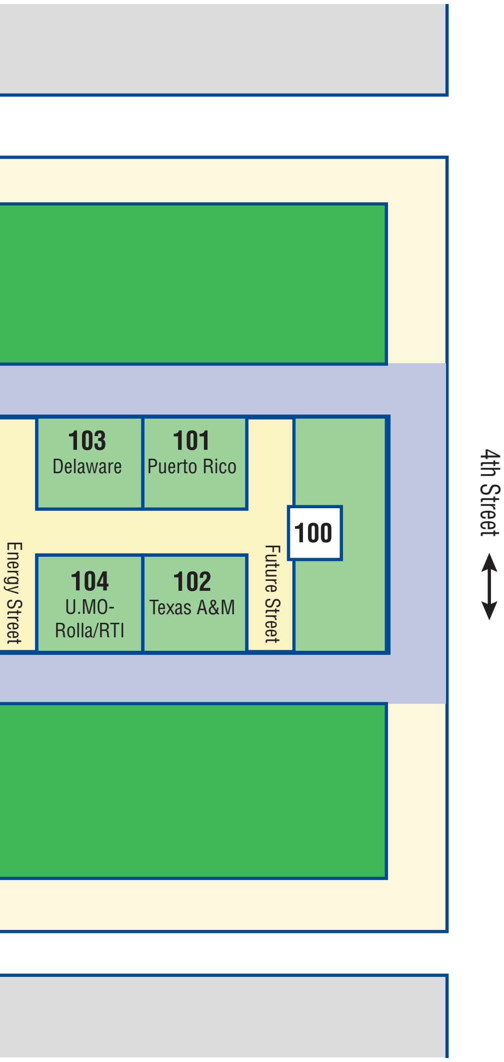
Hot Water: Does the house demonstrate that it can supply all the energy necessary to heat water for bathing, laundry, and dishwashing?

Energy Balance: How well have the teams used only the sun's energy to perform all of the tasks of the competition?

Lighting: Is the lighting of the house elegant, of high quality, and energy efficient, both day and night?

Home Business: Does the house produce enough power to satisfy the energy needs of a small home business?

Getting Around: Does the house generate enough "extra" energy to transport solar decathletes around town in a street legal, commercially available electric vehicle?



Why a Solar Decathlon?

With daily headlines about energy issues, U.S. consumers and policymakers are thinking a lot about energy these days. DOE developed the Solar Decathlon with the nation's energy security and future in mind. Other sponsors include DOE's National Renewable Energy Laboratory and partners BP Solar, The Home Depot, EDS, and the American Institute of Architects.

For the Spectators

The competition will serve as a living demonstration laboratory where concept meets reality. As you watch the competition and tour exhibits, you'll learn to think like a solar decathlete. You'll also learn strategies for reducing your energy consumption and lowering your utility bill. After all, the solar decathletes will need to carry on daily activities just like the rest of us—cooking, washing, running errands, and using a computer to surf the Internet, read e-mail, and write and print documents.

During the competition, you may see the decathletes use some competitive strategies that you wouldn't use in your own home. Everyday life isn't a Solar Decathlon. But no matter what you think about energy—or even if you don't think about it at all—you can learn something from the Solar Decathlon.

Come See How Solar Works!

Solar energy and energy efficiency technologies have come a long way since the 1970s when many new solar products were introduced to the market. Solar panels are many times more efficient and reliable today, and energy-efficient appliances and lighting can save you money.

To update your understanding of energy, join us for the Solar Decathlon. What you take away is up to you, but one thing will be clear—renewable energy is here to stay.

For more details about the ten contests, visit www.solardecathlon.org.

Take a Solar Decathlete Guided Tour!
September 28 – 29 and October 5 – 6
9 a.m. – 5 p.m.

Schedule of Events

Learn More About Solar Energy and Energy Efficiency!

The Solar Decathlon Solar Village will be open September 26 – October 6, 2002, from 8 a.m. to 5 p.m., daily. Visitors can tour village exhibits and learn about energy efficiency and solar energy from the Solar Decathlon teams. As part of the competition, teams will provide guided tours of their houses to the visiting public, September 28 – 29 and October 5 – 6, from 9 a.m. to 5 p.m.

September	Special Events	Contests
19 Thursday – 24 Tuesday Construction of Solar Village		
23 Monday		Begin: Graphics and Communication
25 Wednesday	5 p.m., Sponsor tour and Reception (by invitation only)	
26 Thursday 9 a.m. – 5 p.m., Solar Village open	10 a.m., Opening ceremonies	
27 Friday 9 a.m. – 5 p.m., Solar Village open		Begin: Design Presentation and Simulation
28 Saturday 9 a.m. to 5 p.m., Solar Village open	9 a.m. to 5 p.m., Solar decathlete guided tours	Begin: Design and Livability
29 Sunday 9 a.m. to 5 p.m., Solar Village open	9 a.m. to 5 p.m., Solar decathlete guided tours	Begin: Getting Around End: Design and Livability
30 Monday 9 a.m. to 5 p.m., Solar Village open		Begin: The Comfort Zone, Hot Water, Refrigeration, Energy Balance, Lighting, and Home Business End: Design Presentation and Simulation
October		
1 Tuesday – 3 Thursday 9 a.m. to 5 p.m., Solar Village open		All contests are active, except Design and Livability and Design Presentation and Simulation.
4 Friday 9 a.m. to 5 p.m., Solar Village open	10 a.m. to 5 p.m., Technology Day; Area schools tour Solar Village	End: 5 p.m., All contests, except Getting Around
5 Saturday 9 a.m. to 5 p.m., Solar Village open	9 a.m. to 5 p.m., Solar decathlete guided tours Noon, Closing ceremonies—winner announced 6 p.m., Victory reception (by invitation only)	End: Noon, Getting Around
6 Sunday 9 a.m. to 5 p.m., Solar Village open	9 a.m. to 5 p.m., Solar decathlete guided tours	
7 Monday – 9 Wednesday Disassembly of Solar Village		

Solar Decathlon Jury, Committees, and Judges

Director
Richard King, U.S. Department of Energy

Project Manager
Cecile Warner, National Renewable Energy Laboratory

Design and Livability Jury

This panel of architects and design professionals will judge each house on overall aesthetics and design integration of technical features.

Glenn Murcutt
William Henry Bishop Professor (Visiting Professor Chair)
Yale University
New Haven, Connecticut
Private Practice: Sydney, Australia

Edward Mazria
Founder/Partner
Mazria Riskin Odems, Inc.,
Santa Fe, New Mexico

Steven Paul Badanes
Howard Wright Endowed Chair
University of Washington
Seattle, Washington
Private Practice: Jersey Devil Design/Build

Dr. Ed Jackson, Jr.
Director of Applied Research
American Institute of Architects
Washington, D.C.

Dr. J. Douglas Balcomb
Research Fellow
National Renewable Energy Laboratory
Golden, Colorado

Stephanie Vierra, Assoc. AIA
Consultant
Design and Education Services
Gaithersburg, Maryland

Engineering Design Panel

Dr. Hunter Fanney
Leader: Heat Transfer and Alternative Energy Systems Group
Building Environment Division
Building and Fire Research Laboratory
National Institute of Standards and Technology
Gaithersburg, Maryland

Dr. Dick Hayter
Associate Dean of Engineering for External Affairs
Kansas State University
Manhattan, Kansas

Ron Judkoff
Director
Center for Buildings and Thermal Systems
National Renewable Energy Laboratory
Golden, Colorado

Rules and Regulations Committee

National Renewable Energy Laboratory
- Mark Eastment
- Pamela Gray-Hann
- Sheila Hayter
- Gretchen Menand
- Ruby Nahan
- Charles Newcomb
- Robi Robichaud
- Michael Smith
- Byron Stafford
- John Thornton
- Paul Torcellini

Consultants
- Dan Eberle, Formula Sun/American Solar Challenge, Freeman, Missouri
- Ed Hancock, Mountain Energy Partnership, Boulder, Colorado

Graphics and Communications Judges

National Renewable Energy Laboratory
- Ruth Baranowski
- Shauna Fjield
- Kristine McInvaille
- Susan Moon
- Paula Pitchford
- Jim Snyder
- Nancy Wells

Jill Dixon, National Building Museum, Washington, DC
Ben Finzel, Fleishman-Hillard, Washington, DC
Rene Howard, WordProse, Golden, Colorado
Lani Macrae, U.S. Department of Energy

Special Events and Village Coordinating Committee

National Renewable Energy Laboratory
- Anthony Benedetti
- Zahra Chaudhry
- Linda Floyd
- Bob Hansen
- Patty Kappaz
- Wendy Larsen
- Patricia Plympton
- Michelle Young

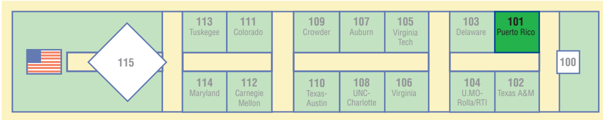
Media Relations

U.S. Department of Energy, Golden Field Office
- John Horst
- Chris Powers

National Renewable Energy Laboratory
- George Douglas
- Gary Schmitz

101 The University of Puerto Rico

Decathlete Way



It Takes a Whole Team

You could easily argue that the University of Puerto Rico's team has more obstacles to overcome than most; after all, it's the only team that has to transport its house across the ocean! Fortunately, the students built a strong team before they took on the challenge of building a house.

The University of Puerto Rico team is made up of two design groups—architects from the Rio Piedras and engineers from the Mayagüez campuses. The Solar Decathlon has enabled them to work together as a whole team for the first time in their academic experience. The competition also required that the students interact with the larger building community on the island—from equipment manufacturers to materials suppliers to builders. As María Soto, an electrical engineering student, puts it, "The experience of working with architects and seeing the different points of view of the different team members as well as working with suppliers has been very challenging for us. We hadn't dealt with students from other fields before. We've all had to learn to depend on one another."

We're competing in a national competition that has the potential to change consciousness. We're designing a system that uses only the simple energy of the sun. We're learning how to work with students in other fields. We're trying to make some changes in the world.

—University of Puerto Rico enginneering student, Francisco Medina

The two design groups began by considering the shape and envelope of their building. Early on, the students had to understand how to build for the climate in Washington, D.C. Most of them have spent their lives in a tropical climate where houses are designed for cross ventilation, not mechanical heating and cooling. After researching Washington weather data, the architects and engineers agreed on an elongated rectangular shape with minimal east- and west-facing facades. The north side of the structure would have fewer windows than the south. They designed the south glazing with a metal shading device that allows the inhabitants to control solar gains. Even with the shading device, the south glazing became a sticking point as the students worked to resolve competing design issues—natural lighting versus heat gains. Ultimately, they altered their design to reduce the glazing area on the south. According to faculty advisor Jorge Gonzalez, "How the engineers and architects interacted became a major pedagogic issue. Both had to take some risks and make some concessions."

