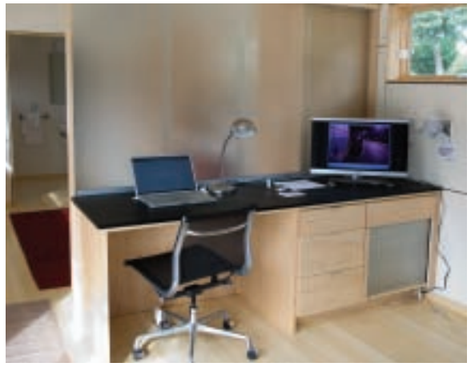
SOLAR DECATHLON

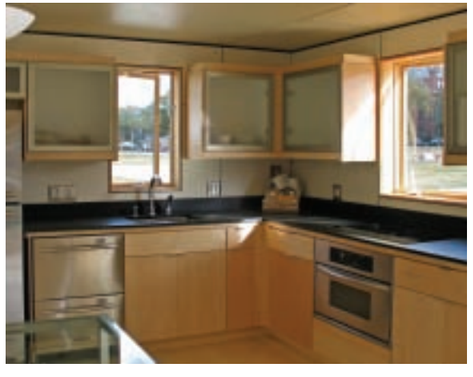
The 2005 International Competition of Solar Home Design

A Rahus Institute—Solar Schoolhouse Publication

Table of Contents

[ABOVE] A fluid inside/outside relationship is integral to the project, with sliding doors, consciously placed windows (for light, air, and view), ample decks, and a supplemental roof deck. This interior/exterior spatial relationship is essential given the project's economical space. The intention was to project a feeling of expansion from the inside by providing a strong visual and physical connection to the greater outdoors. **[BELOW LEFT]** Sliding glass doors contribute to the feeling of greater space. **[BELOW RIGHT]** The house is a fully functional dwelling with bathroom, kitchen and office areas.





Sailing in from Sunny California.

Simple. Fundamental. Elegant. This is the mantra of the California Polytechnic State University (Cal Poly) Solar Decathlon team.

The 2,394 miles that separate the university from the National Mall in Washington, D.C., is, literally, the groundwork for this philosophy. The greatest land distance any team will travel to the competition, along with the desire to fit everything in one truck, led to what the students fondly call the "one truck solution."

Although the constraints of the competition deliberately require all teams to minimize, Cal Poly students decided to take the simplicity concept as far as they could. You will not see a lot of high-tech gadgets on this house, nor is the building elaborate in form. Not only will this help ensure it will fit on one truck, but it fits well with their dedication to passive architectural design strategy. "Ours is an architectural strategy for performance and comfort that encourages the use of the building itself," says Sandy Stannard, a faculty adviser on the team.

While some schools chose to automate their homes as much as possible, Cal Poly took the opposite approach. "We want the user to interact with the house," says architecture student and Project Manager Jon Gambill. This means making a house that is "switch-rich"—plenty of operable windows, shading devices, and user-friendly controls—and relies less on mechanical equipment for heating, cooling, and lighting. The students say this will allow people to "sail" the house, adjusting the "trim" according to conditions of sun, wind, and temperature.

"We support the idea of people controlling their environment," says Stannard. "We see this project as a potential prototype that could be altered to respond to a variety of climactic conditions."

Giving a nod to the climate in California, where the house is likely to end up, the Cal Poly house includes a large south-side opening that adjoins a substantial deck.

continued

Team Data

> California Polytechnic State University

> Approximate Enrollment: 18,500 students [11th]

> Team Size: 49 members [5th]

> Origin City: San Luis Obispo, California
Approximate Distance: 2,394 miles [2nd]

> Approximate Budget: $412,000 [4th]

> www.solardecathlon.calpoly.edu

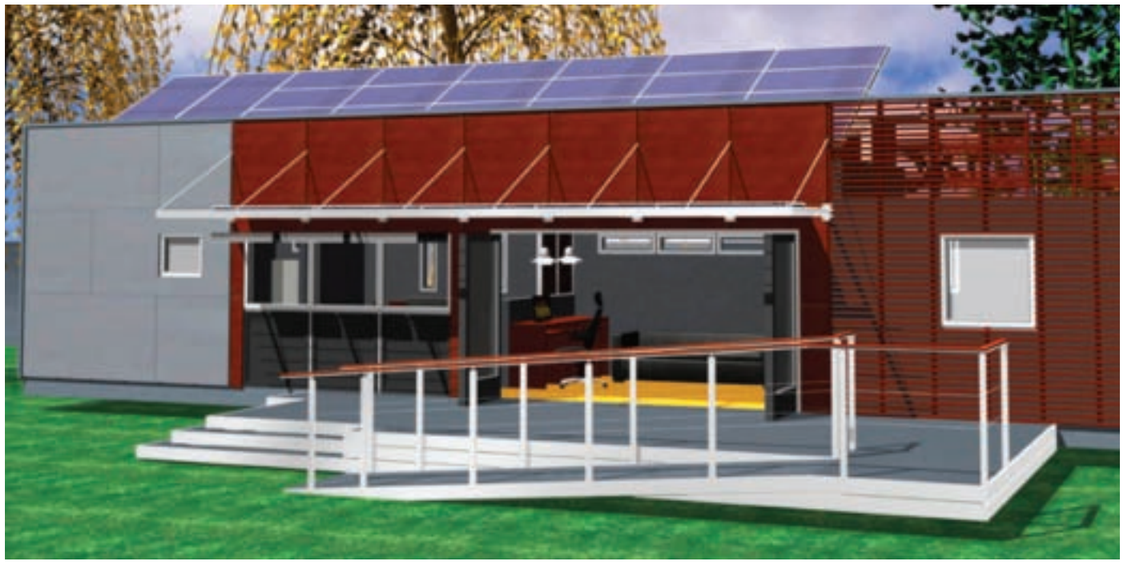
"A beautifully concise home tuned to the climate, detailed for modern living, proportioned and sized to travel across the country on a single truck."

