



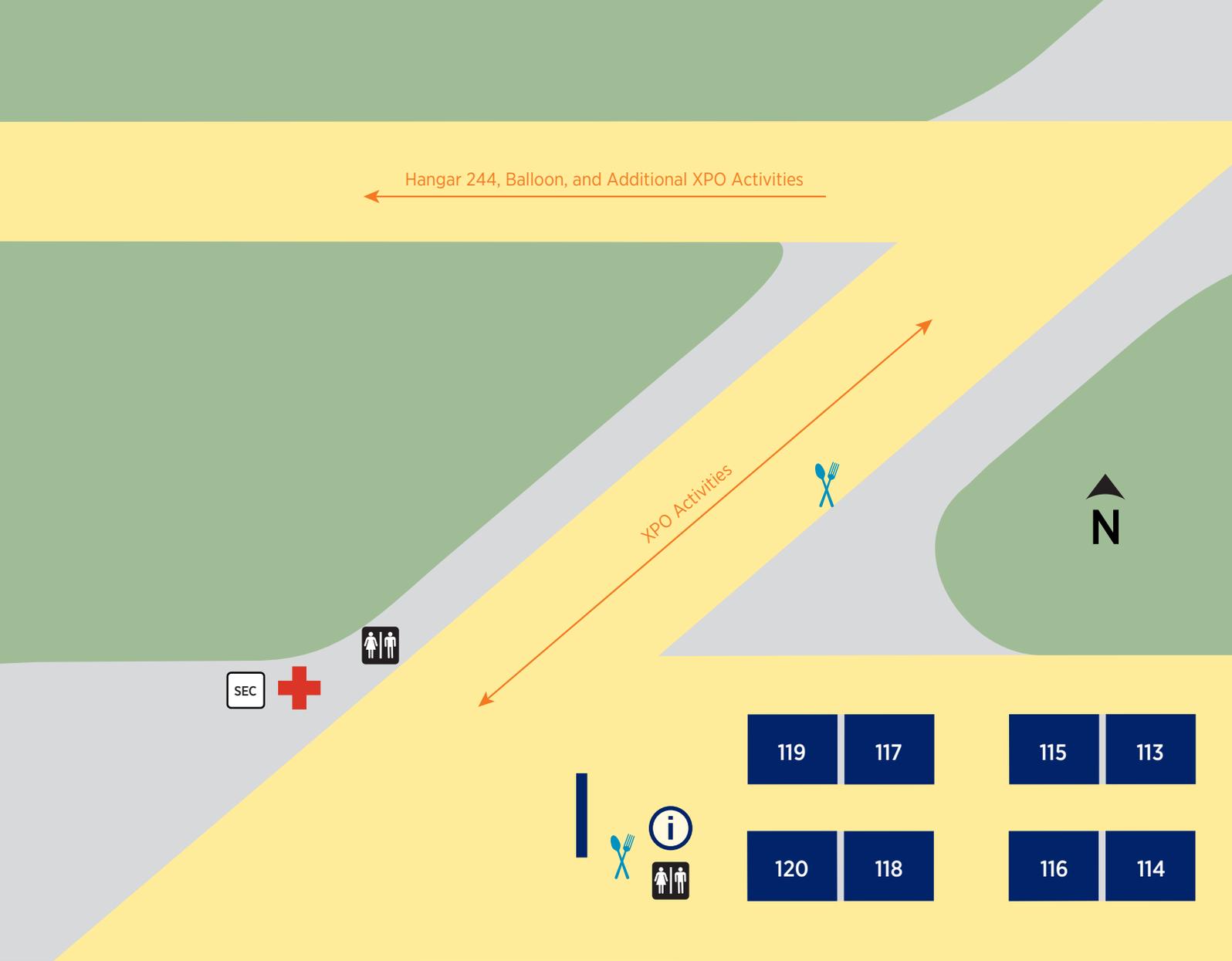
U.S. DEPARTMENT OF ENERGY  
**SOLAR DECATHLON**

# Visitors Guide 2013

Orange County Great Park  
Irvine, California  
Oct. 3-6 and Oct. 10-13  
11 a.m. to 7 p.m.



*Time to shine*



Use your smartphone to scan the quick response (QR) codes found throughout this guide and in the Solar Decathlon village for additional information. Or visit [www.solardecathlon.gov](http://www.solardecathlon.gov).



### KEY

-  Village Entrances
-  Pedestrian Pathways
-  First Aid
-  Restrooms
-  Food/Water
-  Security
-  Shuttle
-  Information - Solar Decathlon

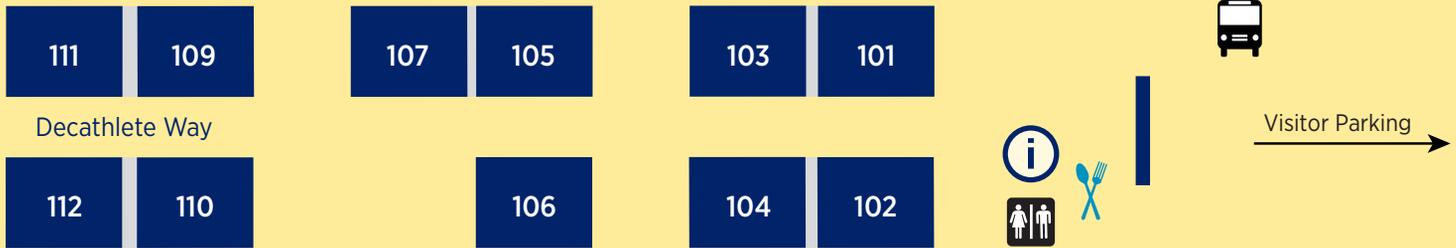


# U.S. DEPARTMENT OF ENERGY SOLAR DECATHLON

Orange County Great Park

Visit the welcome tents  on both ends of the Solar Decathlon village for:

- Additional visitors guides
- Team scores
- An exhibit that shows how much energy the village is producing
- Information about the 10 contests that make up the Solar Decathlon competition.



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Engage with Solar Decathlon 2013 online:



New Zealand's entry in Solar Decathlon 2011.

(Credit: Jim Tetro/U.S. Department of Energy Solar Decathlon)

# Solar Decathlon by the Numbers

## Fun Facts and Statistics

3

Solar Decathlon events worldwide (U.S. Department of Energy Solar Decathlon, Solar Decathlon Europe, and Solar Decathlon China)

2013  
2011  
2009  
2007  
2005  
2002

Years the U.S. Department of Energy held a Solar Decathlon

33

Number of countries represented by collegiate teams participating in Solar Decathlon competitions worldwide during 2013 and 2014

62

Number of collegiate teams participating in Solar Decathlon competitions worldwide during 2013 and 2014

112

Number of collegiate teams involved in U.S. Department of Energy Solar Decathlon events since 2002

29,000

Estimated total number of students participating on Solar Decathlon teams, including those at international events, since 2002

16,800

Estimated number of U.S. Department of Energy Solar Decathlon collegiate participants since 2002

92,538

People's Choice Award votes cast in Solar Decathlon 2011

192

Total Solar Decathlon teams, including those at international events, since 2002

9

Teams participating in the U.S. Department of Energy Solar Decathlon 2013 that competed in a previous Solar Decathlon

357,029

House tours provided at the U.S. Department of Energy Solar Decathlon 2011

# Time To Shine Under the California Sun!

## Welcome to Solar Decathlon 2013!

Every two years, the U.S. Department of Energy Solar Decathlon provides a working display of energy innovation in action.

Until this year, the Solar Decathlon was a capitol event, held in Washington, D.C. Now in Southern California, the Solar Decathlon brings this ambitious and inspiring event to new audiences.

### A student competition.

### A village powered by the sun.

### A public event with purpose.

The Solar Decathlon challenges collegiate teams to design, build, and operate solar-powered houses that are cost-effective, energy-efficient, and attractive. The winner of the competition is the team that best blends affordability, consumer appeal, and design excellence with optimal energy production and maximum efficiency.

The **student teams** competing in the Solar Decathlon spend two years preparing for the event by designing and building their houses. To prepare for the competition, they test and retest their houses to ensure optimized energy production and efficiency.

Last month, the teams transported their houses from campuses across the country and around the world to the Orange County Great Park in Irvine, California. Within days, a temporary **Solar Decathlon village** sprang up—the culmination of collective imagination, creativity, engineering, and ingenuity.

Solar Decathlon 2013 is an event with **purpose**. It:

- Provides participating students with unique training that prepares them for the clean energy workforce
- Fosters collaboration among students from different academic disciplines who otherwise might not have the opportunity to work together until they enter the workplace
- Challenges students to find innovative ways to incorporate practical, affordable, clean energy solutions into homes built for today's consumers
- Drives research and development of energy-efficient products and solutions—and spreads adoption by consumers
- Shows how a house that is connected to a utility grid can produce as much energy as it uses
- Demonstrates how to save money and energy by using affordable clean energy products that are on the market today
- Educates the public about the many benefits of renewable energy and energy efficiency.

All-team photo of Solar Decathlon 2013 collegiate teams at Orange County Great Park  
*(Credit: Stefano Paltera/U.S. Department of Energy Solar Decathlon)*

## It's Their Time To Shine!

### Who are solar decathletes?

**They're world-class competitors.**

**The best and the brightest.**

They're students in architecture and design, engineering, business, and communications. Solar decathletes draw on their strengths and rely on their wits during two years of fundraising, planning, designing, analyzing, and finally building and improving their Solar Decathlon houses.

These student leaders are tomorrow's bright future.

Solar Decathlon 2013 is their time to shine under the California sun.



# Let the Competition Begin!

## At Its Core, Solar Decathlon 2013 Is a Competitive Event.

### What is a decathlon?

By definition, it is a 10-event competition. It's a composite event in which competitors, known as decathletes, take part in each of 10 contests.

The U.S. Department of Energy Solar Decathlon is a competition that challenges collegiate teams to design and build energy-efficient houses powered by the sun. These teams spend two years creating houses to compete in 10 contests.