Mayagüez Campus Team
Francisco Medina, Mechanical Team leader
María Soto, Electrical Team Leader
Samir Elhage
Ubaldo Cordova

Faculty Advisors
Dr. Jorge Gonzalez
Dr. Gerson Beauchamp

Rio Piedras Campus Team
Nancy Nazario, Architecture Team Leader
Jammile Victorio, Funds and Press Team Leader
Vanessa Miranda, Structural Team Leader
Arleen Vazquez

Faculty Advisors
Dr. Fernando Abruña
Dr. Luis Daza

The team was also interested in integrating solar technologies into the overall architectural design. Many Puerto Rican residents use solar hot water, but the team feels that the systems are very poorly integrated. So they designed their roof with two main sections—one for the solar electric system and one for the solar hot water system. Faculty advisor Fernando Abruña says, "We wanted to address architectural design discourse, to maintain a contemporary look. We wanted to integrate the technologies with the building, not to end up with a pastiche of equipment and appliances."

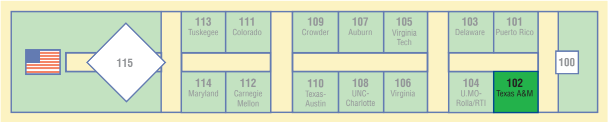
When it came time to decide on the overall interior lighting design, the engineers and architects put forth another strong team effort. The architects chose light paint colors for the interior walls and fixtures, colors that would complement the aesthetics of the space while supplying enough lighting to satisfy the competition's requirements. Together, the engineers and architects ran computer simulations to determine if the plan met their energy efficiency goals. The result is a lighting strategy that pleases both groups—a combination of natural daylighting, effective task lighting, and compact fluorescent and other fluorescent fixtures. The architects even ended up with some creative leeway—they designed a signature system for the central vaulted ceiling of their house and incorporated fixtures that reflect the overall geometry of their house design without compromising on low-energy use.

The Puerto Rico team has embodied the notion of solid teamwork, proving that people from different places with very different ideas can pull together to build a house—even one that has to travel across an ocean!

Team Web site: www.solarhabitat.upr.edu/

102 Texas A & M University

Decathlete Way



You don't have to eat all vegetables and live off the grid. You need to take a couple of these energy-efficient ideas, start with one at a time, and get to a goal of using less energy.

— Texas A&M student, Anthony Saccoccio

Targeting the Builders

Texas A&M tops the charts as one of the best construction science schools in the country. So it's no surprise that these decathletes are using cutting-edge construction science to design and develop their solar home. The Texas A&M team has modified traditional technologies for application to buildings and energy efficiency. The team members are also targeting the building and construction community—which they feel has been largely overlooked—with their outreach campaign.

Let's take a look at some of the team's construction science innovations. Just like your refrigerator or freezer, their house will maintain a constant temperature. Why? Because the decathletes at Texas A&M have applied the mechanics of refrigeration to maintain the comfort level of their home. The faculty advisor, Keith Sylvester, explains this approach. "We are incorporating an interior thermal wall that is filled with water. The water is circulated, heated, and cooled in the wall. The concept comes from refrigeration technology; the heating and cooling of our technology takes a traditional condenser system and submerges it in water. It will allow the homeowner to maintain a constant room temperature." The team designed this wall and may even patent the technology for residential applications.

In addition to a refrigerated interior wall, the decathletes designed their own refrigeration appliance. Team member Anthony Saccoccio says, "One of the biggest uses of energy is the side-by-side door refrigerator. Our team will use a chest-high refrigerator because this design doesn't lose as much cooling." Because the students believe that a typical refrigerator, with a freezer and a cooling compartment, is very inefficient, they're designing a refrigerator with two separate units and two cooling elements. This design will maintain a much more constant temperature in each unit. Sylvester says his team didn't choose the most efficient appliance; instead, they chose an appliance and adapted it, applying new or more appropriate ways to make it more efficient.

The Texas A&M decathletes would like these innovative ideas to be seen not just by consumers but also by contractors, builders, engineers, and architects. "We're pushing a construction science education, to educate the constructors and builders, not necessarily just the architects. We want to target the people that install the technologies such as the manufacturers and contractors," says Saccoccio. "They're the ones who let people know about these features; they will influence the homeowners the most."

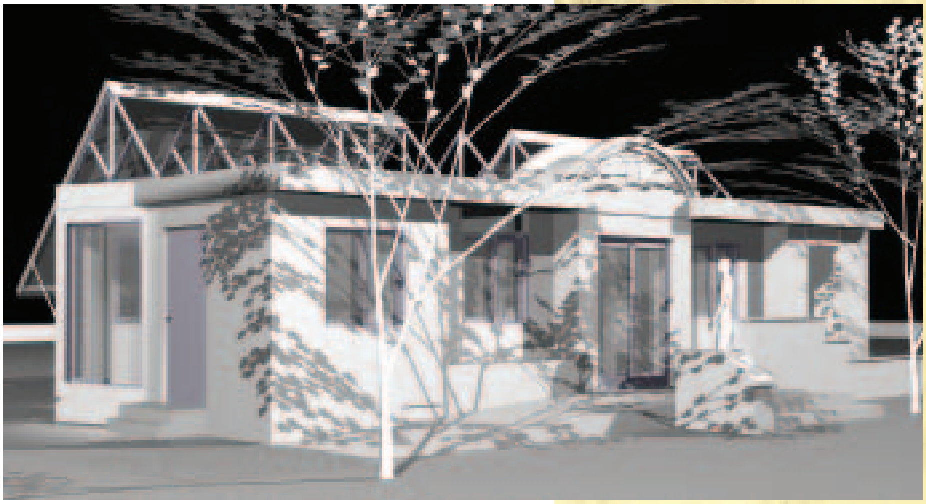
To promote their educational agenda in this direction, the Texas A&M team members will use their solar home as a demonstration facility on campus. Here, they'll give tours, hoping to familiarize the students and faculty in the construction science department with the technologies and educate contractors and other industry representatives who visit the campus.

Student Team Leaders
Sopa Visitsak, Design
Linsay Landers, Communications
John Amalfi, Construction
Matthew Burk, Engineering
Christine Massuud, Web Designer
Ramy Hanna, Visual Simulation
Suwon Song, Energy Simulation
Sakkara Rasisuttha, Energy Efficiency
Evan Putman, Web Designer

Faculty Advisors
Dr. K. Everette Sylvester, Project Leader and Energy Advisor
Dr. Mohammad Haque, Structural Advisor
Mr. Charles Tedrick, Construction Advisor

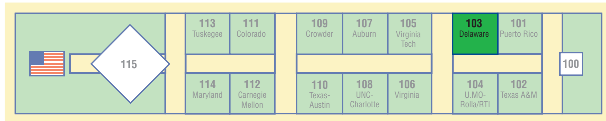
This team emphasizes that little steps toward energy efficiency can make a big difference. "We need to start building the bridge. You don't have to eat all vegetables and live off of the grid," says Saccoccio. "You need to take a couple of these energy-efficient ideas, start with one at a time, and get to a goal of using less energy." Saccoccio adds, "The most stimulating part of the project was finding out the actual ways to be independent and self-sufficient on the sun. But it's not just the solar bit, there are so many products that are energy efficient that go hand in hand with the solar."

Team Web site: archnt2.tamu.edu/solardecathlon/



103 The University of Delaware

Decathlete Way



We've got all of that free energy from the sun—we want to use it!

—University of Delaware student, Tom Shipman

Living with the Sun

Imagine a house that allows its inhabitants to witness the sun's path on its daily journey through the sky. The University of Delaware's Solar Decathlon team has designed just such a house, with a south-facing, curved wall of mostly windows.

The Delaware design not only gives a great view, but it also provides maximum exposure, putting the sun to work. The large south-facing façade demanded careful thinking about window distribution and type. The decathletes put more glazing on the southeast end of the curved wall and less on the southwest end. Their window system was designed to allow natural ventilation throughout the house, putting the semicircular shape to good use. The team estimates that the double-paned, krypton-filled windows are greater than two times more efficient than commonly used windows. Their design also includes approximately 2-foot overhangs above the southeast windows. The students hope that these design decisions will maximize heat and light from the sun into the house during the cold, dark winter season and minimize unpleasant summertime heat.

The team maximized the roof area to maximize the number of solar panels that could be installed. All the sloped roof area of the house, which holds the solar electric panels, faces south for maximum solar access. The portion of the roof that's flat holds the solar hot water system.

The team modified the solar electric system—by expanding the battery bank—from a commercially available, off-the-shelf system that can be tied to the utility grid and furnish backup power. As student team leader Tom Shipman put it, "This system could be put into any house. To the extent possible, it's an out-of-the box system. There are a lot of code issues, and you do need a licensed electrician. One has to be careful—this is electricity. But this is as close to do-it-yourself as you can get. All panels have plug connectors so there's not even any wiring of junction boxes."

Team Leaders

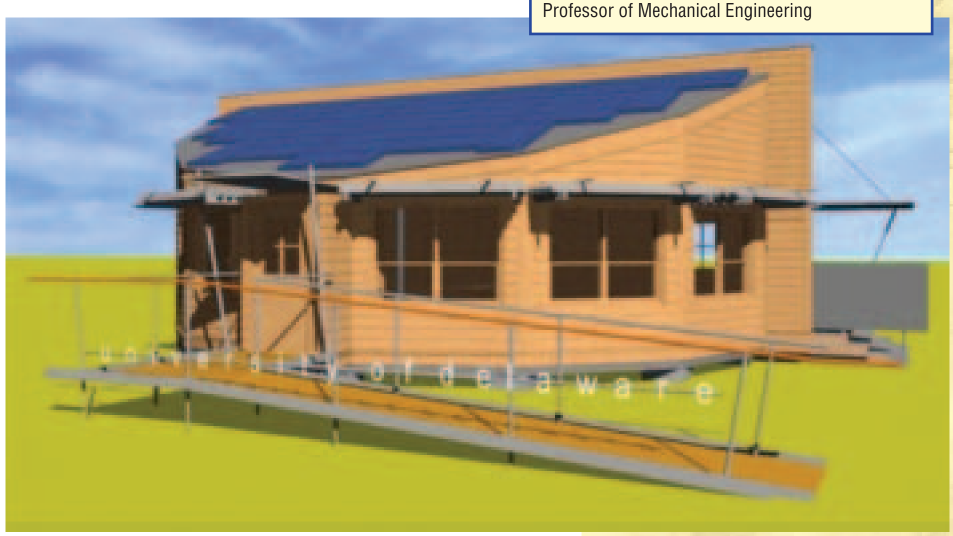
Katherine Piazza, Construction Leader
Thomas Shipman, Technical Leader
Scott Kasprzak, Student Board Member
Jasen Book, Student Board Member
Lauren Leonard, Previous Student Leader (graduated, Spring 2002)

Team Advisors

Dr. James Glancey, Professor of Bioresources Engineering and Mechanical Engineering
Dr. Ajay Prasad, Professor of Mechanical Engineering
Dr. Lian-Ping Wang, Professor of Mechanical Engineering

The solar hot water system will supply hot water for domestic uses as well as space heating. The decathletes are particularly proud of the radiant floor heating system they chose. It consists of Warmboard panels made of fluid tubing placed into a grooved plywood underlayment and aluminum sheeting, which helps with distribution of heat. These Warmboard panels can be used with most types of flooring on both the first and second stories of a house. The house will also have a ground-source heat pump for backup heating and cooling.