Scoring

> Overall Points	809.130
> Overall Standing	3rd Place

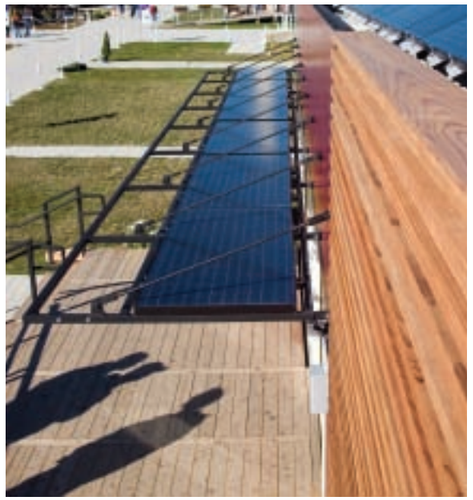
CONTEST	POINTS	PLACE
> Architecture	192.000	2
> Dwelling	95.000	2
> Documentation	82.090	6
> Communication	75.550	10
> Comfort Zone	75.440	2
> Appliances	**80.392**	**1**
> Hot Water	87.917	3
> Lighting	**92.238**	**1**
> Energy Balance	0.000	6
> Getting Around	28.503 [83.9 miles]	10

For an explanation of each contest, see page 2.



[ABOVE] The house was designed from the inside-out with the same care as designing a sail boat, a functionally elegant vessel with architecturally integrated elements, furnishings and storage, making every detail and space count. Transparency, access to adjoining outdoor spaces, and use of a portion of the roof for an outdoor room expands both the virtual and actual size of the house while keeping its ecological and spatial footprint small.

[Below] The PV module awning shades the tank from the higher summer sun. The Trombe Wall then acts as a source of "coolth," and absorbs heat from the house. The PV modules can be moved back and forth to shade the window or let the sun shine on it.



"One of the pleasures of living in our part of California is being able to dine outside year round," explains engineering student Robert Johnson.

"We took a strategic approach to designing the home and its systems," says Johnson. The strategy included some design tradeoffs, including paying less attention to the "Getting Around" contest, partly as a reflection of the students' philosophy. "We focused our energy on supporting the house functions first," Johnson says. "Our team approach supports a less car-oriented lifestyle, so we will drive as far as we can—and then we will bike."

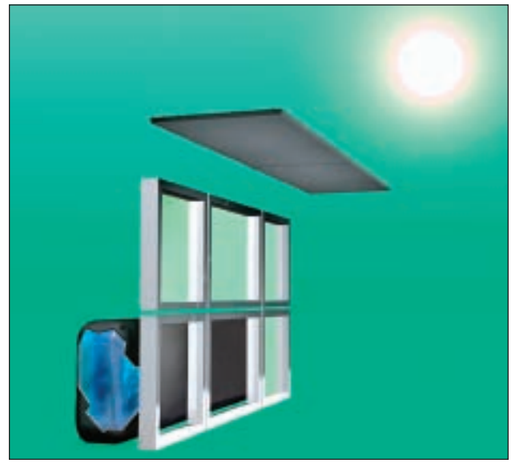
Switch Rich from California

Focusing on simplicity in their approach to home design, the CalPoly team employed a design strategy which incorporated as many mechanical and as few automated systems as possible. The strategy, which they dubbed "switch rich" is meant to help adapt the building to seasonal variations and different climates. It was designed to encourage inhabitants to interact with the home and also helped the team fit the house and its systems on just one truck for the coast-to-coast drive from California to Washington, DC.

The PV array consists of 28 solar panels capable of generating as many as 4.9 kilowatts. Mounted on the house's flat roof, the system is equipped with two maximum power point trackers, allowing the PV array to operate efficiently at all times of the day. The house is equipped with two liquid flat plate collectors that provided domestic hot water. A heat transfer fluid is circulated through the collectors where it absorbs energy from the sun. This heat is then transferred to the water in the storage tank. The hot water system is an active system with a pump to move water through the collectors. The 1/12 horsepower pump circulates water up to the collectors on the roof and through the heat exchanger in the storage tank. At night, the pump shuts down allowing the fluid from the collectors to drain into the drainback tank, preventing the heat transfer fluid from freezing. A thermal storage tank stores the hot water produced by the solar thermal system during the day for use at any time during the day or night. It also has an electrical heating element that can be used to heat the water when energy from the sun in not sufficient.

Sliding doors, consciously placed windows (for light, air, and view), a supplemental roof deck, and a 13-foot wide retractable wall on the south side of the house promote a feeling of expansion from the inside while maintaining the home's small physical footprint. Daylighting is the predominant lighting source, supplemented with small energy-efficient lights. The electric lighting is designed to provide ambient luminescence with a touch of focal glow. The chosen lighting technologies include fluorescent, compact fluorescent, and light emitting diodes (LED); dimming technology is utilized where appropriate for energy savings and user control.

CalPoly house is made from local and reclaimed materials and includes three distinctive sets of materials for each major section of the house (mechanical, living, and cooking). Materials were selected based on their ability to promote human health and to reduce environmental impact. The house will return to the San Luis Obispo campus to become part of the College of Architecture and Environmental Design's "Center for Construction Excellence." It will serve as a case study for environmental issues and architectural design.



[Above] Cal Poly used a black water tank, (a type of Trombe Wall) as thermal mass. In winter, the lower sun shines directly on the tank, and heats the water. At night the warm water radiates heat into the house.