Middlebury College wins first place in the Solar Decathlon 2011 Market Appeal Contest. (Credit: Stefano Paltera/U.S. Department of Energy Solar Decathlon)

Competition Schedule	Public Exhibit Hours: 11 a.m. to 7 p.m.				
	Thursday, Oct. 3	Friday, Oct. 4	Saturday, Oct. 5	Sunday, Oct. 6	Monday, Oct. 7
<b>Awards Ceremonies</b>					
	 Opening Ceremony at 9:30 a.m.				
<b>Contests (100 points each)</b>					
 Architecture					
 Market Appeal					
 Engineering					
 Communications					
 Affordability					
 Comfort Zone	Indoor temperature and humidity measurements				
 Hot Water	Hot water draws				
 Appliances	Refrigerator and freezer temperature measurements, dishwashing and clothes washing and drying tasks				
 Home Entertainment	Cooking, lighting, dining, computer, and home theater tasks				
 Energy Balance	Measurement of electricity produced and consumed				

The contests are designed to gauge how well the houses perform and how livable and affordable they are. Each contest is worth 100 points—for a possible total of 1,000 points. The three teams with the most points at the end of the competition win a trophy for producing a house that:

- Balances energy production and consumption
- Is cost-effective, attractive, and easy to live in
- Maintains comfortable indoor living conditions
- Supplies energy to household appliances for cooking, cleaning, and entertainment
- Provides sufficient hot water.

## Scoring

Teams earn points three ways.

1. **Task completion** – Teams complete household tasks such as cooking, washing dishes, and doing laundry.
2. **Monitored performance** – Each house performs to specified criteria such as maintaining a comfortable indoor temperature range.
3. **Jury evaluation** – Jurors who are experts in their fields (such as architecture, engineering, and communications) award points for features that cannot be measured (such as aesthetics and design inspiration).

Contests based on task completion or monitored performance are called **measured contests**. Those based on jury evaluation are called **juried contests**.

## Solar Decathlon 2013 juried contests are:

- Architecture
- Engineering
- Communications
- Affordability
- Market Appeal

## Solar Decathlon 2013 measured contests are:

- Comfort Zone
- Hot Water
- Appliances
- Home Entertainment (with juried components)
- Energy Balance

Closed to Public		Public Exhibit Hours: 11 a.m. to 7 p.m.			
Tuesday, Oct. 8	Wednesday, Oct. 9	Thursday, Oct. 10	Friday, Oct. 11	Saturday, Oct. 12	Sunday, Oct. 13
		10 a.m.	10 a.m.	10 a.m.	
Architecture Jury visits team houses					
Market Appeal Jury visits team houses					
Engineering Jury visits team houses					
Communications Jury visits team houses					
Affordability Jury visits team houses					

# 10 Contests of Solar Decathlon 2013

## 1. Architecture (juried)



Teams are challenged to design and build attractive, high-performance houses that integrate solar and energy efficiency technologies seamlessly into the design. A jury of professional architects focuses on architectural elements, holistic design, lighting, inspiration, and documentation.

## 2. Market Appeal (juried)



Each team built its house for a target client of its choosing. The Market Appeal Jury, composed of homebuilding industry professionals, evaluates the responsiveness of the house design to the characteristics and requirements of the target client while also considering livability, marketability, and buildability.

## 3. Engineering (juried)



These houses represent the best of modern engineering. For the Engineering Contest, a jury of professional engineers evaluates each house for functionality, efficiency, innovation, reliability, and documentation.

## 4. Communications (juried)



From team websites to signage and public tours, the Communications Contest challenges teams to educate others about their houses and their experiences. A jury of communications professionals evaluates Web content, an audiovisual presentation and information, the quality of onsite graphics, the delivery of messages to target audiences, and the use of innovative methods to engage audiences.

## 5. Affordability (juried)



The Affordability Contest encourages teams to design and build houses that perform well in the competition yet are also affordable. A professional estimator determines an estimated construction cost of each house, and teams earn 100 points for achieving an estimated construction cost of \$250,000 or less. Points are reduced for estimated construction costs of more than \$250,000.

**6. Comfort Zone**  
(measured)



For the Comfort Zone Contest, teams design their houses to keep temperature and humidity steady, uniform, and comfortable. Full points are awarded for maintaining narrow temperature and relative humidity ranges during specified periods of time. The target temperature range is 71°–76°F (22.2°–24.4°C). The target for relative humidity is less than or equal to 60%.

**7. Hot Water**  
(measured)



The Hot Water Contest assesses whether a house's water heating system can supply all the hot water needed for daily washing and bathing. Teams score points by successfully completing several simulated showers by delivering 15 gallons (56.8 L) of hot water in 10 minutes or less.

**8. Appliances**  
(measured)



This contest is designed to mimic the appliance use of an average U.S. home. Teams earn points for refrigerator and freezer operation, washing and drying laundry, and running the dishwasher.

**9. Home Entertainment**  
(measured and juried)



The Home Entertainment Contest gauges whether a house has what it takes to be a home. How well does it accommodate the pleasures of living, such as sharing meals with friends and family, watching movies in a home theater, and surfing the Web? The contest includes holding two dinner parties and one movie night for six neighboring decathletes, who act as jurors by awarding the host team points based on the quality of the meal, ambiance, and overall experience. Teams also must complete operational tasks with their lights, televisions, and computers. That's why this contest is both measured and juried.

**10. Energy Balance**  
(measured)



Each team house is equipped with a bidirectional utility meter that enables competition organizers to measure the net energy the house produces or consumes over the course of the competition. Teams that produce more energy than they consume over the duration of the contest earn the full 100 points for this contest.

# Who's Who at Solar Decathlon 2013

## The Teams

The collegiate teams that design, build, and operate the competition's solar-powered houses represent the next generation of clean energy architects, engineers, and entrepreneurs. As you visit the team houses, consider the creative spirit, sense of place, and positive energy they evoke. Ask questions. Search for ideas for your own home. And choose your favorites. Don't forget to vote for the People's Choice Award (see back cover).

## Students Rule, but Jurors and Organizers Are Important, too.

All Solar Decathlons are about the students. Their shining talent, energy, and commitment take center stage. However, this event can only be successful with the efforts of the following individuals and organizations.

## Jurors

Solar Decathlon 2013 jurors are distinguished leaders in their fields. Juries are composed of individuals at the top of their respective professions who bring academic excellence and practical, in-the-field experience to the competition. The Solar Decathlon organizers value the jurors' contributions and thank them for their work.

## Architecture

- Amy Gardner  
*University of Maryland School of Architecture, Planning, and Preservation*
- Richard N. Swett  
*Climate PROSPERITY Enterprise Solutions LLC*
- Victor Olgay  
*Rocky Mountain Institute*

## Market Appeal

- Susan Aiello  
*Interior Design Solutions*
- Brian Baker  
*Baker Development Group LLC*
- Steve Glenn  
*LivingHomes LLC*

## Engineering

- Brad Oberg  
*IBACOS Home Building Specialists*
- Kent Peterson  
*P2S Engineering*
- Mark Thornbloom  
*Kelelo Engineering*

## Communications

- Ariel Schwartz  
*Co.Exist (Fast Company magazine)*
- Mark Walhimer  
*Museum Planning LLC*
- Haily Zaki  
*Secret Agent PR and Dwell on Design*

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A student sets the last solar panel on his team's house during Solar Decathlon 2009. (Credit: Stefano Paltera/U.S. Department of Energy Solar Decathlon)



## Organizers

### U.S. Department of Energy

#### Office of Energy Efficiency and Renewable Energy

#### Building Technologies Office

Solar Decathlon director: Richard J. King

The U.S. Department of Energy works to ensure America's security and prosperity by addressing its energy, environmental, and nuclear security challenges through transformative science and technology solutions. Within the Department of Energy, the Office of Energy Efficiency and Renewable Energy accelerates development and facilitates deployment of clean energy technologies and market-based solutions that strengthen U.S. energy security, environmental quality, and economic vitality. Its Buildings Technologies Office works closely with industry, manufacturers, and academia to research and develop technical solutions and practices for energy-efficient living and work spaces.

The Solar Decathlon supports the Energy Department's efforts to solve U.S. energy challenges through:

- Renewable electricity generation (including electricity generated from solar, water, wind, and geothermal sources)
- Energy-saving homes, buildings, and manufacturing
- Sustainable transportation (including electric vehicles, homegrown fuels, and fuel cells).

The competition also supports the Obama administration's "all of the above" energy strategy—to reduce energy costs for American families, cut carbon pollution that causes climate change, and strengthen U.S. energy security.

Since the first U.S. Department of Energy Solar Decathlon in 2002, nearly 17,000 students have taken advantage of the unique training opportunity that is the Solar Decathlon. This extraordinary event helps ensure that energy-smart and attractive solar-powered houses—along with the extraordinary corps of students who design and build them—find their time in the sun. As the next generation of architects, engineers, and builders, these decathletes are well-positioned to apply hands-on experience to strengthen our planet's future clean energy economy.

[www.energy.gov](http://www.energy.gov)

[www.eere.energy.gov](http://www.eere.energy.gov)

### National Renewable Energy Laboratory

Solar Decathlon event production manager: Sara Farrar-Nagy

Since 2002, the National Renewable Energy Laboratory (NREL) has served as the primary organizer of the U.S. Department of Energy Solar Decathlon by providing everything from technical expertise to communications outreach in support of each successful event.

NREL focuses on creative answers to today's energy challenges. The laboratory's researchers are dedicated to transforming the way the world uses energy. For more than 35 years, NREL has been a leader in successful innovation of energy efficiency and renewable energy, and its discoveries shape the nation's transportation alternatives and provide sustainable options to power homes and businesses.

NREL's research and partnerships have given the United States and the world clean, sustainable energy choices. In that spirit, NREL applauds the brainpower, altruism, and competitiveness displayed at Solar Decathlon 2013.

[www.nrel.gov](http://www.nrel.gov)



Opening day at Solar Decathlon 2009

(Credit: Stefano Paltera/U.S. Department of Energy Solar Decathlon)

# Southern California Institute of Architecture and California Institute of Technology

DALE, the Dynamic Augmented Living Environment, is this year's entry for the SCI-Arc/Caltech team. Made of two movable, prefabricated modules that open to allow the outdoors in, DALE celebrates the active California lifestyle and fosters thriving through its dynamic architecture.

DALE is a small house that enables its occupants to live large. It is designed to embrace California's climate and inspire a spirit of extreme living in the context of today's sustainable movement. The team presents DALE as an answer to the recent trend of supersized, suburban mansions that elevate cost and material while focusing on largeness. By contrast, DALE reflects an appreciation of and delight in a sustainable living space and aims to reclaim the spirit of Southern California.