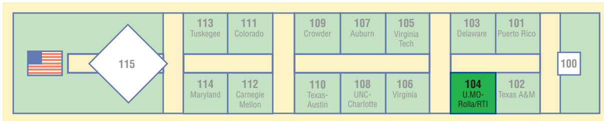
The students freely admit that their decision to create a signature, semicircular house is not without certain energy-related risks. Sometimes watching the sun can mean getting burned. As the team's lead faculty advisor Lian-Ping Wang noted, "This design represents our thinking now. It's quite possible a more conventional, rectangular shape may have worked better, but we don't know yet. The competition will be our test." Bottom line: they like the design for aesthetic and psychological reasons—in Delaware, it feels good to live with the sun.



Team Web site: www.me.udel.edu/asme/solar/

104 University of Missouri—Rolla The Rolla Technical Institute

Decathlete Way



We didn't want our house to look like a high-tech science fair project. We wanted it to look warm and friendly and inviting to the visitor. We wanted to build a house with solar technology in a structure that appeals to conventional taste.

— University of Missouri–Rolla project manager, Bob Phelan

Going Solar with Comfort and Style

The members of this team forced themselves to think outside of the technical engineering box and more like Missouri consumers. These decathletes decided to build the solar home of today, not tomorrow: a conventional ranch design with all the modern conveniences of today's lifestyle. From architecture, to interior wood furnishings, to décor, to appliances and even the solar panels, the team strives to welcome visitors, especially those from their home state, into their cozy home.

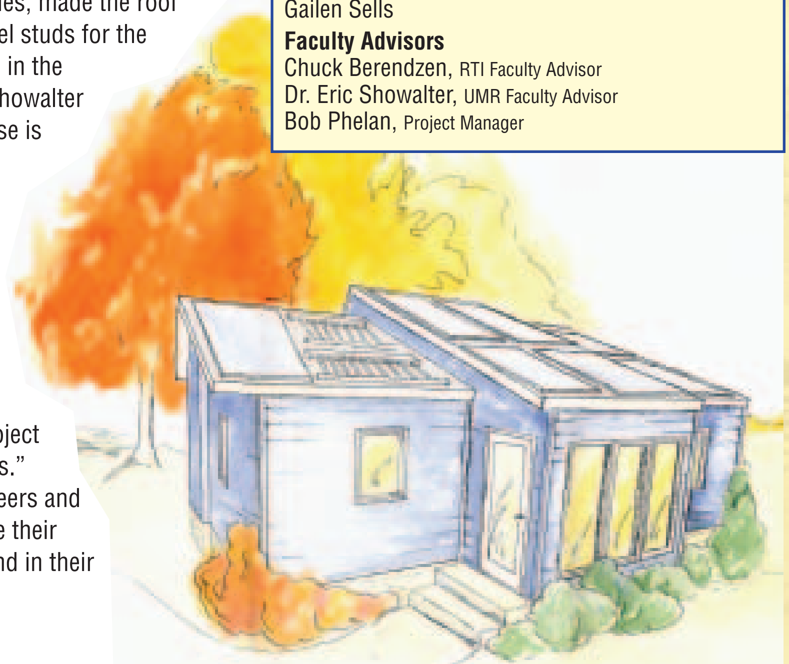
The team consists of students from the University of Missouri—Rolla (UMR), primarily an engineering school, and the Rolla Technical Institute (RTI), a high school and adult building trades vocational school also in Rolla. The partnership of these two schools resulted in some unique features for the house, including elegant cabinets, an innovative bookshelf, and a deck (features built by the RTI high school students). RTI students not only trained in carpentry for this project, they also trained in steel stud construction, innovative heating and cooling system installation, and new drafting software. They also gained experience in the integration of solar electric systems. "It's a wonderful project and learning experience," says Shawn Hawk, one of the RTI students. "I learned new computer skills and how to build a house, met new people, and had a lot of fun." UMR team members learned drywall installation, household wiring, and the many other challenges of basic home construction.

In all likelihood, the house's most celebrated feature is the sunroom. In this small yet useful room, windows stretch from the floor to ceiling and porcelain tiles line the floor. These tiles help with passive heating and cooling. The tiles will also remind the team of its sponsors—for a donation of $100 each, local sponsors' names were engraved on the tiles by the students. The home's electrical equipment is also located in the sunroom, in an unconventional display. "All of the main components of the electrical equipment fit into the east wall of the sunroom—it's the nerve center of the house, the brain," says Corry Hailey, the team's student director for design and construction.

Team Members
Chris Stevens, Team Leader
Amy Schneider, Director of Development
Corry Hailey, Director of Design/Construction
Ritesh Sagi, Director of Operations
Kristin Williams
Ryan Thornton
Carolina Parada
Bill Cason
Shawn Hawk
Zack Schmidt
Gailen Sells

Faculty Advisors
Chuck Berendzen, RTI Faculty Advisor
Dr. Eric Showalter, UMR Faculty Advisor
Bob Phelan, Project Manager

Transportation to the National Mall was another influence in this team's design strategy. They divided the house into three sections, each built on modified trailer frames, made the roof hinged to decrease the height for travel, used lightweight but strong steel studs for the frame, and adopted a "no nails policy." In other words, nothing is nailed in the house—everything is glued first and then screwed. Team advisor Eric Showalter says, "When you're transporting the house across country, and the house is rattling for 1,000 miles, a stiff, tight structure is important for its safe transport." Christopher Stevens, an aerospace engineer, adds that it's been kind of funny during construction, "You don't hear the sound of hammers, just the whirring of drills in the background."

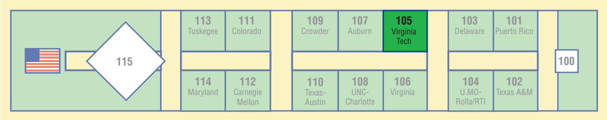


After the competition, the house will return to Missouri where the students will continue to research energy efficiency and solar power—two issues that have heightened awareness. Stevens says, "Now, whenever I go into a building or a home, I see all of these little inefficiencies, and it drives me nuts. Why is that window there? This project makes you aware. This experience will impact all of our lives and careers." Hailey adds, "The students involved will be the next generation of engineers and builders, and they will always remember this experience and incorporate their knowledge of solar power and energy management into their practice and in their own homes."

Team Web site: web.umr.edu/~sunhome/

105 Virginia Polytechnic Institute and State University

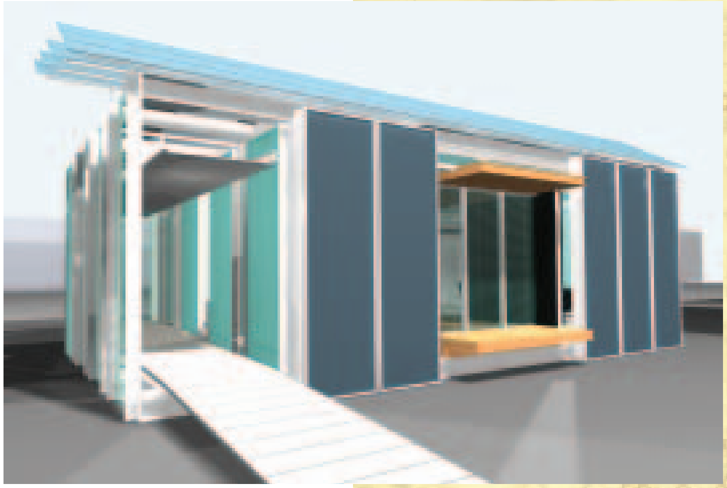
Decathlete Way



The Art of Integration

Virginia Tech perfected the art of integration with a design strategy in which one house feature can perform multiple functions. This strategy exemplifies the concepts of efficiency and utility. The team, which includes Architecture, Industrial Design and Engineering students, feels their house is a successful marriage of the three disciplines.

One of the team's most notable and versatile features is the Skywall panel. This south-facing wall panel has structural integrity as well as passive solar functions. "With the desire for passive solar gain, we stretched the building in an east-west direction to achieve maximum southern exposure," says James Jones, a faculty advisor. "The long wall along the south allows us not only passive solar heat gain, but it also acts as an active solar collector. Our design strategy integrated the structural wall and the active thermal wall, which heats water for domestic use and the radiant heating system." The east and west walls are also Skywall panels.



The Skywall panel, a transparent and translucent wall panel with good insulating properties, also plays a role in daylighting contributions. The wall allows as much natural light as possible, contributing to overall lighting levels. Jones explains, "We used an aerogel product with high thermal resistance that lets light into the space. It's also highly insulated, which minimizes the transfer of heat between the inside and outside of the house."

The photovoltaic panels represent another example of integration; the panels produce energy and also act as a shading device for the building. Project team advisor Bob Dunay comments on this strategy. "We took a significant stance to celebrate PV and not try to hide it. It's a benevolent umbrella, both a collector of energy and a shading device. It gives the building a strong identity not normally associated with residential buildings."

The appliances also serve multiple functions. Beyond their individual uses, the appliances combine into a unit that helps regulate the temperature inside the house. "We integrated all of the appliances into one area, the 'north wall module'," says Robert Schubert, the team's lead advisor. "As a unit, they will act as a thermal buffer and will protect the rest of the building."

Even this team's approach to light embodies its strategy—daylighting and artificial light are integrated to define the spatial quality of the house. A special lighting technology, commonly used on backlit signs, was used to distribute light over a broad area. This luminous ceiling device, as well as skylights and dayligthing from the Skywall panel, combine to light the home gracefully.

With a sophisticated energy management system, this team made the control of complex energy systems simple. The advanced control system provides maximum power point tracking for the PV array, battery charge control, electrical load management and daylighting control, in addition to thermal comfort control.

This control system even includes a remote monitoring feature. So when you travel or go on vacation, the monitoring system can vigilantly monitor your house. Just imagine...

No house sitting required.

Team Web site:
www.caus.vt.edu/vtsolar/

We took a significant stance to celebrate PV and not try to hide it. It's a benevolent umbrella, both a collector of energy and a shading device. It gives the building a strong identity not normally associated with residential buildings.

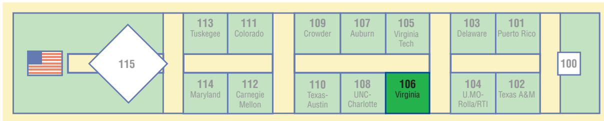
—Virginia Tech faculty advisor, Bob Dunay

Decathletes
Aaron Allen
Jesse Christophel
Aaron Emmons
Jason Kovac
Alok Mallick
Ross Marks
Dave Miller
Yousef Nawas
Chollaporn Ounkomol
John Rozado
Jun Xu

Team Advisors
Bob Dunay
Mike Ellis
Jim Jones
Matt Lutz
Mike O'Brien
Bob Schubert
Mehdi Setareh

106 The University of Virginia

Decathlete Way



We're not designing our house for the sake of being contemporary. We're guided by ethics. The house's design emphasizes technologies that we consider important for the future, and our goal is to integrate them into a lifestyle that is both ecologically aware and comfortable for the homeowner.

—University of Virginia student, Josh Dannenberg

It's Not Your Father's House

Throughout the ages, young people have tried new things. We know that their music is louder and their hairstyles more "creative" than those of their parents, but students at the University of Virginia are raising the bar even higher. They're building a house that their fathers—and mothers—would barely recognize.

For starters, there's the "smart wall," the nerve center of the house, and the first thing you notice on entering the front door. This large light-emitting diode (LED) wall has a touch screen PC connected to a Web site that runs the controls of the house. The house runs independently on a computer system, but the smart wall offers a human interface. The wall can control temperatures inside the house.

Early on, the students decided to use reclaimed and sustainable materials wherever possible. They're using birch and bamboo, which are fast-growing, sustainable trees. For the exterior finish, they selected copper cladding that was reclaimed from a roof. The design also features a rain screen composed of wood reclaimed from shipping pallets. They're milling the wood down and putting it into aluminum frames. The panels of porous wood stop most of the rain and shade the copper.

Those same reclaimed pallets show up again outside the house as louvered window coverings. You'll see no overhangs on this house, because the students opted for the precise control of incoming sunlight afforded by the louvers in combination with the smart wall. Tilted down, the louvers stop direct gain from the sun; tilted up, they reflect light up to the living room, acting as light scoops.

For heating and cooling, the team settled on radiant floor heating and valance cooling instead of a forced air system. This combo heats and cools evenly throughout the house, which speaks to the comfort level. The valance cooling was a pipe along the top of the south wall with a cooling fluid pumped through it.

The house also boasts a green roof for grass or plants, providing residents with private patio space. It's positioned to afford a view of the solar energy system, giving residents an intimate connection with their power source.

As with many other design decisions, the topic of window placement provoked a spirited debate among team members. For aesthetics, they originally planned for skylights to cover much of the roof space. Negotiation among the team's engineers (who wanted fewer skylights and better insulation) and architects (looking for beauty and lots of natural light) produced a better solution with fewer skylights, but nearly as much light.

David Click, a project manager, sums it up best. "The process of engineers collaborating with architects has given me a new vantage point. I'm used to working with four people. It's been great to work with so many—about 100 people have been involved in this." Throughout the entire design and construction process, the team has included 71 students from the School of Architecture, 24 from the School of Engineering and Applied Science, and 6 from the College of Arts and Sciences.

"A new vantage point" seems to be a good way to describe this house. And, although it may look a bit different, the students hope fathers, mothers, grandparents, and children will come to visit—and feel right at home.

Team Web site: solarhome.lib.virginia.edu/

Project Managers

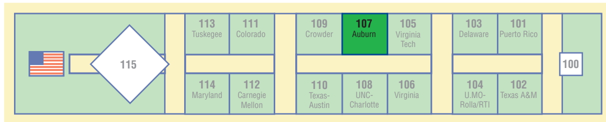
Adam Ruffin, School of Architecture
David Click, School of Engineering and Applied Science
Charlotte Barrows, School of Architecture
Josh Dannenberg, School of Architecture
Ben Dorrier, School of Engineering and Applied Science
Tim Sweeney, School of Engineering and Applied Science

Faculty Advisors

John Quale, Assistant Professor, School of Architecture, Architecture Advisor
Paxton Marshall, Associate Professor and Assistant Dean for Undergraduate Affairs, School of Engineering and Applied Science, Engineering Advisor
Dan Pearce, Research Scientist, School of Engineering and Applied Science, Engineering Advisor

107 Auburn University

Decathlete Way



Even though the dogtrot is an example of southern vernacular architecture, we feel it will appeal to consumers everywhere.

—Auburn student, Lesley Hoke

Bridging the Gap to Acceptance

The Auburn team has built a house first inspired by their forefathers—that is, of course, with all of today's bells and whistles.

The Auburn house is loosely based on a traditional southern design, called the dog-trot, which incorporates a central porch that divides the house into two halves. However, while the house has references to traditional southern design, such as a metal roof with deep overhangs and the dog-trot design, this house is far from conventional.

When modern technologies, such as solar electricity, passive solar heating, solar hot water, energy-efficient windows, and daylighting are layered over this floor plan, the result is a thoroughly comfortable and high-performing house—and proof that a successful balance between traditional architecture and modern engineering can be achieved.

"Our home contains a number of references to southern vernacular architecture," says Lesley Hoke, an Auburn student. "Our tiled central hallway is reminiscent of the dirt-floored breezeway that linked the two living areas in southern dog-trot homes. We feel this design will have great appeal to all consumers," says Hoke.

In fact, most of the decisions made while designing and finishing the house were focused on consumer appeal and overall livability of the house. "We wanted a house with a modern, upscale feeling that blended the best of southern living with the best of modern convenience," explains Hoke.

Premium interior finishes, including cherry veneer hardwood floor, as well as wall coverings that reflect the colors of the earth and sky, help make the house feel like a home and not a solar laboratory.

Likewise, the appliances were selected for their look and feel, not solely their energy efficiency. In fact, all of the appliances in the Auburn house can be purchased off the shelf at any appliance retailer.

"New technologies are most successful when they are integrated into everyday life," says Auburn professor Henry Brandhorst. "Our goal was to entice consumers to incorporate some of the features showcased in our house into their own homes."

The true heart of this house is in its solar and energy efficiency features. For example, passive solar water columns (large, permanent columns of water) provide a beautiful design focal point in the central living area, while serving the practical function of moderating temperature fluctuations.

Structurally insulated panels (SIPs), which combine the traditionally separate framing, insulation, and sheathing components into one panel, create a tight building envelope minimizing air infiltration. This helps keep the warm air inside and the cold air outside during the winter, and vice-versa during the summer. SIPS, which Auburn has used to build the floors and walls, create a better insulated building, are faster to erect, and are more environmentally friendly than conventional building methods.

The total package of the design and the advanced engineering creates a thoroughly modern home that is comfortable and costs far less to operate than the average home.

Team Web site: www.ausolar.org

Team Members

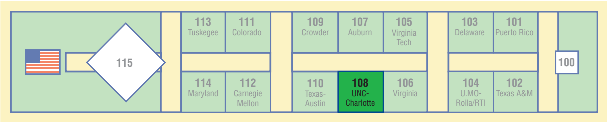
Wilson Clemmons, Industrial and Systems Engineering
Abby Dunlap, Mechanical Engineering
Lesley Hoke, Architecture
Zac Shotts, Mechanical Engineering
Samuel Tyus, Electrical Engineering

Team Advisors

Sushil Bhavnani, Department of Mechanical Engineering
Henry Brandhorst, Deputy Director Space Research Institute
Alan Cook, School of Architecture
Mark Nelms, Department of Electrical and Computer Engineering
Jeff Smith, Department of Industrial and Systems Engineering
Steve Taylor, Department of Biosystems Engineering
David Umphress, Department of Computer Science and Software Engineering

108 University of North Carolina at Charlotte

Decathlete Way



Casting a Warm Glow

The glow of morning's first light is something to behold. Students from the University of North Carolina are looking to capture that same sort of glow and bring it inside their Solar Decathlon house throughout the afternoon.

They're doing it with "Kalwalls." A composite panel of insulation between two panes of plastic material, a Kalwall lets in 10% of the light, giving a translucent effect when the sun is shining brightly. In this house, you'll see Kalwalls on the south wall of the living room and bedroom. Students believe that these will let in a nice glow and make the rooms more interesting.

The living room, kitchen, and sunroom form a multiple-use common space. The bedrooms are separated for privacy with pocket doors. Different types of interior materials indicate and reinforce these public/private zones.

From the beginning phase of this competition two years ago, the North Carolina students "got with the program" of using recycled and green materials. Their carpet is recycled and some of the flooring is made from reused rubber tires. The building exterior is metal, which saves more than a few trees.

The decathlon framework encourages the teams to be as innovative as possible, and these students responded by developing a linkage between water heating and space heating and cooling. Their compressor is something that you might find on a yacht. Some of the excess heat the air conditioner exhausts from the house will be captured and used to heat water in tandem with a small solar hot water panel on the roof. This way, they were able to minimize the size of both systems. The 4.5-kilowatt photovoltaic system is also tied in, providing power for lighting, appliances, charging the car, and wherever else it's needed.

When fresh air is desired, the skylights and the kitchen door and windows can be opened. A screened-in room brings in more fresh air, as well as providing a comfortable place to relax. Overhangs on the south side are sized to cut off the sun in summer, but let sun in during winter.

For shading purposes, windows on the east and west sides are placed adjacent to bumpouts (an extension of the south wall). A lot of the natural lighting comes from the skylights and two more windows on the north facade.

Last year, students in a lighting seminar custom-designed some of the lighting systems. The lights over the kitchen island, designed to complement the skylight, and the compact fluorescent lights in the office are products of the seminar students.

This is just one more example of the lengths students have gone to for this competition. Custom lighting, walls that glow, and an air conditioner that also heats water? It's all part of a day's—or two years—work for University of North Carolina students.

After the competition, all that work will reap rewards for years to come. "The house will be a permanent educational component of the university—a classroom that serves both architectural and engineering students and displays the evolving technologies of the living and building environment," says Dale Brentrup, faculty advisor.