Notes



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<http://go.usa.gov/jpdC>



## Features

- Two prefabricated modules move across a rail system and open easily to create an outdoor living space that triples the inhabitable square footage.
- A vinyl exterior skin provides a tight, waterproof body glove and replaces traditional sheathing and finish.
- Two partitions suspended from ceiling tracks in the living module divide the house into a bedroom, living room, and home office—or vanish to create one large living area.
- A core module houses the mechanical room, bathroom, and commercial-sized kitchen.
- Sliding solar canopies offset from each module have vertical louver panels for shade, ventilation, and privacy.
- Interchangeable platforms can vary from a solar thermal collector to a sports rack to an integrated hammock.

## Technologies

- A steel superstructure with a pair of embedded motorized bridge crane end trucks moves the modules.
- Spring-loaded cable and hose reel assemblies with a fixed connection to a municipal water and power source hold all the hoses and cables as they travel with the movable modules.
- A 28-panel photovoltaic (PV) array produces all the house's electricity.
- The HVAC system uses state-of-the-art solar water heating technology with solar thermal evacuated tube collectors to maintain a comfortable interior temperature.
- A house monitoring system collects solar energy production data, monitors energy and water consumption, and controls indoor temperatures.
- A unique safety system monitors the movement of the house.

# Stevens Institute of Technology

Ecohabit aims to redefine the relationship between a house and its occupants. It is a house that addresses sustainability in all facets—from form, through construction, to the dynamics of its use. It is L-shaped, which maximizes views of, and access to, the generous outdoor living space. The house adapts to its occupants' needs and provides them with feedback on ways to reduce energy use to live more sustainably. Intelligent energy systems monitor the house, its occupants' behaviors, and regional climate information. In doing so, Ecohabit “cohabits” with its occupants—enabling house and user to learn from each other to create a more energy-efficient and sustainable lifestyle. Ecohabit’s innovative technologies allow it to be an ultra-efficient house, designed to help its occupants live, learn, and grow with it.



Notes



<http://go.usa.gov/jpdF>



## Features

- Transparent doors fold away to provide access to two large decks sheltered by a large solar roof overhang.
- The architectural design splits the house into separate “dry” and “wet” modules to allow for an energy-efficient distribution for the plumbing system.
- The modular interior space includes a master bedroom, a bathroom, and a flex room that can become a home office or second bedroom.
- The green roof and wall help insulate the house and collect rainwater for irrigating plants.
- A central machine room functions as the “brain” of the house.

## Technologies

- An integrated PV system maximizes the use of available space and powers the house without large roof panels.
- An on-demand hot water system heats water when needed.
- Bio-phase-change material allows the house to harness the sun’s energy and heat during the day and release it at night.
- The misting system collects condensate from inside the house and uses it to mist the exterior HVAC unit, increasing its efficiency.
- The smart energy management system monitors weather patterns, the habits of occupants, and their energy use to create a comfortable and energy-efficient living environment.

# Czech Republic

Czech Technical University

The AIR House is designed for the generation of 50+-year-olds who are empty-nesters and nearing retirement. Many of the Czech Technical University team's parents fall into this demographic, which inspires a compelling conversation about senior housing. The AIR House, a prototype for an affordable (A), innovative (I), and recyclable (R) house of the future, is designed for the Czech tradition of spending weekends in the countryside. Czech seniors can use the AIR House as a weekend getaway during their pre-retirement years and as a permanent residence when they retire.

The AIR House offers an energy-efficient, environmentally responsible house that considers its inhabitants' comfort and health. The AIR House is made entirely of wood, including the load-bearing structure as well as the thermal insulation, façade, finishing, and furniture. Materials were selected according to their effects on the five human senses.



Notes



<http://go.usa.gov/jpV5>



## Features

- Natural wood fiber thermal insulation envelops a living area that features a wood façade, finishing, and furniture, including strong and lightweight laminate timber panels.
- A solar wooden canopy protects the enveloped area from sun and wind while generating electricity.
- A painted do-it-yourself wall façade enables occupants to write and erase messages.
- A charging station powers a pedelec (electric bicycle).
- A generous outside terrace expands the interior space for cooking, gardening, relaxation, and storage.
- An integrated edible natural garden mediates between the house and its surroundings.

## Technologies

- PV panels generate all the electricity needed to operate the house.
- Wood fiber insulating material regulates moisture levels and provides acoustic and thermal insulation.
- A solar water heating system ensures the preparation of hot water.
- A radiant chilled ceiling system provides comfort and stability to the interior environment.
- When needed, an air-conditioning unit with a direct evaporator conditions the relative interior air humidity and supplies fresh air.
- A greywater system collects water from the shower and wash basins, filters it, and reuses it to irrigate plants, thus reducing water consumption.
- The basic and intuitive smarthome control system allows occupants to monitor energy production and consumption and operate it remotely using a mobile device.

# Stanford University

Stanford University designed the Start.Home to provide energy efficiency at the push of a button to a new generation of environmentally conscious occupants. With modular architecture and advanced controls to optimize each component, the house aims to spark a revolution by lowering the entry barrier for an ultra-efficient house and making sustainability trendy, social, and affordable.

The Start.Home is built on a simple, three-by-three modular grid and integrates core, public, and private modules as well as multiple technologies to optimize value and energy efficiency. These spaces can be added or subtracted to allow the house to grow with the family by filling the role of bedrooms, solariums, studios, or garages. All of these spaces are powered at the push of a button by the CORE, which plugs directly into the public module, completing the home environment.



Notes



<http://go.usa.gov/jpdW>



## Features

- The prefabricated core module includes a kitchen counter and appliances, bathroom and laundry room, and a mechanical room with integrated electrical and plumbing systems.
- Exterior redwood siding and interior Douglas fir hardwood floors were salvaged from old homes in the California Bay Area.
- A custom building energy management system with intuitive controls and a prominent interface gathers electricity and water use data and visualizes it to the occupants for motivation and goal setting.
- A great room for dinner parties or game nights can spill out to the expansive backyard patio through large glass sliding doors that blur the boundaries between indoor and outdoor living.
- An edible backyard garden provides fruits and vegetables.

## Technologies

- The CORE mechanical room integrates the Start.Home power generation and controls into one centralized “engine” with modular additions to extend the control system to each living space.
- A modular framework supports future additions.
- Structural insulated panels maintain a tight and insulated building envelope.
- A greywater system filters and reuses laundry water for exterior irrigation.
- A heat-recovery ventilator works with an efficient heating/cooling system, automated windows, phase-change materials, energy-efficient ceiling fans, and a tri-zone ductless mini-split system to provide year-round comfort and natural ventilation.

# Norwich University

Norwich University's mission is to show that high-performance, solar-powered dwellings can be both affordable and beautiful. The Delta T-90 House accommodates New England's unique seasons and is designed to be affordable for those earning 20% less than the Vermont median income.

The house explores the hidden values and richness within a conservation-based lifestyle and respects the interdependency between the economy and the built environment. The Delta T-90 House is guided by the beliefs that high-performance, solar-powered dwellings should be available to all and that good design is not a function of cost. By maximizing the building envelope first and then using simplified mechanical systems as a supplement, the design prioritizes passive functionality and reduces primary energy demand to minimize the house's lifetime operational costs.

Notes



<http://go.usa.gov/jppG>



## Features

- The locally harvested northern white cedar rain screen draws from the traditional wood siding found in barns and utility buildings across New England.
- A flat roof with a fully integrated PV array introduces modern elegance and accommodates the region's average of 120 days of annual snow.
- Thick, 16-inch walls with deep-set windows minimize heat loss and reinforce a spirit of protection and strength.
- Ample daylighting and high ceilings, rarely found in affordable housing options, create a grand and spacious ambiance.
- No floor area is dedicated to mechanical systems, making every square foot of floor area (excluding storage and laundry areas) usable by occupants.

## Technologies

- The building-integrated PV system, with panels that adhere to the flat roof, eliminates the weight and costs associated with racking and mounting hardware. These panels work in low levels of sunlight to provide power to the house even in less-than-optimal solar conditions.
- A mini-split heat pump HVAC system with a single supply diffuser provides widely available, compact, and easily serviceable heating and cooling without the need for duct work or overt mechanical elements.
- The heat-recovery ventilation system provides continuous ventilation to the interior while reducing humidity levels and keeping the building envelope dry. The system is 92% efficient, ductless, and whisper-quiet.

# Team Texas

The University of Texas at El Paso and El Paso Community College

Team Texas has created ADAPT, a house that reflects the nature of El Paso. Built at the confluence of two nations and three states, the house honors the myriad cultures present in Far West Texas and uses innovative technologies to model flexibility, utility, and high efficiency in a new suburban environment.

ADAPT was designed with a belief that a home is not just a location or state of mind but a place where the heart is. The house emulates the indigenous Pueblo Indian adaptations to the Chihuahuan desert and creates a bubble of comfort that feels natural on the mountain plateau, high desert, chaparral, or verdant farmland, where it maximizes the use of solar energy—the most abundant resource in the Desert Southwest.



Notes



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<http://go.usa.gov/jpvJ>



## Features

- Corten steel panel walls will age to a beautiful patina.
- Accents of color and light infuse the house with a rustic, Southwestern ambiance.
- A canopy that covers the porch supports the solar panels and provides shade to the house-length deck.
- There is ample patio space for outdoor living.
- Flexible interior spaces blend together with an aesthetic of flow and movement, with large windows that provide sweeping views of the deck, yard, and skyline.

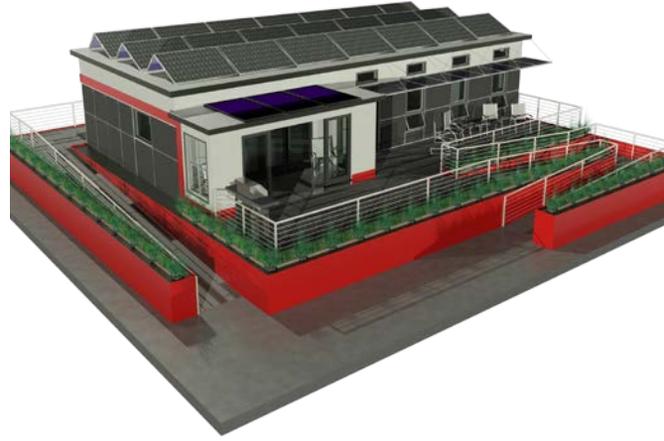
## Technologies

- An adjustable-height foundation system enables the house to be transported easily and rest on and connect to six steel beams.
- The walls of the house are made of a strong fiber composite material that is a powerful insulator and highly resistant to fire.
- Bifacial solar collection units produce electricity for the house by gathering solar energy from both the top and the bottom of the units.
- A ductless radiant heating and cooling system circulates fully as a closed loop of radiant heat.
- A separate set of pipes in a chilled-beam system moves water through a variable refrigeration unit and chills the fluid before it travels through the ceiling to cool the interior spaces.