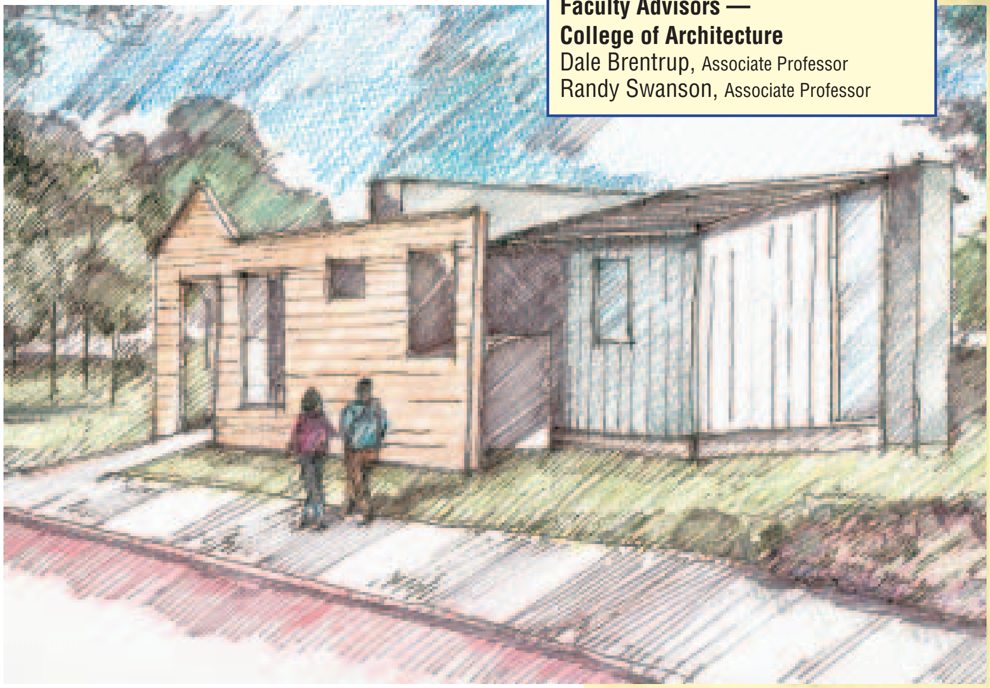
Team Web site: www.uncc.edu/lighting/

I was surprised at how detailed the drawings must be. The whole process was intellectually stimulating. I'm a 4th year student, and I had never seen anything like this—continuing the process beyond the simple design.

—University of North Carolina student, Eric Boyd

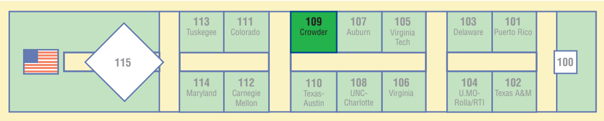
Design/Construction Team Members — College of Architecture
Richard Boswell
Eric Boyd
Mark Chaffee, Graduate
Ryan Clark
Paul Graham
Daniel Miller
Kerry Kalish
Darian Walker

Faculty Advisors — College of Architecture
Dale Brentrup, Associate Professor
Randy Swanson, Associate Professor



109 Crowder College

Decathlete Way



Exchanging Ideas Energizes the Community

The team from this two-year community college nestled in the Heartland brought solar into its design and the community into the project. The Crowder College decathletes, with backgrounds as varied as blacksmith art and computer science, used their community as a resource. As local sponsors offered to donate products, visit the campus, and assist with installation, the students educated these sponsors and community members about solar technologies and energy efficiency. It was the beginning of a very important dialogue.

It's been a very educational and community-oriented process. It's not just the students participating in the project. Community members and sponsors have been jumping in and helping.

—Crowder College student, Monty Pugh-Towe

One of the first exchanges took place during the design phase, just one exchange that team advisor Art Boyt characterizes as a "cross-pollination of ideas." While the Crowder team was studying solar theory, they connected with a local architect. The architect presented a French cottage design to the team and the team introduced the architect to solar power. Boyt notes, "The architect changed our perspective from 'How do you build a solar house?' to 'How do we incorporate solar features into our design?' How do we add the solar features so amenities operate off of sunlight?"

The team also worked hard to isolate yet ventilate the house's building envelope. Boyt feels that there's currently a lot of resistance to energy efficiency because of concerns with air quality in a tight building envelope. "We wanted to thermally isolate the inside of the building while still providing fresh air," says Boyt. "A positive heat recovery system allows a tightly built building to have ventilation to the outside, but to avoid the energy (heat or air conditioning, or both) loss in the building. This ventilation also prevents sick building syndrome."

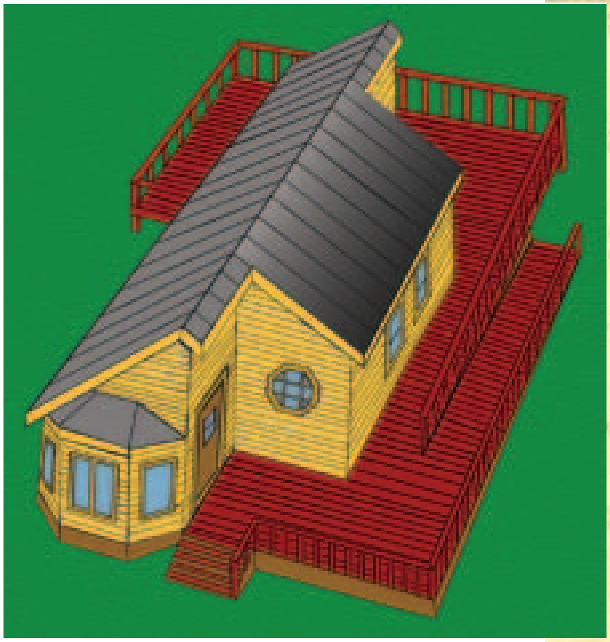
The team shared these ideas with All American Kanbuild, a local manufactured homebuilder, who was looking for a way to reduce the likelihood of sick building syndrome. Team member Monty Pugh-Towe recalls, "We introduced our team sponsor, KanBuild, to a positive heat recovery system and solar features. They build hundreds of buildings a year and this was a new approach that they had never tried in any of their buildings." In return, the team learned about portable buildings from Kanbuild.

Team Members
Joel Lamson
Coty Pringle
Kelly Gossett
Monty Pugh-Towe
Lori Kern
Tom Brown
Gale Perry
Dolores Jennings
Ray Becker
Cinder Beeler

Faculty Advisors
Art Boyt
Kevin Newby

The Crowder team is also applying a "daylight harvesting" system. With this system, sensors in the ceiling of the house monitor the lighting levels in the different rooms. As the light outside the house changes, the lighting inside the house adjusts, always striking a balance. The team will also incorporate motion sensors in all the rooms, so the lights will go out if no one is in the room.

Working in collaboration with BP Solar, Watts Radiant (radiant floor company), and a roofing company, the team designed a hybrid system that combines solar thermal and PV. Not only will the entire south roof be dedicated to solar hot water collection for domestic hot water and space heating, the entire south roof will be covered with solar electric PV panels. The students spent many hours in research and design before building this hybrid system. They feel it will provide so much electricity and excess hot water—you may just find the team soaking in the hot tub on their deck!

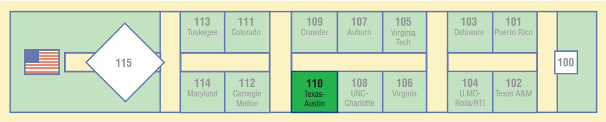


Boyt feels that making the contacts, bringing students and industry together, is a key aspect of this project. Plus he notes, "The greatest asset of a two-year school is that there are always fresh ideas. We ask a lot of questions and we scramble harder for the information. And, we reach out into the community for people with expertise."

Team Web site: www.crowder.edu/solar/

110 Decathlete Way

University of Texas at Austin



Our design lets you take the core of your house—the kitchen, laundry room, and bathroom—to the beach with you for the weekend or permanently move the entire house to another state.

— UT Austin graduate student, Jennifer Tullis

UT Austin Redefines Mobile Home!

Imagine you are buying a new house. The house is exactly what you are looking for and then you turn a corner and see…. an RV trailer parked in the living room! That just might be the wave of the future if the Solar Decathlon team from the University of Texas at Austin (UT Austin) has its way.

The Austin team has indeed incorporated an Airstream RV trailer into its house design. Dubbed the Mobile Utility Unit, or MUU, the trailer cleverly houses the kitchen, laundry room, and bathroom in this one-of-a-kind house. The trailer is "docked" in a bay right in the middle of the house. Even though the trailer serves a utilitarian purpose, it is being completely retrofitted and redecorated so that it blends with the rest of the house.

The UT Austin team members hope the Airstream trailer will give them an advantage over other teams because it addresses several energy efficiency problems as well as complementing the modern American lifestyle. "Americans are becoming increasingly nomadic and not staying in the same location for very long anymore," explains Jennifer Tullis, a UT Austin graduate student.

"Our design lets you take the core of your house—kitchen, laundry room, and bathroom—to the beach with you for the weekend or permanently move the entire house to another state," added Tullis. The MUU, coupled with the ease of assembly and disassembly of the modular design, makes it quite possible to buy one house and take it with you wherever life leads you.

Aside from the ease of relocation, the MUU presents creative solutions to important energy efficiency issues as well. The hot water, generated from a roof-mounted solar collector and stored in a series of tanks built adjacent to the trailer, does not need to travel far to the shower, dishwasher, or washing machine, which means there is very little heat loss. The MUU also has the added benefit of containing all the heat and humidity created by these modern necessities in the trailer, thereby reducing the costs for air conditioning in the summer.

In addition to the creative MUU, this house is packed with solar and energy efficiency features. The team employed state-of-the-art engineering tools, such as wind tunnel testing to help determine the best size and placement of windows, and Solar Path computer modeling to design the optimal solar photovoltaic system.

The team looked to gain advantages over their competition wherever possible. For instance, they are custom building their refrigerator to include more insulation. In addition, they are using an induction cook top, which transfers heat directly to the special magnetic cookware and the food so there is very little loss of heat. The microwave oven uses halogen flash-bake technology, and the outdoor BBQ is a solar oven.

Despite extensive engineering and architectural work, which balanced the performance and livability of the house, the Austin team hopes much of what it has done is appealing to the do-it-yourself homeowner. Because they have used simple concepts such as better insulation, extensive shading, and appliances that use less electricity, the UT Austin team hopes visitors can use some of these practical ideas in their own homes.

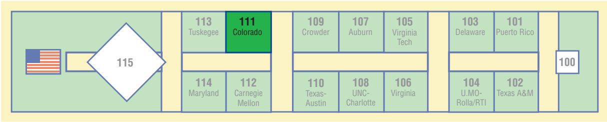
Team Web site:
mather.ar.utexas.edu/cadlab/decathlon/

Team Members
Jennifer Tullis, Passive Systems, Publicity, Foundation
Sarah Row, Design Development, Frame
Rik Haden, Construction Leader
Sharon George, Hot Water, Frame
Supapong Thamasarnsoonthorn, Interior, Passive Systems, Frame
Nathan Engstrom, Procurement, Walls
Joshua Jackson, Design Development, Walls
Shivani Langer, Passive Systems, Power, Roof

Team Advisors
Michael Garrison, Associate Professor, School of Architecture
Pliny Fisk III, Adjunct Professor of Architecture and Co-Director, Center for Maximum Potential Building Systems

111 The University of Colorado at Boulder

Decathlete Way



We want people to realize that solar design can look good and doesn't need to be the dated designs we all remember from the 70s.

—CU student, Matthew Henry

The All-American Solar Home

The University of Colorado at Boulder (CU Boulder) team had one goal in mind from the very first day of their Solar Decathlon experience. They wanted to prove that solar energy can work in just about any house—even yours!

They intentionally designed their house to be more like an everyday American home than a perfectly designed experimental solar house. The result of the CU Boulder design approach is a "beautiful house that also happens to be highly efficient and solar powered," says Matthew Henry, a CU senior.