# Missouri University of Science and Technology

Missouri University of Science and Technology designed Chameleon House to epitomize an adaptable living environment. With versatile features that form a chameleon skin—and spaces designed to maximize flexibility, comfort, and convenience—Chameleon House flexes easily to meet as many market and regional needs as possible.

Chameleon House rejects a paradigm of technology for technology's sake. Instead, its creators were guided by the belief that technology is important only to the extent that it significantly enhances a user's experience. The design avoids unnecessary complexity in favor of a simple approach that uses seamless engineering of systems to prove that sustainable living can be easy and enjoyable. Chameleon House continuously adapts to its surrounding environment and integrates multiple technologies to maximize comfort and flexibility.



<http://go.usa.gov/jpp4>

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## Features

- Seasonally transitional exterior siding panels alternate between a light, reflective side and a dark, absorptive side.
- A south-facing solarium expands the floor plan to an outdoor living space.
- Folding glass doors separate the solarium from the kitchen and dining area—not only regulating the space but also serving as a passive solar feature and buffer to the outside environment.
- A partition wall separates the bedroom and main living area—or can be rolled into a closet to create additional space.

## Technologies

- The prominent PV system is optimized for flat roofs and uses reflectors between the rows of generating panels to increase total energy production.
- A mixed-mode residential HVAC system marries the automation system and the house HVAC system.
- A radiant heating system with tubes beneath the concrete floor circulates water to heat the interior space of the house from the bottom up.
- A capillary mat cooling system above the drop ceiling is similar to an in-slab radiant heating system but cools from above the living space, providing a thermal gradient (warm at the floor, cooler at the ceiling).
- A predictive-control home automation system uses weather data to predict hour-by-hour temperatures and adjust accordingly.

**JULY 2014  
VERSAILLES, FRANCE**

[www.solardecathlon2014.fr](http://www.solardecathlon2014.fr)



Congratulations to **THE UNIVERSITY  
OF WOLLONGONG (AUSTRALIA)**,  
Winner of Solar Decathlon China 2013!

August 2013 | Datong, China | [www.sdchina.org](http://www.sdchina.org)



U.S. Department of Energy Solar Decathlon  
**2011 Winners**

**First**  
University of  
Maryland



**Second**  
Purdue University

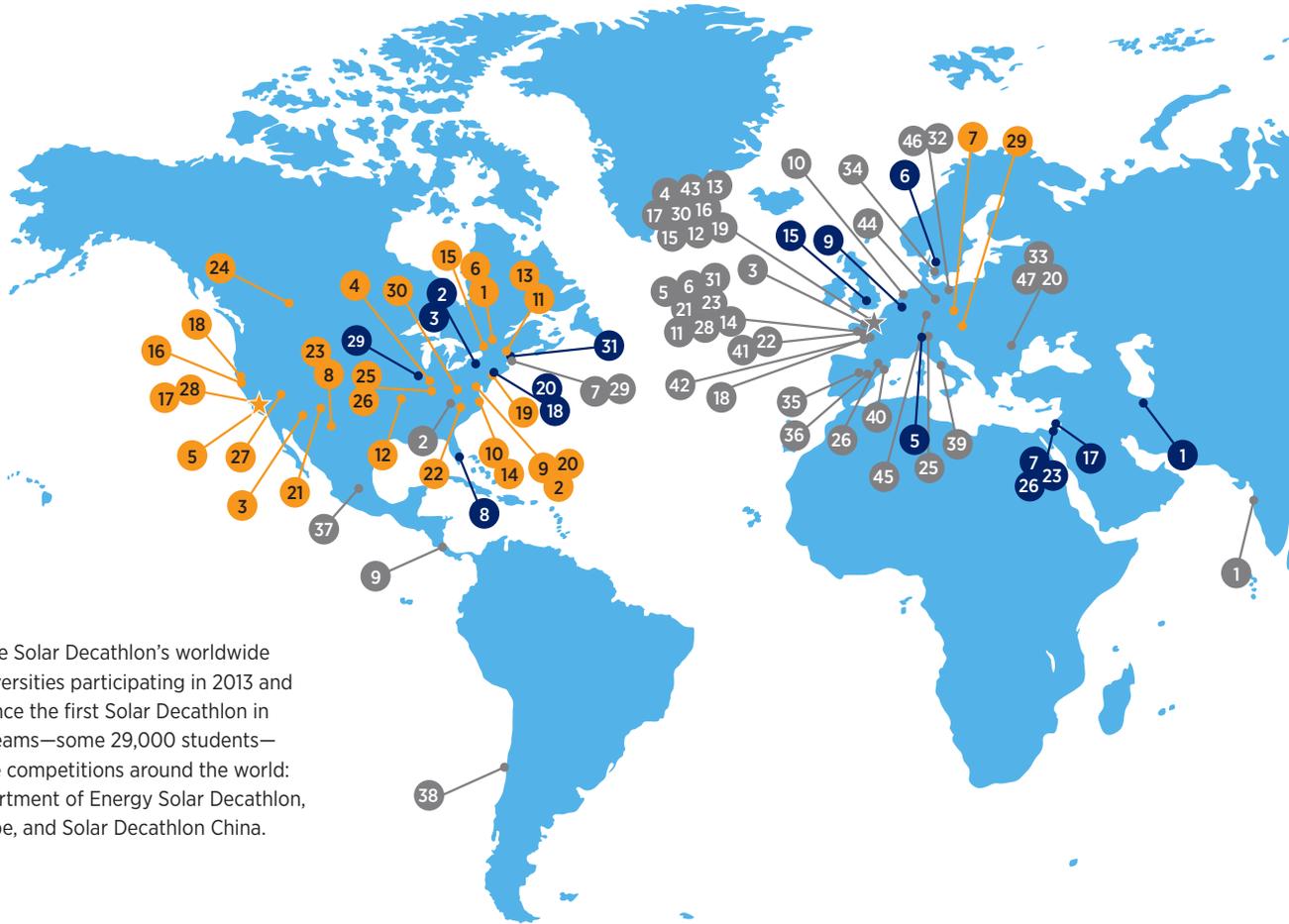


**Third**  
Victoria  
University of  
Wellington  
(New Zealand)



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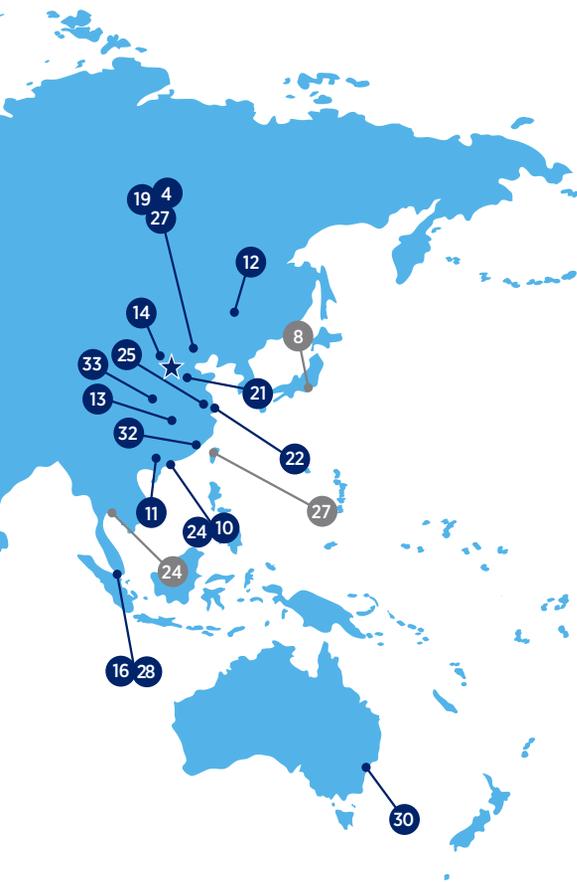
# Where in the World Is Solar Decathlon?



This map illustrates the Solar Decathlon's worldwide reach by showing universities participating in 2013 and 2014 competitions. Since the first Solar Decathlon in 2002, 192 collegiate teams—some 29,000 students—have engaged in three competitions around the world: the flagship U.S. Department of Energy Solar Decathlon, Solar Decathlon Europe, and Solar Decathlon China.

## Solar Decathlon Europe 2014

- |  |  |   |  |
|--|--|---|--|
| ★ Versailles, France                           | 10 Delft University of Technology                    | 22 ISSBA  | 32 Technical University of Berlin                        |
| 1 Academy of Architecture - IIT Bombay         | 11 Ecole des Mines Nantes                            | 23 IUT Nantes                                       | 33 Technical University of Civil Engineering Bucharest   |
| 2 Appalachian State University                 | 12 Ecole des Ponts Paris Tech                        | 24 King Mongkut's University of Technology Thonburi | 34 Technical University of Denmark                       |
| 3 Architectes Ingénieurs Associés              | 13 ENSA Marne la Vallée                              | 25 Lucerne University of Applied Sciences and Arts  | 35 Universidad de Alcala de Henares University           |
| 4 Atlansun                                     | 14 ENSA Nantes                                       | 26 Medieco  | 36 Universidad de Castilla - La Mancha                   |
| 5 Audencia Group                               | 15 ENSA Paris Malaquais                              | 27 National Chiao Tung University                   | 37 Universidad Nacional Autonoma de México               |
| 6 Audencia Nantes                              | 16 ENSG  | 28 Novabuild  | 38 Universidad Tecnica Federico Santa Maria - Valparaiso |
| 7 Brown University                             | 17 ESB ESTP Paris                                    | 29 Rhode Island School of Design                    |  |
| 8 Chiba University                             | 18 ESIEE Paris                                       | 30 SAMOA  |  |
| 9 Costa Rica Institute of Technology - Cartago | 19 IFSTTAR   | 31 SCE  |  |
|  | 20 Ion Mincu University of Architecture and Urbanism |   |  |
|  | 21 Institut des Matériaux Jean Rouxel                |   |  |