To get there, the team decided to break one of the so-called "must-have" solar design principles—the roof is not at the perfect angle for the solar cells. "We wanted to show that solar design can be adapted to and incorporated into just about any house and not exclusively in competitions such as the Solar Decathlon," says Celeste Leidich, a CU senior.

In fact, a guiding principal of the CU team was public access and acceptance rather than maximum solar energy production. Team members recognized early on that their corner lot gave them a unique opportunity and decided to orient the house more to the pedestrian traffic passing by than to the sun. "We want visitors to see as much of our house as possible because we are not sacrificing aesthetic appeal and livability to maximize PV," says Henry.

Team Members
Glenn Cashmore, Project Manager
Matthew Henry, Architectural Design Lead
Adam Jackaway, Lighting and Passive Solar Design
Celeste Leidich, Team Coordinator
Jessica Lorentz, Fundraising
Leslie McClure, Materials Coordinator
Mike Renner, Engineering Design Lead
Blaise Stoltenberg, Mechanical Systems
Mike Wassmer, Solar Thermal and Simulation
Zeke Yewdall, Electrical Systems

Team Advisors
Michael Brandemuehl, Associate Professor, Civil, Environmental, and Architectural Engineering
Julee Herdt, Assistant Professor, Architecture

Although CU team members recognize that solar energy production will be slightly decreased, they feel the benefits from the enhanced visual appeal far outweigh any drawbacks. "We wanted to build a house you could find in any neighborhood—a house that also happens to be powered by the sun. So, in the end, we have a more interesting and beautiful product that we feel creates more opportunity for broad acceptance," adds Henry.

It is this neighborhood feel that the CU team hopes will help visitors envision adding solar and energy efficiency features to their houses. Recognizing that few building sites are perfect for solar electricity, the CU team worked through common issues and developed innovative solutions.

"Designing for real world problems allowed us to come up with creative solutions, saving consumers time and money," says Henry. "We dealt with potential obstacles head-on to show that solar energy and energy efficiency can work in most cases. For example, to address the issue of overheating in the summer from the extensive use of glass, we developed a unique louvered door that can slide in place to shade the large windows."

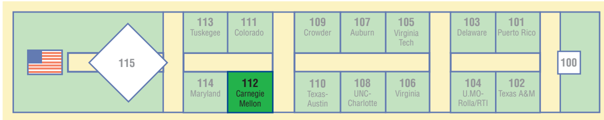
Other unique building materials were incorporated into the house in addition to the louvered door. The team also made extensive use of environmentally sensitive materials, such as sunflower board cabinets, bamboo flooring, and recycled plastic sheeting and flooring. "Not only are these materials comparable to traditional building materials, they are much better for the environment and are readily available to the public," says Leidich.

Although the CU Boulder house might not be the perfect house for solar electricity production, by blending solar electricity and energy efficiency with the all-American home, it just might be the perfect house for the future. "We want people to realize that solar design can look good and doesn't need to be the dated designs we all remember from the 70s," concludes Henry.

Team Web site: solar.colorado.edu/

112 Carnegie Mellon University

Decathlete Way



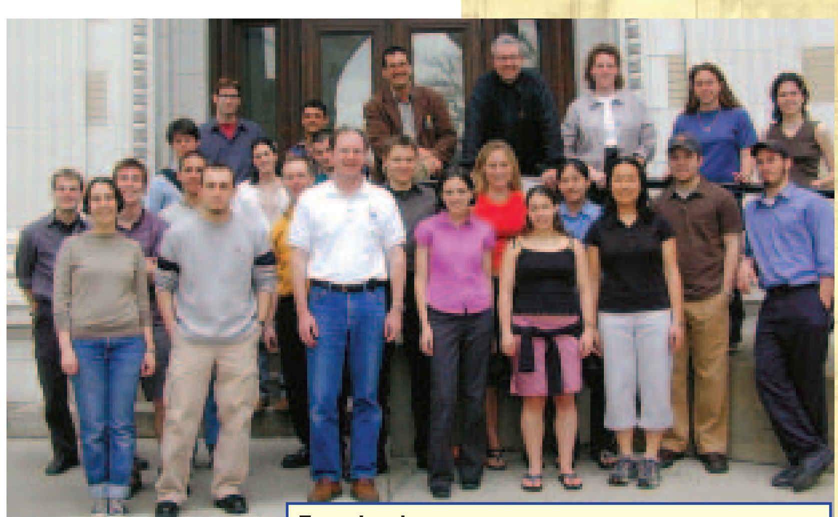
Building this house has made it real. We started with a lot of talk, but when you're building and have to analyze every single piece of material—where it was born, how to get it here—it is amazing. We just want to see what's out there.

—Carnegie Mellon student, Andrew Lee

A Dose of Urban Reality

Urban legends and myths are part of our modern culture. But when students from Carnegie Mellon were contemplating their house design, they landed smack dab in the face of urban reality.

Their school is in Pittsburgh, so these students know full well that city spaces come at a premium. At risk of penalty, they're "breaking the Solar Decathlon rules" and building a two-story house, because they feel so strongly that one-story houses will not be viable in the future. A ranch home simply takes up too much space.



Their house is designed for an urban corner, and it makes a statement about being a good neighbor, if a somewhat unorthodox one at that. After all, how many of your neighbors have a fully functioning solar-electric system on the roof, which is mated to a solar thermal array, which works hand-in-glove with a water-source heat pump? How many of your neighbors' homes are constructed so tightly and run so efficiently that they consume only 10% of the energy of a "normal" house? This house has all of that and more.

Part of the "more" is the building materials themselves. It seems entirely appropriate that a group of college students would use old shredded up blue jeans to insulate their house. Batt insulation for the structure is made from recycled denim scraps from a domestic jeans factory. They're also using wheatboard (a composite of straw) and Plyboo® (a bamboo product) for flooring and room dividers. Bamboo is a fast-growing, renewable crop. The siding material is Eastern white pine, a local product that doesn't require long-distance trucking. There's no odor to the materials, which makes the house healthy for people. "Our materials are recycled, reclaimed, and rapidly renewable," says Stephen Lee, a faculty advisor.

And the ingenuity doesn't stop there. The building envelope is prefabricated building panels, which the students are constructing themselves. No nails will be used to attach these, meaning that all of the seals will be maintained. And because they want a structure that locks together, they're not running electricity through the walls. Electrical wiring runs under the flooring, which is 2-foot by 2-foot tiles of Plyboo, in a $2^1/_2$-inch airspace. Six of the tiles are removable, so the electrical and communications units are easy to relocate.

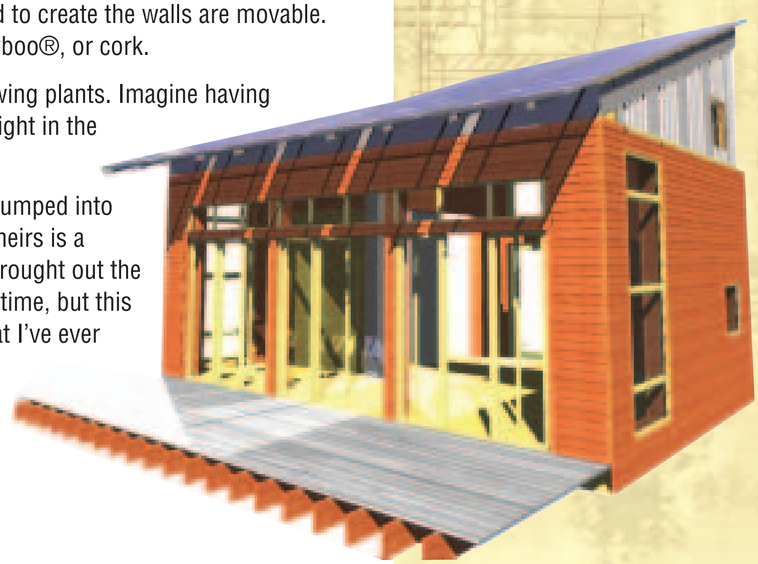
Team Leaders
David Green, Stage I, Project Manager
Andrew Lee, Stage II, Project Manager
J. Herrington, R. Hill, G. Jordan, L. Schmitt,
R. Stahlman, M. McMorrow, J. Vizzi, S. Wang
Stage III, Design and Construction Crew

Faculty Advisors
Stephen R. Lee, AIA, Professor, School of Architecture
Thomas Spiegelhalter, Visiting Professor, School of Architecture
Susan Wilson Tolmer, Assistant Director of Development, College of Fine Arts
Elizabeth Wellman, Special Faculty, School of Design
Visit the CMU Web site to meet the rest of the team.

The whole house operates as a modular structure. The internal panels used to create the walls are movable. The walls are basically a tubular metal frame with an in-frame of fabric, Plyboo®, or cork.

Atop the wet core (kitchen, bath, mechanical) is a flat "green" roof for growing plants. Imagine having your own garden—your own piece of the country—on top of your house right in the middle of the city!

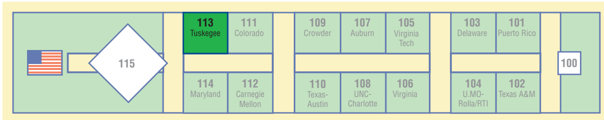
When you look at this house, you'll see that the Carnegie Mellon students jumped into this project with their eyes wide open, facing their urban reality head on. Theirs is a working house designed for a working city, and designing and building it brought out the best in them. Stephen Lee summed it up. "I've been a professor for a long time, but this project has elicited the highest degree of enthusiasm from the students that I've ever seen."



Team Web site: www.arc.cmu.edu/carnegie_team

113 Tuskegee University

Decathlete Way



We wanted a design that was both a link to the past and to the future—that makes it easier for people to accept.

—Tuskegee faculty advisor, Dr. Ben Oni

New Solar for the Old South

Take a drive through communities in the South, and you'll soon notice a favorite local pastime—settin' on the porch for a spell, sipping sweetened tea or an icy mint julep. According to student team member Trey Raines, "Traditional architecture in the South uses passive cooling strategies such as porches and breezeways. We based our design on a southern house type, the dog-trot." Dating from at least the 19th Century, the dog-trot house derived its name from the central shaded breezeway running through the house, where hunting dogs would sleep to escape the summer heat.

Intent on a successful marriage of new technologies to old traditions, the team set to designing their entry. Dr. Ben Oni, the team's faculty advisor, said, "We wanted a design that was both a link to the past and to the future—that makes it easier for people to accept." The students also wanted to design the most beautiful house they could, one that would settle gracefully into its permanent home on the university campus.

To get started, engineering students did research and calculations to determine what type and number of photovoltaic panels to use. They also considered the proper slope of the roof a key part of the design. Next, the engineering team supplied parameters based on energy efficiency and space requirements to the design team. Oni said that all the students were aiming for maximum efficiency coupled with compelling aesthetics.