### Solar Decathlon Europe 2014

- 39 Università Degli Studi di Roma TRE
- 40 Universitat Politècnica de Catalunya – Barcelona
- 41 Université d'Angers
- 42 Université de la Rochelle – Espace Bois de l'IUT
- 43 Université Paris-Est
- 44 University of Applied Sciences – Erfurt
- 45 University of Applied Sciences Frankfurt am Main
- 46 University of the Arts Berlin
- 47 University Politehnica of Bucharest

### U.S. Department of Energy Solar Decathlon 2013

- ★ Irvine, California
- 1 Algonquin College
- 2 American University
- 3 Arizona State University
- 4 Ball State University
- 5 California Institute of Technology
- 6 Carleton University
- 7 Czech Technical University
- 8 El Paso Community College
- 9 George Washington University
- 10 Hampton University
- 11 Middlebury College
- 12 Missouri University of Science and Technology
- 13 Norwich University
- 14 Old Dominion University
- 15 Queen's University
- 16 Santa Clara University
- 17 Southern California Institute of Architecture
- 18 Stanford University
- 19 Stevens Institute of Technology
- 20 The Catholic University of America
- 21 The University of New Mexico
- 22 The University of North Carolina at Charlotte
- 23 The University of Texas at El Paso
- 24 University of Calgary
- 25 University of Kentucky
- 26 University of Louisville
- 27 University of Nevada Las Vegas
- 28 University of Southern California
- 29 Vienna University of Technology
- 30 West Virginia University

### Solar Decathlon China 2013

- ★ Datong, China
- 1 Abbaspour University of Technology
- 2 Alfred State College
- 3 Alfred University
- 4 Beijing Jiaotong University
- 5 Bern University of Applied Sciences
- 6 Chalmers University of Technology
- 7 College of Management Academic Studies
- 8 Florida International University
- 9 Ghent University
- 10 Guangzhou Academy of Fine Arts
- 11 Guilin University of Technology
- 12 Harbin Institute of Technology
- 13 Huazhong University of Science and Technology
- 14 Inner Mongolia University of Technology
- 15 London Metropolitan University
- 16 National University of Singapore
- 17 Neri Bloomfield School of Design and Education
- 18 New Jersey Institute of Technology
- 19 Peking University
- 20 Polytechnic Institute of New York University
- 21 Shandong Jianzhu University
- 22 Shanghai Jiaotong University
- 23 Shenkar College of Engineering and Design
- 24 South China University of Technology
- 25 Southeast University
- 26 Tel Aviv University
- 27 Tsinghua University
- 28 Universiti Teknologi Malaysia
- 29 University of Illinois at Urbana-Champaign
- 30 University of Wollongong
- 31 Worcester Polytechnic Institute
- 32 Xiamen University
- 33 Xi'an University of Architecture and Technology

# Team Austria

Vienna University of Technology

Team Austria's entry, LISI, is a simple, smart, sustainable house. Powered by a rooftop solar photovoltaic system, LISI generates more power than it uses over the course of a year. The house adapts to a range of climate zones and flexes to meet a variety of lifestyles. The compact-yet-spacious atrium is designed from lightweight, recyclable construction components.

In developing LISI, Team Austria was guided by a vision for a healthy, sustainable future as well as a concept that can adapt to meet many lifestyles and climates. Viewing the house as a "social creature" eager to find its place in a richly diverse community, Team Austria honors a sense of stewardship in the use of our planet's most precious resources.



Notes



<http://go.usa.gov/jpvT>

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## Features

- Renewable and eco-friendly construction and insulation materials made of timber are easily transported and provide indoor climate comfort and carbon-neutrality.
- Changeable architectural elements create a variety of sensory conditions—closing to form a protective cocoon for occupants and opening to allow them to expand their space.
- Two patios create a balance between interior and exterior, public and semi-public spaces.
- An automated screen and awning system provides shade to keep the living spaces cool and comfortable.
- A patio herb garden draws water from a rooftop reservoir.
- Generous storage, completely integrated into the walls, frees the primary indoor space.

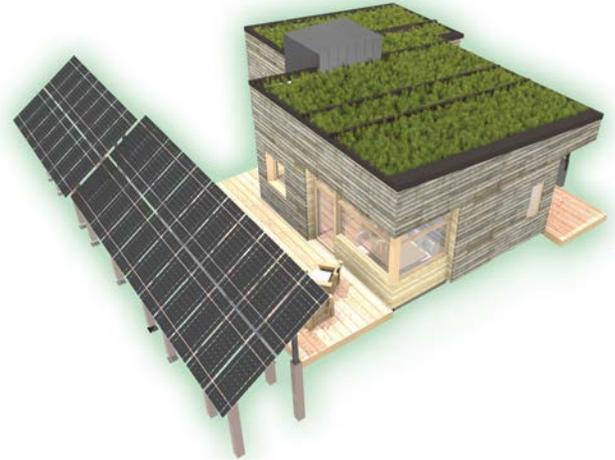
## Technologies

- PV modules connect to a smart load management system and provide more electricity than the house needs.
- A centralized utility room contains all the automated mechanical systems the house needs, including a PV monitor, ventilation, plumbing, and hot water supply.
- Two high-efficiency, air-water heat pumps supply cold and hot water for space heating and cooling as well as for domestic hot water.
- An energy-recovery ventilation unit acts as a heat and humidity exchanger between exhaust air and fresh intake air, keeping the living spaces comfortable and healthy.
- A multifunctional subfloor system regulates the entire building's indoor climate using water, air, and active cubic capacity.

# Middlebury College

Middlebury College has created InSite, a house that reconnects people with their community and emphasizes environmental, economic, and social sustainability. InSite offers the privacy and comforts that appeal to 21st-century homebuyers by balancing public and private spaces.

The Middlebury College team envisions InSite as a house for local living. It symbolizes the team's belief that community is a natural resource, that sustainability is as much about people as it is about energy, and that by constructing less, we can create more. It is targeted to young Vermont families and was designed as one piece of a larger human and natural ecosystem. InSite can be integrated into an existing walkable community—suggesting a model of living applicable on any scale.



Notes



<http://go.usa.gov/jpVh>



## Features

- Reclaimed wood materials come from the local region and are historically suited to the local climate.
- An exterior solar path replaces the traditional rooftop array to create an exterior walkway shaded by solar panels.
- A lush green roof contributes to the thermal envelope of the house, sequesters carbon, and helps manage storm-water runoff.
- A north-sloping roof minimizes exposure to Vermont's cold Northern winter winds.
- A steel skeleton with exposed connections visible in the interior educates visitors about the unique construction.
- Thick and densely insulated walls with a dining nook and a window seat create a comfortable refuge for nature viewing.

## Technologies

- A centralized energy hearth mechanical chimney consolidates all the mechanical, electrical, and plumbing systems into one modular unit to increase efficiency while reducing the wiring, ductwork, and plumbing required.
- Windows and vents placed high in the mechanical module create the chimney effect for unwanted hot air, while vents placed low on the shaded north side allow cool air to enter and flow through the house on hot days.
- The energy-recovery ventilator uses stale, outgoing air to dry and condition incoming air, providing ventilation without releasing the conditioned air.
- The building-monitoring system allows residents to visualize their energy use and better understand the environmental impacts of their lifestyle.

# University of Southern California

fluxHome celebrates the cultural and technological changes of the 21st century. The house combines a transformable envelope system with customizable components and smart-home technology to allow it to be configured in a multitude of lifestyle scenarios. By re-imagining the suburban tract home as a dynamic spatial environment, the house reflects the diverse lifestyles and ecologies known to Southern California.

In designing fluxHome, the University of Southern California team focused on developing a truly accessible model for energy-independent, low-cost housing that reflects the best qualities of indoor-outdoor living in Southern California. Celebrating diverse ecologies and microclimates, fluxHome is not only a highly energy-efficient prototype but also a new residential model for the changing nature of contemporary experience that can be rapidly deployed to market.

Notes



<http://go.usa.gov/jpwB>



## Features

- The material palette consists of sustainable and recycled materials.
- Modular, prefabricated furniture elements combine off-the-shelf components with digital fabrication technology and enable occupants to customize their living space.
- An aperture system of retractable skylights, operable windows, light shelves, baffles, and sliding and folding window walls enables occupants to easily regulate their environment and privacy.
- A centralized courtyard, porch, and veranda contain vertical gardens and living walls to merge the indoors with the outdoors.
- Vertical gardens and lawns filter the air and allow users to grow their own vegetables and herbs with minimal water use via a drip irrigation system.
- A smart-home automation system monitors passive and active energy systems and can be controlled with a mobile device.

## Technologies

- Light and air are used to improve indoor comfort and integrate complicated automation systems.
- A compact, efficient building form and rain screen facade minimize solar heat gain while maximizing insulation and thermal equilibrium.
- A solar chimney with a retractable skylight modulates sunlight and air for natural ventilation and daylighting and connects users to the outdoor environment by framing the sky.
- A combination heat pump system provides heating, cooling, and domestic hot water in one product.
- Ambient light-emitting diode lighting and daylighting used throughout the house minimize energy loads, while innovative light shelves and window hoods provide shading.

# The University of North Carolina at Charlotte

UrbanEden is a series of four connected indoor and outdoor spaces that create a unique urban living environment. The interior adapts to maximize comfort year-round and opens to a private, plant-filled exterior living area. Innovations in concrete and glass technology, combined with the creative use of simple technologies, nurture a healthy urban lifestyle that is completely powered, heated, and even cooled by the sun.

Inspired by the City of Charlotte's reinvestment in its urban core as the focal point of a thriving region, the ultra-efficient UrbanEden signifies a commitment to sustainability, vibrancy, diversity, and technological innovation. The house provides sophisticated urban ambiance while helping occupants reduce their carbon footprint by fusing enthusiasm for the city with respect for and intimacy with nature.



Notes



<http://go.usa.gov/jppk>



## Features

- The pre-cast geopolymer cement concrete structure reinvents a historic building material to provide a sound barrier to city noise and a 90% reduction in carbon footprint over conventional concrete.
- A retractable solar PV panel rack, which remains over the roof in winter to allow the sun to stream in through the southern window wall, extends over the patio in summer to provide shade and cool the outside living space.
- Four rooms include both an indoor and outdoor component to maximize efficiency, comfort, and flexibility.
- Reconfigurable spaces and elements include a living room and home office. The living room features an entertainment center that transforms into a Murphy bed to accommodate overnight guests.
- An exterior living wall, or vertical garden, offers privacy while providing food, flowers, and the ambiance of a plant-filled room.