Team Members

Olugbenga Adalumo, Computer Science
Diwanna Baskins, Architecture
Eric Bell, Construction Science and Management
Cliston Cole, Electrical Engineering
Steven Johnson, Construction Science and Management
Francois Kuate, Electrical Engineering
Robert McElroy, Construction Science and Management
Trey Raines, Architecture
Keisha Richardson, Architecture
Brian Wilkerson, Electrical Engineering

Team Advisors

Dr. Ben Oni, Associate Professor of Electrical Engineering
Dr. Donald Armstrong, Associate Professor of Architecture

Raines says that the team is quite pleased with the resulting two-story design with a southern-style screened porch. He added that the second story was no small feat given the 18-foot height limitation (to prevent one house from shading another) imposed by the competition. The house has an airy and inviting feel, with lots of interior open space, which, by design, is also easier to heat and cool. Most of the home's heating requirements will be met by passive solar from south-facing windows, but there is a central heat pump unit for backup. Cooling needs will be met with natural ventilation to the extent possible, but the heat pump can serve as backup here as well.

For building materials, the decathletes are relying on wood, which they think is the most flexible in terms of building and transportation. The insulation is rigid foam for the roof and bat in the floor and the walls. The structure is wrapped in plywood siding, chosen for its insulating value and its tendency to release solar heat before it radiates into the interior. All windows have double-pane insulating glass.

The home's solar electric system should provide enough power for about 6 sunless days. A 4-foot by 10-foot thermal panel with underlying pipes supplies the hot water. Standby electric hot water is also built in, but faculty advisor Dr. Arunsi Chuku says, "We hope we don't use it."

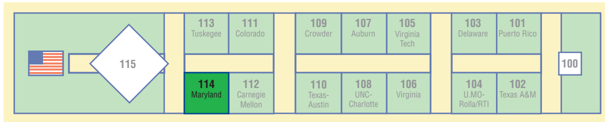
To further reduce energy consumption, the team will use compact fluorescent lamps, which are cooler and more efficient than incandescent lamps. Lighting is controlled by a computer automated system that adjusts lighting levels relative to available sunlight. Team members also incorporated light-colored interior paint as a daylighting feature to lessen the electric light requirements during the day. And when it came to zeroing in on the home's appliances, the team performed a Web search for models with only the highest efficiency ratings.

In summing up their experience, several decathletes mentioned the opportunity to learn things they "wouldn't have learned otherwise." And with the Tuskegee students finding out firsthand that these technologies work, it seems safe to say that energy efficiency and renewable energy are well on their way to bringing a new tradition to the old South.

Team Web site: tusolar.tusk.edu/

114 University of Maryland

Decathlete Way



The Home-Team Advantage

The University of Maryland is only 12 miles from the National Mall. That's all. With the Solar Decathlon competition site so close to campus, students are looking to capitalize on their home-team advantage.

This includes building a house with a traditional look that blends in with area neighborhoods. There is a major difference, though—this is a *solar* home designed to maximize the amount of energy collected from the sun while conserving energy at every opportunity.

"Our strategy is to use the entire house to collect energy. All the rooms except the office have south light—natural daylight. We're using the natural elements and maximizing their advantage to the house," says Alex Yasbek, the current project manager.

The large deck adorning the south side of the house and the porch on the north side are two more expressions of the home-team advantage. Other teams were compelled to streamline their entries for the long haul across hundreds of miles of open roads. Not so for the Maryland entry. The covered porch on the north side is almost like another room, making this small house feel much larger. In nice weather, or even if it's raining, this deck will be a comfortable place to relax.

On cloudy days, some of the lights inside the house will turn on, but not at full power. The house is equipped with photo sensors that determine how much light is needed. All lights are energy-saving compact fluorescents, and most are recessed can lights, which add architectural appeal. A skylight and clerestory introduce daylight and reduce lighting loads during the day.

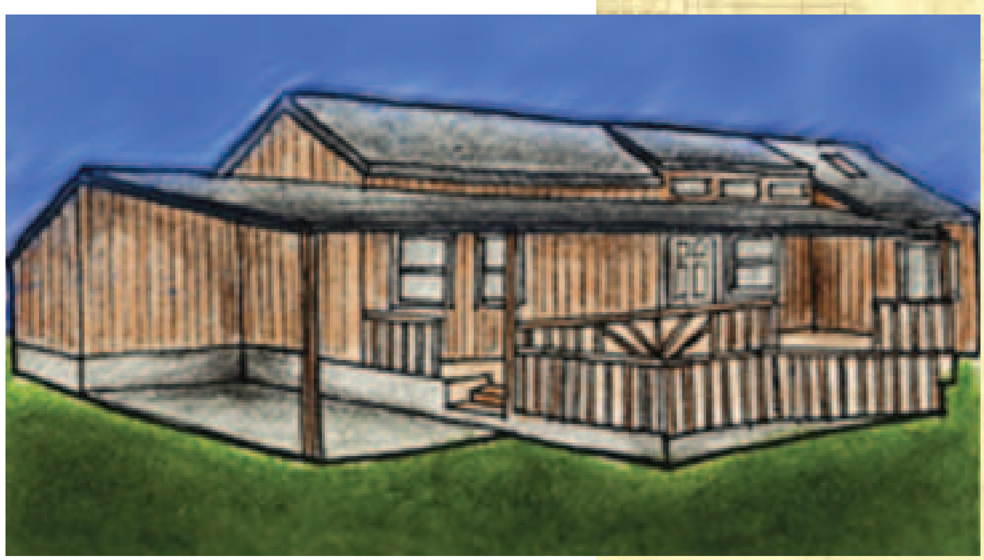
In addition to lighting, appliances were chosen with an eye toward electricity and water savings. It all adds up over the life span of the product, because lighting and appliances are used on a daily basis. "Every consumer uses appliances and lighting—they can be switched without a whole lot of effort. Eventually, you'll need to replace the refrigerator anyway, so why not choose the efficient one?" says Andrew Hunt, former project manager.

A solar thermal system (using evacuated glass tubing) provides both space heating via a radiant floor and domestic hot water. Storage is in traditional, well-insulated solar hot water tanks.

You'll see an impressive array of bluish-purple PV panels completely covering the southern roof of this house. The average homeowner in a grid-connected situation could manage nicely with a much smaller array, but Maryland students felt that the team that collected the most energy would do the best. They're hedging their bets; the house is energy efficient, and they have a 5.8-kilowatt array—one of the largest PV systems in the competition.

During the design phase, Maryland students talked to a lot of people on campus. During the construction phase, they branched out and opened the house to tours on Maryland Day—an annual event that draws about 60,000 people. Word has gotten around, and people are curious. They call or stop by the house frequently and ask for tours. The students are hoping that some of these same people will show up to cheer them on during the competition. After all, the competition is only 12 miles away.

Team Web site: www.solartech.umd.edu/



Early on, we visited a home with radiant floor heating. We loved it. You could feel the difference the second you walked inside.

—University of Maryland student, Alex Yasbek

Team Leaders
Alex Yasbek, Project Manager
Catherine Buxton, Assistant Project Manager
Andrew Hunt, Former Project Manager
Brian Chamberlain, Electrical Manager
Hans Harris, Site Construction Manager
Elizabeth Thorstensen, Interior Designer
Robyn Hladish, Public Relations
Scott Heatwole, Construction Engineer
Holly Campbell, Radiant Floor Engineer
Teresa Broadnax, Concrete and Ventilation System
Meng-Yi Lin, Michele Robinson, Electric Car

Faculty Advisors
Dr. Jungho Kim, Mechanical Engineering

U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy

Proud sponsors of the Solar Decathlon, bringing you a prosperous future where energy is clean, abundant, reliable, and affordable.

www.eren.doe.gov

National Renewable Energy Laboratory

The U.S. Department of Energy's National Renewable Energy Laboratory (NREL) welcomes the Solar Decathletes who have come from around the country to participate in this first-of-its-kind competition. Anyone intrigued by cutting-edge ideas in architecture, energy, or the environment will want to explore the impressive Solar Village on the National Mall.

NREL is honored to be a sponsor of the Solar Decathlon. Such a role came naturally for NREL—DOE's primary laboratory for renewable energy and energy efficiency research and development. Our laboratory in Golden, Colorado, is home to the National Center for Photovoltaics, where world-class scientists explore new methods and materials for turning sunlight into electricity. Researchers in NREL's Center for Buildings and Thermal Systems likewise have forged a leadership role in energy-efficient building design.

NREL works to nurture a wide range of technologies that benefit our economy, our national security, and our environment. Our research portfolio extends beyond solar and building design, into wind power, biomass power, biofuels, geothermal energy, hydrogen, fuel cells, distributed power, advanced vehicle design, and basic energy science.

The benefits of research into renewable energy have never been more critical to our nation. Resources such as sunlight and wind can be put to work producing electricity, fuel, and valuable chemicals with little—if any—pollution. The United States imports about 60% of its petroleum, so there is a pressing need to find non-fossil-fuel alternatives.

This year, as NREL celebrates its 25th Anniversary, we can look back and take pride in the progress we have made toward those goals. Since the laboratory got its start as the Solar Energy Research Institute in 1977, we have successfully developed materials and technologies that have been instrumental in reducing the cost of solar electricity by 80%.

In the buildings arena, NREL has developed software that helps architects design cost-effective, energy-efficient structures and developed technologies such as "smart" windows that darken in bright sunlight to help keep buildings cool. By combining energy efficiency with renewable energy technologies, we are working with the nation's homebuilders to advance the concept of "zero energy buildings"—structures that produce nearly as much energy as they use.

The Solar Decathlon is a training ground for the architects, scientists, and engineers who will help the nation shape its energy and its architectural future. We at NREL join with our fellow Solar Decathlon sponsors in wishing these student teams continued success—throughout the competition they face now, and in meeting the exciting challenges that await them tomorrow.

NREL is a contractor-operated laboratory owned by the U.S. Department of Energy and managed by Midwest Research Institute (MRI) of Kansas City, Missouri; Battelle Memorial Institute of Columbus, Ohio; and Bechtel Corporation of San Francisco, California. Pictured is the Solar Energy Research Facility at NREL.

BP Solar

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The natural source
for electricity®

Imagine a world where energy is abundant and available whenever and wherever you need it. Energy so simple you hardly know it's there. No noisy engines. No emissions. No refueling. No massive power plants. That world is solar, and it's quickly taking shape as a result of events such as the Solar Decathlon.

BP Solar is proud to sponsor the Solar Decathlon and to support its mission of promoting the development and use of solar energy. The Solar Decathlon showcases the opportunities that exist in the exciting and challenging field of energy efficiency and renewable energy. It's a field that BP Solar believes can be used to improve the quality of people's lives and the environment worldwide.

For almost 30 years, BP Solar has worked to develop the technology and infrastructure to support widespread use of solar energy around the world. BP Solar operates nine manufacturing plants in the United States, Spain, Australia, India, and elsewhere around the world.