## Technologies

- A hybrid passive/active hydronic radiant heating and cooling system uses only pump energy to control temperature, unlike conventional hydronic systems.
- A system of embedded capillary tubes circulates cool water through the high-mass, pre-cast concrete walls and up to a heat exchanger mounted on the roof, removing heat accumulated in the walls and resulting in cooling without the use of compressors or refrigerants.
- The use of geopolymers produces a unique concrete binder that contains no Portland cement and is one of the first-known uses of a geopolymer mix in a building envelope.

# Kentucky/Indiana

University of Louisville, Ball State University, and University of Kentucky

The Phoenix House is designed to help families rebuild resilient communities in the wake of a natural disaster. The house can be assembled rapidly using two prefabricated modules that include a main living core and a secondary bedroom module. The house uses durable, low-maintenance, reclaimed materials and an open floor plan with a vaulted ceiling to maximize space. Designed to be self-sustaining, the Phoenix House produces all of its energy from PV panels and recycles much of its own water.

Using reclaimed materials throughout, the Phoenix House incorporates elements of an old house into a new one. It combines traditional and contemporary aesthetics in the interior and exterior and supports green living by enabling families to be less reliant on nonrenewable sources of energy.



Notes



<http://go.usa.gov/jpVV>



## Features

- Exterior cladding made of a fiber cement panel rain screen and reclaimed wood siding is built for high durability and low maintenance.
- The multipurpose living room transforms into an entertainment space, home office, or extra bedroom and extends to a large deck.
- An open floor plan with vaulted ceilings and a loft maximizes space and storage.
- The bathroom doubles as a weather shelter with a steel door, multiple layers of envelope materials, and a non-shattering window.
- The master bedroom features French doors that open to a private patio enclosed by a grapevine-covered green wall.
- A natural kitchen garden provides fresh herbs and vegetables.

## Technologies

- Structural insulated panels used in the walls and roof systems enable increased efficiency, ease of construction, and improved structural resistance.
- The sloped roof houses 7.6 kW of solar panels to power the house.
- An energy-recovery ventilator constantly exchanges air to provide high air quality.
- A solar water heating system integrated with the HVAC system increases the overall energy efficiency by sharing energy between the house systems through hot and cold air recovery.
- A motion-controlled, light-emitting diode lighting system maximizes energy efficiency.
- A unique electrical cable wall system enables electrical and data cabling to be quickly installed with connections made behind a removable baseboard.

# University of Nevada Las Vegas

The University of Nevada Las Vegas designed its DesertSol house to reflect the spirit of the Mojave Desert. With reverence to the sun as both a source of harsh conditions and a solution for sustainable living, DesertSol harnesses abundant sunlight for solar electricity while capturing rain to provide evaporative cooling and irrigation. The ultra-efficient house is envisioned as a vacation home for a seasonal retreat—a basecamp for desert adventures that responds to its unique environment.

DesertSol makes careful use of the desert's solar and water resources. Its design fuses modern architecture with a weathered aesthetic, the comfort of carefully selected materials, and the excitement of intriguing spaces to foster a spirit of openness and adventure.



Notes



<http://go.usa.gov/jpVH>



## Features

- A weathered wood rain screen shades the building's structure.
- Digitally fabricated retractable solar shade screens shield the hottest sides of the house in the summer and provide direct sun for warmth in the winter.
- A water feature captures water from the occasional desert downpour and uses it for irrigation and spot cooling on the outside deck with a cool tower, which uses less water than conventional misters.
- Folding doors open completely, allowing indoor activities to spill onto the outdoor deck space and doubling the square footage for entertaining.
- A home automation system ensures the house operates at peak efficiency and allows the lights, appliances, and thermostats to be controlled from an easy-to-use interface on a mobile device.

## Technologies

- PV panels provide electricity and shade the outdoor living space.
- Solar thermal collectors provide radiant floor and water heating.
- Advanced structural design framing clad in reclaimed, pre-weathered materials saves lumber and provides more insulation to the living spaces.
- A fire-protection sprinkler system combined with a potable water plumbing system ensures that fresh water is available each time a cold-water fixture is used and results in a non-stagnant sprinkler system.
- Layers of closed-cell, open-cell, and continuous rigid insulation ensure that the house is air-tight and highly heat-resistant and prevents thermal bridging.

# Team Capitol DC

The Catholic University of America, George Washington University, and American University

HARVEST HOME is an ecologically responsible house that harvests and replenishes natural resources to forge a deep-rooted connection to the natural environment. A habitat for renewal and regeneration, the house features sophisticated control and biomedical systems to serve returning U.S. military veterans and help them adjust and flourish in a sustainable civilian community.

HARVEST HOME is designed to calm the mind, body, and spirit through the use of public and private spaces, multiple decks, and rich landscaping. By fostering active interaction with the house's energy systems and edible garden, HARVEST HOME promotes a greater appreciation of life, personal strength, and recognition of new life possibilities.

Notes



<http://go.usa.gov/jpvm>



## Features

- Reclaimed and recycled materials compose the wall framing, exterior decking, rain screen, interior flooring, and furniture.
- Integrated landscaping balances edible and native plants and blurs the interior and exterior environments to create a healthy and beautiful space.
- Careful attention to natural ventilation enables the house to capture breezes, creating a comfortable environment with abundant fresh air.
- A greywater collection system harvests rainwater and reuses it for landscaping to nurture the edible garden.
- Through a distributed network of activity sensors, the biomedical suite takes measurements unobtrusively to provide physical-therapy data and analyze the living habits of the homeowner.

## Technologies

- PV and flat-plate solar thermal systems produce electricity for the house and heat the domestic hot water.
- An under-floor heating and cooling distribution system supplies air at floor-level from ductwork connected to a central air handler located in the mechanical closet, allowing less stale air to be mixed with the fresh air and enabling the air handler to work more efficiently.
- An interactive and adaptable shading screen on the large southern glazed façade passively improves energy performance in response to the exterior climate conditions.
- The smart home management system not only monitors and tracks the energy used and saved but also adapts to the occupant's lifestyle—with minimal effort on the occupant's behalf.

# Team Alberta

University of Calgary

Borealis addresses the housing needs of professionals working in remote locations, such as those found in the northern regions of Alberta, Canada. This modular house is easy to transport and assemble, it's affordable, and it provides a comfortable and sustainable home away from home.

Borealis was designed in consideration of the housing shortages and high housing costs driven by the region's resource industries (energy, mining, and forestry). It provides an alternative to crowded work camps and brings a solution to the difficulty of finding labor to build housing in these areas. Named after the iconic Northern Lights and lush Boreal forest, Borealis is designed to be sustainable and ecologically sensitive.



Notes



<http://go.usa.gov/jpv3>



## Features

- The three-module design features a core shared module with a central kitchen that separates two mirrored private modules that can be configured as work or rest spaces.
- A living wall in the bathroom hosts abundant plant life for cooling, air purification, and connection to plant life throughout the year and is sustained by large sun-tunnel skylights.
- Exterior cladding uses sustainable products such as responsibly sourced, naturally moisture- and rot-resistant cedar wood siding and fiber cement boards that use post-industrial waste wood fiber.
- Large, south-facing windows provide natural light and views to the outdoors and tilt and turn open to provide passive cross-ventilation.

## Technologies

- A roof-mounted solar PV array is controlled by a system that monitors individual panels to allow site-specific array optimization. Micro-inverters allow maximum production of electricity from every panel without the array being dependent on any one panel.
- Light-emitting diode fixtures are used throughout the house to achieve ultra-high efficiency and use 10 times less energy than traditional incandescent bulbs.
- A custom energy monitoring system provides feedback on the lighting, appliance, and mechanical loads and enables optimization of the mechanical system at any location using a simple Web interface.
- The central mechanical room controls all activity within the house from one convenient location.
- A solar water heating system harnesses the sun's energy to heat domestic hot water.

# Arizona State University and The University of New Mexico

Arizona State University and The University of New Mexico designed a house that celebrates its unique equilibrium with the desert environment. SHADE (Solar Homes Adapting for Desert Equilibrium) is intended to grow and adapt with its users. With independent modules that can be combined in various configurations and a prominent solar canopy that provides a shaded outdoor extension of the house, SHADE is built for a community-oriented, indoor-outdoor lifestyle.

SHADE pays tribute to the interdependence of desert plant life while maximizing occupant comfort and flexibility. Solar energy, regionally proven passive heating and cooling, and intensive water management nurture a healthy and sustainable habitat, and flexible, modular spaces foster a broader community concept.

Notes



<http://go.usa.gov/jpVj>



## Features

- Screens on the walls provide cooling shade and a still boundary layer of air, mimicking the needles on the saguaro cactus, which perform similar functions.
- Fiber-cement board highlights the material warmth of the wooden shade structure as it reflects the Southwestern sunsets.
- Tanks store collected rainwater, which is used to irrigate the landscape.
- Rain screens grow the native species of flowering vine and bougainvillea and provide a climate barrier.
- Modular furniture elements enable the flexible room space to be configured as a kitchen, dining room, living room, bedroom, or office.
- Natural clay coating the interior walls provides a humidity buffer.

## Technologies

- The independent solar canopy is composed of 36 high-efficiency mono-crystalline PV panels.
- Phase-change material distributed throughout the house stores thermal energy and buffers temperature fluctuations by redistributing the energy as passive heating and cooling.
- The capillary radiant system in the ceiling, working with the phase-change materials in the floors, passively charges at night while the ceiling mechanics shift the peak load.
- A thermal battery in the mechanical room concentrates low temperatures at night and then slowly thaws ice to cool the space during the day in an adaptation of commercial-scale ice storage systems.
- A whole-house system controls the energy systems and monitors the efficiency of the solar panels.

# Santa Clara University

Radiant House is driven by three E's: efficiency, economics, and elegance. The house incorporates bamboo and takes it to a new level by using the sustainable material for structural wall and joist systems. Radiant House is an elegant, adaptable, and affordable house with a spacious and versatile great room, a large deck and patio area, and clean separation between private and public spaces.

Radiant House was guided by the belief that sustainable living can be affordable, appealing, and accessible to everyone. With an open floor plan and ramps leading to and from the house, Radiant House is fully accessible and features spacious rooms and furnishings.