Today, BP is the world's largest private-sector consumer of solar power, as well as one of the largest manufacturers of solar modules. BP employs solar technology at almost 400 sites already, including many of the company's new BP Connect service stations. A total of 3.5 megawatts of solar power capacity is installed today at stations across the globe. This saves around 3,500 tons of carbon dioxide (CO_2) emissions per year.

BP Solar is at the forefront of the international solar electric industry, producing more than 50 megawatts of solar products each year. And BP's investment in solar technology is on track to deliver 300 megawatts of solar panels by 2007, providing the ability to supply energy to 5 million people.

BP Solar is a unit of BP, the largest producer of oil and gas in the United States. BP also is one of the two largest gasoline retailers in the United States.

BP Solar congratulates all the Solar Decathlon participants for their hard work and enthusiasm in developing effective solar solutions for homes and home businesses. We hope that their hard work and creativity will educate and inspire even greater interest in renewable solar electricity.

The Home Depot

The Home Depot is proud to show its commitment to environmental sustainability and promotion of energy-efficient products as a sponsor of the Solar Decathlon.

As the leading retailer of energy-efficient consumer products, The Home Depot supplied many energy-saving products to these accomplished teams and to the Solar Decathlon Village.

The Home Depot is committed to providing customers with information about energy conservation through our "E+" Energy Program. There is no better way to "think globally and act locally" than by conserving energy in the home. With even the smallest do-it-yourself projects, you can begin reducing your energy bills today.

While the techniques and materials used in the Decathlon homes are state of the art, most are also state-of-the-shelf products, available today at The Home Depot. There are energy-saving tips for everyone's home. Whether sealing a house with caulk or weather-stripping or installing an attic fan or a programmable thermostat, The Home Depot can show you how.

Look for the green E+ logo on our Web site (www.homedepot.com) to find simple instructions for all sizes of projects that will save energy and save money. You can even learn how to conduct your own home energy audit.

The Home Depot's commitment to environmental sustainability is also visible through our support of environmental organizations such as The Nature Conservancy, The Conservation Fund, and hundreds of other nonprofits, and through our efforts to bring down the long-term cost of affordable housing through our work with Habitat for Humanity. During a recent build of seven homes with Habitat for Humanity, The Home Depot, working with Southface Energy Institute, ensured that each house attained an Energy Star rating, which translates to hundreds of dollars of energy savings per year for the homeowners.

The Home Depot congratulates all the solar decathletes on their tremendous accomplishments.
We also thank our partners, Philips Lighting, Malibu Lighting, Fiskars, Variflex, Port-a-Floor, and Andersen for their efforts with the teams and the Solar Decathlon Village. We've seen that everyone has a role to play in protecting our limited resources.

The Home Depot in Louisville, Colorado, provided their parking lot for use as a building site for the University of Colorado team.

EDS

EDS is proud to be a major sponsor of the first U.S. Department of Energy Solar Decathlon. This event offers a unique opportunity to promote the use of clean, renewable energy to millions of visitors to our nation's capital. Sponsoring the Solar Decathlon represents a natural evolution of our existing work with the Department of Energy and will help showcase innovative applications of solar power. For many years, EDS was a sponsor of the Department's popular Sunrayce, an annual intercollegiate competition to design and race solar-powered cars.

We look forward to supporting the creative design, engineering, and communications efforts of students from world-class colleges and universities with which we have strong recruiting relationships. Competing in the Solar Decathlon is great preparation for the kind of work employees can expect in a career at EDS: solving complex problems in a culture that thrives on team spirit.

EDS is the world's leading provider of information technology services, and a big part of our business is delivering secure "anywhere, anytime" access to information and communications. For the Solar Decathlon, we'll be supplying end-to-end wireless capabilities to a village built virtually overnight on the National Mall. We'll be providing the network infrastructure for the event, as well as Internet access. And we're making sure each decathlete has equal access to the Internet, while also supporting the decathlon officials' communication needs. In addition, we're providing connection for the Internet terminals on the Mall so that event visitors will be able to monitor the competition and get the latest contest information.

To support its commitment to the decathletes, EDS has assembled its own team of experts. Cisco is providing the hardware and software required to support the infrastructure, including wireless local area network (LAN) components, firewall monitoring, and equipment such as switches and antennas. Nextel is supplying dozens of wireless telephones to support decathlon officials on the Mall, as well as instant messaging for officials and competitors. WorldCom is providing Internet access at the Solar Decathlon Headquarters and throughout the competition venue using wireless broadband technology.

EDS is honored to be part of the Solar Decathlon. The event will help educate consumers and ignite the creativity of the next generation of researchers, architects, engineers, and builders as they embark on their careers. We're delighted to provide the mobile communications needed to get the job done. And we salute all this year's participants.

About EDS

EDS, the leading global services company, provides strategy, implementation, business transformation and operational solutions for clients managing the business and technology complexities of the digital economy. EDS brings together the world's best technologies to address critical client business imperatives. It helps clients eliminate boundaries, collaborate in new ways, establish their customers' trust, and continuously seek improvement. EDS, with its management-consulting subsidiary, A.T. Kearney, serves the world's leading companies and governments in 60 countries. EDS reported revenues of $21.5 billion in 2001. The company's stock is traded on the New York Stock Exchange (NYSE: EDS) and the London Stock Exchange.

The American Institute of Architects

The American Institute of Architects (AIA) first demonstrated its staunch commitment to energy conservation a quarter of a century ago. In cooperation with the U.S. Department of Energy (DOE), AIA members in the late 1970s devoted approximately $1 million in Institute funds to educate architects and their partners in the construction industry on energy-efficient and renewable-energy practices and technologies. What was state-of-the-art thinking then has become standard practice now, from low-tech to high-tech: increased insulation, natural ventilation, and thermal massing to fluorescent lighting, PV, and computer-controlled building systems. The AIA's Committee on Energy, formed in 1977, spearheaded the Energy and Architecture continuing education program between 1978 and 1983. That program culminated in the "Line on Design and Energy" theme for the 1984 AIA National Convention. The Committee on Energy's work was taken up again in 1990, when the AIA formed the still-active Committee on the Environment. That committee's work with DOE has included the Top 10 Green Projects awards, announced each Earth Day since 1998; the Sun Wall design competition for the south façade of DOE's Forrestal Building; and—perhaps the most exciting yet because it involves the practitioners of tomorrow stretching the technology of today to its limits—the Solar Decathlon.

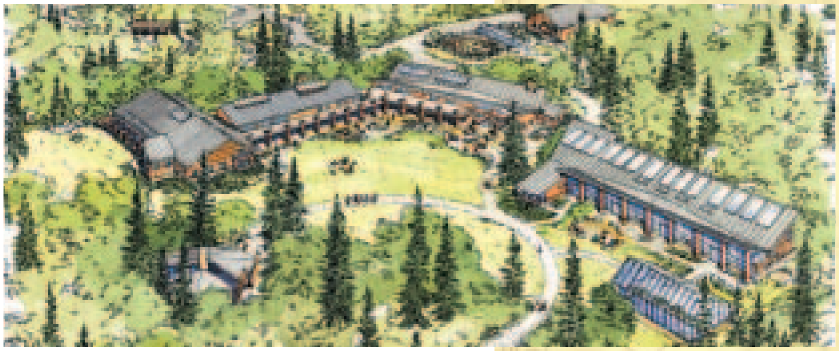
Shown here are examples of the resource-efficient buildings named as the 2002 AIA Top Ten Green Projects, which included projects designed for the federal government, large and small businesses, nonprofit organizations, and individuals, proving the environmental, social, and economic benefits of sustainable design for clients of any size.

Camp Arroyo, Livermore, California
Designed by Siegel & Strain Architects

Cabins at this environmental education camp rely on solar orientation, shading, and operable clerestory windows for heating and cooling and solar panels for hot water and backup radiant heat.

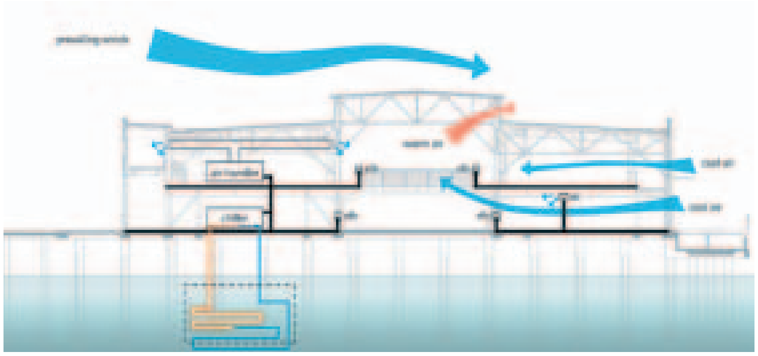
Bank of Astoria, Manzanita, Oregon
Designed by Tom Bender, AIA

This 7,500-square-foot bank features natural ventilation and cooling as well as zoned high-efficiency fluorescent lighting to supplement natural lighting.



Puget Sound Environmental Learning Center, Bainbridge Island, Washington
Designed by Mithun

A PV array provides more than half the power for the learning studio in this 70,000-square-foot facility. The sun also provides half the hot water needs for the lodge and dining hall. Ventilation replaces air conditioning. And natural light is supplemented with high-efficiency fluorescent lights.



Pier 1, San Francisco, California
Designed by SMWM

A dilapidated waterfront warehouse has become 140,000 square feet of class-A office space. Heated or chilled water flows through radiant tubes in the floor slabs to regulate the inside temperature, using the bay as the heat sink.

For More Information

DOE Office of Energy Efficiency and Renewable Energy
Information about all renewable and energy efficiency technologies in the DOE program
www.eren.doe.gov

Consumer Energy Information
A consumer-oriented guide to energy efficiency and renewable energy, including the popular Energy Savers booklet
www.eren.doe.gov/consumerinfo

Database of State Incentives for Renewable Energy (DSIRE)
Including state, local, utility, and selected federal incentives that promote renewable energy
www.dsireusa.org

Efficient Windows
A primer on windows and a guide to selecting energy-efficient windows for specific regions
www.efficientwindows.org

Energy Star
Contains a locator map for purchasing Energy-Star labeled products and a Home Improvement Toolbox
www.energystar.gov

Photovoltaics
An introduction to photovoltaics, also called PV or solar electricity
www.flasolar.com/photovol_main.htm

Solar Buildings
Covers zero-energy buildings and other solar building technologies.
www.eren.doe.gov/solarbuildings

State Energy Alternatives
What is Renewable Energy? Why Consider Renewable Energy? What's Going on in My State?
www.eren.doe.gov/state_energy

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www.homedepot.com

Andersen Windows
www.andersencorp.com

Philips Lighting
www.lighting.philips.com

Intermatic Malibu
www.malibulights.com

Fiskars
www.fiskars.com

EDS (Electronic Data Systems)
www.eds.com

WorldCom
www1.worldcom.com

Cisco Systems
www.cisco.com

Nextel
www.nextel.com

American Institute of Architects
www.aia.org

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