Notes



<http://go.usa.gov/jppz>



## Features

- A structural wall and joist system is composed of a blend of standard lumber and bamboo—much of which is in raw, unrefined form to avoid the need for unsustainable treatment.
- Solar panels are seamlessly integrated into the roof structure using an integrated rail system.
- A charging station is located at the front of the house to allow homeowners to recharge their electric vehicle with extra power from their solar array.
- The generous living space features high ceilings and clerestory windows that fill the interior with light and open to allow hot air to rise and escape.

## Technologies

- The radiant heating and cooling system embedded in the ceiling drywall uses radiant panels to heat the house with hot water or cool the house with cold water—ensuring a uniform environment.
- The rooftop PV system incorporates passive cooling below the solar panels to increase their efficiency.
- As part of the water heating and storage system, a solar thermal panel supplies heat to a tank containing organic phase-change material. This tank is used to maintain the temperature of the domestic hot water system.
- An application custom-written by the Santa Clara University team monitors the entire house; provides a real-time display of energy performance; and controls the temperature, lights, sliding doors, windows, and blinds.

# West Virginia University

Preserving Energy with Appalachian Knowledge, or PEAK, invites its residents to embrace a new Appalachian way of living with contemporary, mountaineer design that blends subtly with automated smart systems. In doing so, PEAK integrates innovative technologies and passive design techniques to maximize energy efficiency and support sustainable design practices and approaches.

PEAK is a realistic blueprint that adapts modern technologies to traditional architecture. It captures the Appalachian spirit of West Virginia and aims to change the vision society has of energy-saving homes by combining affordability, energy efficiency, and reliability within a comfortable home setting. Its unique style augments elements of a rustic log cabin with innovative and modern home automation and energy-saving technologies.

Notes



<http://go.usa.gov/jpwQ>



## Features

- A solar chimney in the center of the house provides passive ventilation and represents a hearth that mimics the feel of a traditional Appalachian house.
- Walls, floors, and ceilings made of structural insulated panels provide higher insulation levels while maintaining a rustic “log cabin” aesthetic.
- The kitchen’s state-of-the-art smart appliances drastically reduce energy consumption by communicating with one another and making decisions to reduce power use.
- A rooftop garden minimizes heat collection and water runoff and maximizes the usable area for growing edible vegetation.
- A living wall conditions the interior climate and provides fresh herbs and produce.

## Technologies

- Sustainable energy systems—a PV system and a solar water-heating system—provide quick and sufficient hot water and virtually eliminate the burden of electricity bills.
- The user-friendly, all-encompassing home automation system allows users to control all systems using a smartphone or tablet.
- The climate-control system enables room-by-room temperature and lighting adjustments. Through smart HVAC technology, users can set different zoning preferences without disturbing the settings of other rooms.
- An integrated health-monitoring system with floor-integrated scales and accompanying wrist bands calculates the users’ body mass index and helps monitor blood pressure and other health factors, integrating holistic health into the home environment.

# Team Ontario

Queen's University, Carleton University, and Algonquin College

ECHO is a functional and livable starter house that strikes a balance between engineering and architecture. The house generates more energy than it uses and sets a higher standard for the next generation of sustainable housing. With a vision to change the way young prospective homeowners live and think, ECHO is designed to set a precedent that echoes into future generations.

The house achieves its ultra-high efficiency by first minimizing heating and cooling requirements through a highly insulated, airtight envelope and controlled solar gains. It then efficiently conditions the interior space with an integrated mechanical system. The highly efficient and sustainable design strikes a balance between tradition and innovation. It meets the needs of the current generation and ultimately aims to resonate through time.



<http://go.usa.gov/jpvA>

Notes



## Features

- Bright and spacious living spaces are flooded with natural light.
- A modern interior is clad with local, reclaimed materials and up-cycled accessories, including hardwood flooring composed of reclaimed trees from urban developments and reclaimed furniture.
- A multipurpose room evolves to serve as an office space or bedroom for one or two small children.
- Easy-to-use building controls and reconfigurable furniture maximize convenience and comfort.
- The roof channels rainwater into a water feature, where limestone rocks neutralize acidic precipitation.
- A small kitchen herb garden adds to the natural aesthetic and connection to the environment.

## Technologies

- A sloped exostructure holds the PV array and solar thermal systems and is designed to maximize the benefits of passive shading.
- A unique wall structure, along with vacuum insulation panels, enables the house to withstand harsh Ontario weather with an insulating capacity more than twice that of a conventional home.
- An integrated mechanical system provides space heating, cooling, dehumidification, and domestic hot water through a single system.
- A predictive shading system uses daily weather forecasts from the Internet to run computer simulations and determine the optimal shading placement on southern glazing.
- A mobile application allows occupants to control aspects of the house using a mobile device.

# Solar Decathlon 2013 Sponsors



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Invented for life



## Bosch

Bosch believes it is our obligation to find economical ways to create a sustainable energy supply and a brighter future. This year, Bosch will spend close to \$5 billion on global research and development, with approximately 45% focused on products that help enhance energy efficiency and protect the environment. We are committed to finding energy-efficient solutions while enhancing the quality of life. We are pleased to support the U.S. Department of Energy Solar Decathlon, as we have for many years, and are indeed privileged to donate our products to many of the 2013 student teams.

In the United States, the Bosch Group manufactures and markets automotive original equipment and aftermarket solutions, industrial drives and control technology, power tools, security and communication systems, packaging technology, thermotechnology, household appliances, solar energy, and healthcare telemedicine and software solutions. Having established a presence in the United States in 1906, Bosch employs approximately 15,000 associates in more than 100 locations, with consolidated sales of \$10.6 billion in fiscal year 2012.

[www.bosch.us](http://www.bosch.us)



## Cisco

Cisco is a leader in innovative technology that is transforming how government organizations better protect, serve, and educate their constituencies. One example of this leadership is Cisco's sponsorship of the U.S. Department of Energy Solar Decathlon 2013, for which Cisco is sponsoring Internet access that enables the competition by connecting the teams and organizers. Cisco is also providing a world-class wireless Internet experience for visitors to the Solar Decathlon village and XPO.

Today's agencies are working to modernize federal IT infrastructures to help streamline processes, better connect government employees, serve citizens, and protect our country. Through our proven, secure cross-architecture approach, Cisco is enabling government leaders to rethink how they deliver and safeguard critical services and assets during unprecedented budgetary challenges while increasing workforce productivity, enhancing operational efficiencies, and driving down costs. Our solutions accelerate technology performance and business decisions and deliver a high-quality, secure, assured experience.

[www.cisco.com](http://www.cisco.com)



## Edison International

For more than 125 years, Edison International has supported the growth and success of Southern California by safely providing reliable and affordable electric service. Edison International also has a long-standing tradition of investing time and money in the neighborhoods it serves and across communities where it can make a difference.

As a sponsor of the U.S. Department of Energy Solar Decathlon 2013, Edison International supports the innovation and creativity generated from this event that lead to future alternative energy solutions.

“Edison International is a proud partner with the City of Irvine and the U.S. Department of Energy Solar Decathlon 2013 and XPO,” said Gaddi Vasquez, senior vice president of Government Affairs for Edison International. “Through this partnership, Edison is supporting the teams’ innovation and imagination by encouraging them to build solar homes that blend design excellence with energy efficiency.”

As part of Edison International, Southern California Edison has been a leader in renewable energy for more than 20 years. To date, Southern California Edison has more than 40,000 customers who have installed solar panels on their homes or businesses, representing 460 MW of clean power.

[www.sce.com/csi](http://www.sce.com/csi)



## Schneider Electric

As a global specialist in energy management with operations in more than 100 countries, Schneider Electric offers integrated solutions across multiple market segments, including leadership positions in utilities and infrastructure, industries and machines manufacturers, non-residential buildings, data centers and networks, and in residential buildings. Focused on making energy safe, reliable, efficient, productive, and green, the group’s 140,000-plus employees achieved sales of \$30.8 billion (24 billion euros) in 2012 through an active commitment to help individuals and organizations make the most of their energy.

In conjunction with this mission, Schneider Electric is proud to have been a sustaining sponsor of the U.S. Department of Energy Solar Decathlon since 2009. Schneider Electric supplies the microgrid solution that enables a safe and reliable electrical connection between the Solar Decathlon village and the utility service during the event. The company also provides energy management products in more than half of the competition houses through direct donations to the competing universities as well as consulting services from its energy experts.

Schneider Electric is also a sponsor of Solar Decathlon Europe (since 2010) and Solar Decathlon China (which debuted in August 2013).

[www.schneider-electric.com](http://www.schneider-electric.com)

**WELLS  
FARGO**



## Wells Fargo

At Wells Fargo, we embrace the responsibility to lead positive environmental change by finding new ways to minimize our energy consumption, reduce waste, and support renewable sources of energy while building stronger communities. We believe when our communities do well, we do well and recognize that our environmental impact goes beyond how we operate.

Since 2005, Wells Fargo has provided \$21 billion in environmental finance to support the global economy and environment. In 2012, Wells Fargo released a set of environmental commitments to be achieved by 2020. Part of our commitment includes a \$100-million environmental grants commitment by 2020 to create a “greener” future for the communities we serve. Through our Clean Technology and Innovation Grant Program, we look to find, foster, and fund projects and entrepreneur programs that support the commercialization of new and emerging clean technologies.

As part of this vision, we are proud to be a sponsor for Solar Decathlon 2013. We congratulate all who are involved with Solar Decathlon 2013 and working to develop America’s clean technology infrastructure.

[www.wellsfargo.com](http://www.wellsfargo.com)



A student decathlete prepares for one of the Solar Decathlon 2011 Home Entertainment Contest dinner parties. (Credit: Stefano Paltera/U.S. Department of Energy Solar Decathlon)



## Alliance for Sustainable Energy

The Alliance for Sustainable Energy LLC manages and operates the National Renewable Energy Laboratory for the U.S. Department of Energy. A limited liability company, the Alliance for Sustainable Energy is equally owned and governed by Midwest Research Institute and Battelle. For Solar Decathlon 2013, the Alliance is pleased to provide uniforms for event organizers.

[www.allianceforsustainableenergy.org](http://www.allianceforsustainableenergy.org)



## Applied Materials Foundation

The Applied Materials Foundation is proud to support the Solar Decathlon as it works to engage the innovators of tomorrow in clean technology today. Funded by Applied Materials—a global leader in providing manufacturing solutions for the semiconductor, flat-panel display, and solar PV industries—the foundation celebrates the achievements of the solar decathletes as they promote the benefits of renewable energy.

[www.appliedmaterials.com/about/cr](http://www.appliedmaterials.com/about/cr)



## Ingersoll Rand

Ingersoll Rand advances the quality of life by creating and sustaining safe, comfortable, and efficient environments. Our people and our family of brands work together to enhance the quality and comfort of air in homes and buildings; transport and protect food and perishables; secure homes and commercial properties; and increase industrial productivity and efficiency. We are a \$14-billion global business committed to a world of sustainable progress and enduring results.

[www.ingersollrand.com](http://www.ingersollrand.com)



## Irvine Ranch Water District

Established in 1961 as a California Water District, the Irvine Ranch Water District provides drinking water, sewage collection and treatment, recycled water, and urban runoff treatment to Central Orange County, California. Irvine Ranch Water District encompasses nearly 181 square miles extending from the Pacific coast to the foothills. The district serves the City of Irvine and portions of Costa Mesa, Lake Forest, Newport Beach, Tustin, Santa Ana, Orange, and unincorporated Orange County.

Irvine Ranch Water District is providing drinking water to the collegiate team participants for the entire on-site duration of Solar Decathlon 2013 as well as water service delivery to and removal from the team competition houses.

[www.irwd.com](http://www.irwd.com)



## Leverage Information Systems (LEVERAGE)

A full-service IT systems integrator supporting the network technology for the Solar Decathlon village and XPO, LEVERAGE supports some of the most important networks in the world, including those for national security, intelligence, defense, federal, state and local government, and national science programs as well as finance, healthcare, and enterprise customers.

[www.leverageis.com](http://www.leverageis.com)



## MicroPlanet

MicroPlanet products are used by utilities, businesses, and homeowners to optimize incoming voltage, improve power quality, and manage bidirectional distributed energy from solar photovoltaics and wind. Our technology regulates voltage steplessly, with unrivalled speed and accuracy. We are proud to support our second Solar Decathlon to ensure, once again, that the village microgrid provides consistent, optimized voltage to each contestant and to ensure that the energy generated by each team's solar PV installation is integrated smoothly back onto the microgrid. Congratulations to all the teams competing in Solar Decathlon 2013.

[www.microplanet.com](http://www.microplanet.com)



## University of California Irvine

Located in coastal Orange County, University of California Irvine was founded in 1965. One of only 62 members of the Association of American Universities, it's ranked first among U.S. universities under 50 years old by the London-based Times Higher Education. The campus claims three Nobel laureates and is known for academic achievement, premier research, innovation, and its anteater mascot. Led by Chancellor Michael Drake since 2005, UC Irvine has more than 28,000 students and offers 192 degree programs. It's Orange County's second-largest employer, contributing \$4.3 billion annually to the local economy. In support of Solar Decathlon 2013, UC Irvine sponsored the competition observer corps and helped recruit volunteers for School Day.

[www.uci.edu](http://www.uci.edu)



## American Society of Heating, Refrigerating, and Air-Conditioning Engineers

ASHRAE provided two full-service meals to Solar Decathlon 2013 student decathletes and organizers during the village assembly period.



## Electrolux

Electrolux partnered with Pella Windows to sponsor School Days programming and school bus grants.



## KB Home

KB Home, one of the nation's largest and most recognized homebuilders, provided a generous donation for programming and support of the Solar Decathlon 2013 and XPO.



## MC Dean

MC Dean provided support for the village microgrid design and electrical service provider transition.



## Nomoi Design

Nomoi Design provided architectural photography of the Solar Decathlon team houses as well as high-definition, 360-degree virtual tours for the Solar Decathlon website.



## Pella Windows

Pella Windows partnered with Electrolux to sponsor School Days programming and school bus grants.



## Tierra Verde Industries

Tierra Verde Industries provided waste management and recycling services for the Solar Decathlon village and XPO.



## U.S. Department of Energy SunShot Initiative

The U.S. Department of Energy SunShot Initiative provided programming of the SunShot Innovation Pavilion at the XPO.



### American Institute of Architects

Partnered with the Construction Specifications Institute and the National Institute of Building Sciences to provide National CAD Standards licenses to the Solar Decathlon 2013 teams.



### National Fire Protection Agency

Provided Solar Decathlon 2013 teams with access to the NFPA 70: National Electrical Code handbook.



### American Solar Energy Society

Provided solar-industry outreach for the event through its award-winning *Solar Today* magazine.



### National Institute of Building Sciences

Partnered with the American Institute of Architects and the Construction Specifications Institute to provide National CAD Standards licenses to the Solar Decathlon 2013 teams.



### ARCOM

Provided construction specification software and electronic resources to Solar Decathlon 2013 teams.



### Point Six Wireless

Provided the sensor equipment in the team houses that provides data for measured competition contests.

## Autodesk

### Autodesk

Helped Solar Decathlon 2013 teams design their competition houses by providing training and tutorials in the Autodesk 3D design software.



### RSMeans

Provided the CostWorks Web-based cost-estimating program to Solar Decathlon 2013 teams, helping them compete in the Affordability Contest.



### Construction Specifications Institute

Partnered with the American Institute of Architects and the National Institute of Building Sciences to provide National CAD Standards licenses to the Solar Decathlon 2013 teams.



### National Association of Home Builders

Provided building-industry outreach for the Solar Decathlon event.



### International Code Council

Provided Solar Decathlon 2013 teams with access to the 2012 International Residential Code and 2012 International Building Code.



### Solar Energy Industries Association

Provided solar-industry outreach for the Solar Decathlon event.



### U.S. Green Building Council

Provided building-industry outreach for the Solar Decathlon event.

# XPO

## You Came for the Solar Decathlon. Stay for the XPO!

Once you've toured the Solar Decathlon village, explore the XPO at the Orange County Great Park. The XPO is a clean, renewable, and efficient energy exposition showcasing technology, education, products, arts, and business opportunities related to clean and renewable energy generation and efficient energy use.

It features visionary and innovative companies, products, and educational opportunities. Through fun, interactive exhibits and activities, the XPO will provide you with information about a broad range of energy-efficiency concepts and products in home design, transportation, consumer products, food production, and education.

You'll experience ways to implement clean energy practices and activities. When you visit the XPO, you'll leave with tools and resources to live a more energy-efficient life.

Don't miss these XPO attractions!

- **SunShot Innovation Pavilion** – An educational trade show that connects consumers with clean energy companies, products, and services while showcasing educational activities and booths that highlight the Department of Energy's SunShot awardees and nonprofit partners

**Free!**

**Open to the public!**

**Oct. 3–6 and Oct. 10–13**

**11 a.m.–7 p.m.**

**See the XPO Visitors Guide for additional details about XPO attractions.**

- **Powerful Ideas Classroom**, sponsored by the Bosch Community Fund – A series of events and activities for students of all ages focused on science, engineering, and architecture, including the **Kids Discovery Village**, where curious minds can get an interactive look at energy, design, and innovation
- **Powerful Ideas Symposium**, sponsored by the Foundation for the Great Park – Guest speakers and panelists present innovative ideas related to clean, renewable, efficient energy and its connection with the world and our everyday lives
- **Competitors Pavilion** – A showcase of the colleges and universities competing in Solar Decathlon 2013 as well as the winners of the U.S. Department of Energy Housing Innovation Awards and the American Institute of Architects Orange County Student Design Competition Awards
- **Transportation Zone** – Electric vehicle competitions in the California Challenge, electric vehicle ride-and-drives and demonstrations, and industry experts sharing information about the variety of highly fuel-efficient "green" vehicles on the market today and in the near future
- **Palm Court Arts Complex** – Artistic gallery exhibitions in which guests can explore, discover, and experience how art can be influenced by the environment and the environment by art
- **Farm + Food Lab** – Exhibits and workshops on the benefits of locally grown food and how to grow nutritious food and maintain healthy gardens
- **XPO Food Pavilion** – A central gathering place that features organic produce, healthy food, and refreshments and seating for Solar Decathlon and XPO guests
- **ABC Green Home** – A highly energy-efficient home created by Southern California Edison, *Green Homebuilder* magazine, and a host of innovative and creative vendors and suppliers located at the Orange County Great Park



[www.the-xpo.org/](http://www.the-xpo.org/)

Solar Decathlon 2013 collegiate team members gather beneath the Orange County Great Park balloon. (Credit: Stefano Paltera/U.S. Department of Energy Solar Decathlon)

# People's Choice Award

## Vote for Your Favorite Solar Decathlon 2013 House!

### This is your time to shine!

Vote for your favorite Solar Decathlon house and help its team win the People's Choice Award. It's all about bragging rights!

The winning team will receive its award in a private presentation on Saturday, Oct. 12.

In 2011, more than 92,000 votes were cast. Help us reach 100,000 votes in 2013!

### Cast your vote now!

If you have a QR code reader, scan this with your smartphone. It will take you to the voting site for the People's Choice Award. Or cast your vote by visiting [go.usa.gov/jpyw](http://go.usa.gov/jpyw).



The People's Choice Award is sponsored by Applied Materials Foundation.

## Keep track of your favorite houses here, and then vote for the People's Choice Award!

- **101** DALE (Southern California Institute of Architecture and California Institute of Technology)



- **109** LISI (Team Austria: Vienna University of Technology)



- **116** Borealis (Team Alberta: University of Calgary)



- **102** Ecohabit (Stevens Institute of Technology)



- **110** InSite (Middlebury College)



- **117** SHADE (Arizona State University and The University of New Mexico)



- **103** AIR House (Czech Republic: Czech Technical University)



- **111** fluxHome (University of Southern California)



- **118** Radiant House (Santa Clara University)



- **104** Start.Home (Stanford University)



- **112** UrbanEden (The University of North Carolina at Charlotte)



- **119** PEAK (West Virginia University)



- **105** Delta T-90 House (Norwich University)



- **113** Phoenix House (Kentucky/Indiana: University of Louisville, Ball State University, and University of Kentucky)



- **120** ECHO (Team Ontario: Queen's University, Carleton University, and Algonquin College)



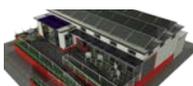
- **106** ADAPT (Team Texas: The University of Texas at El Paso and El Paso Community College)



- **114** DesertSol (University of Nevada Las Vegas)



- **107** Chameleon House (Missouri University of Science and Technology)



- **115** HARVEST HOME (Team Capitol DC: The Catholic University of America, George Washington University, and American University)

