2009 U.S. Department of Energy Solar Decathlon Media Report

Executive Summary

2009 marked the fourth U.S. Department of Energy Solar Decathlon. The competition is one of the Department of Energy's signature programs designed to promote energy efficiency, renewable energy and green jobs. It is a competition where twenty teams of university students from the U.S. and abroad compete to design and build revolutionary solar powered houses. All of the houses are Zero Energy Homes, which produce as much energy from renewable sources as they consume. Their work culminated in an unprecedented display of "green" innovation and design when the competition took over the National Mall in October and the teams competed to see which house was the best designed and engineered energy efficient house.

New this year, the solar village was connected to a micro-grid constructed on the Mall which connected to Pepco, Washington, DC's power company, in order to push extra energy into the city's grid. As a result of the micro-grid, the competition featured a new Net Metering contest to educate participants and the public on smart meters and smart grid technology. Ultimately, it was this contest that determined the overall winner of the Decathlon: Team Germany.

At a time when green energy initiatives are well-funded and more popular than ever, the competition was fortunate to serve as a shining example of energy efficient innovations and the evolution of solar power. However, the Decathlon cut through through the static of other "going green" media stories to educate the public about the benefits of photovoltaics, while making the competition seem new again.

Fortunately, the homes, the students and the stories behind them were more than enough to draw hundreds of media and hundreds of thousands of visitors to the Mall. In addition, we generated an unprecedented amount of media coverage and impacted hundreds of millions of readers and viewers to experience the Decathlon.

Highlights from this year's Decathlon include:

- Generated more than **923,772,079** impressions with Solar Decathlon messages (this estimate includes print, online and broadcast coverage).
- Reached more than **175,240,449** readers through print and online coverage in top-tier outlets, including *The New York Times, the Washington Post*, *the Los Angeles Times, USA Today, Newsweek.com and The Economist.com*.

- Facilitated newspaper coverage in over **265 newspapers** across the country.
- Conducted **74** radio interviews nationwide, garnering a total audience of more than **75,116,872** listeners. Nationally syndicated interviews were conducted with CBS Radio Network, National Public Radio, ABC News Network, Marketwatch Network, FOX News Network, USA Radio Network, SkyView Network and CNN News Network.
- Secured coverage on major news networks including ABC News, Associated Press Broadcast, CNN, Fox News, NBC's "The Today Show", CBS's 60 Minutes, and Reuters Broadcast attend.
- Television news stories occurred in every home market, the total number of **television stories nationwide** was over **730**.
- Produced online coverage on key blogs and news sites including: CBS News, CNET, MSNBC, dWell, Huffington Post, Popular Science, Daily Kos and the Today Show and The Economist.
- Generated an unprecedented **8,743** unique visits and more than **23,136** page views on the SolarDecathlon.gov website during the competition.
- Maintained relationships with leading reports who, well after the event, continue to reach out to Decathlon representatives and request interviews.

"All the News That's Fit to Print"

The New York Times

Washington Edition
Today, milder, drier, returning sunshine, highs near 70. **Tonight,** mainly clear, chilly, lows in mid-40s. **Tomorrow,** limited sunshine, highs in upper 50s. Weather map, Page B18.

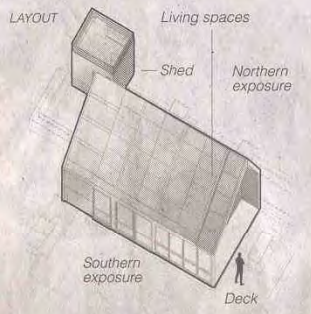
VOL. CLIX . . . No. 54,827 TUESDAY, OCTOBER 13, 2009 $2.00

The New York Times

Solar Living, Without Compromising on Lifestyle

Built for Comfort

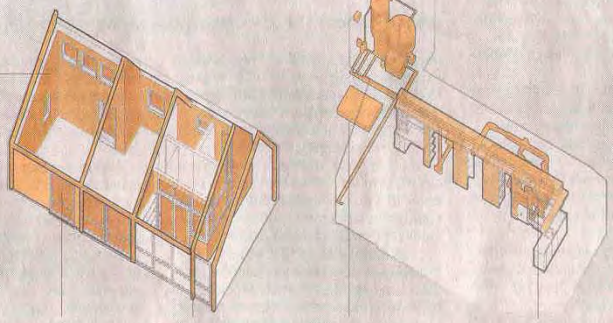
The Solar Decathlon, a Department of Energy competition to design and build an attractive and efficient solar house, has 20 entries designed by students from universities in the United States and foreign countries. The houses, assembled on the National Mall in Washington, are judged on aesthetic appeal, energy production and conservation and other characteristics.



MINNESOTA The University of Minnesota's house has a gable roof that is offset to the north, allowing a larger area for solar panels on the south. The roof angle is optimized for the lower winter sun in Minnesota's latitudes.

DESIGN FEATURES

INSULATION Polyurethane closed-cell foam has high insulating value and allows walls to be thinner.



PHOTOVOLTAICS These panels convert sunlight to electricity, and also serve as cladding for the house.

WINDOWS Large south-facing windows let the sun heat the interior.

WOOD FRAME Exterior members are covered in enameled steel for durability.

WATER COLLECTION Rainwater and water from cleaning is collected and used to irrigate exterior plantings.

COOLING A desiccant reduces humidity, improving the efficiency of the electric air conditioner.

SOLAR THERMAL These panels provide heat for water and heating systems and to recharge the cooling desiccant.

BIFACIAL PANELS Photovoltaic cells on glass absorb light from both sides, increasing efficiency.

OTHER TEAMS

TEAM SPAIN Photovoltaic cells cover the roof, which pivots on a ball-and-socket joint to follow the sun. In high winds the roof can be locked in place.

CORNELL The living spaces are a series of interconnected silos made from corrugated steel, with other agricultural-themed touches.

VIRGINIA TECH Movable glass panels filled with aerogel insulation and laser-cut stainless steel screens give the house a futuristic look.

Sources: University of Minnesota; Cornell University; Technical University of Madrid; Virginia Polytechnic Institute and State University

MIKA GRÖNDAHL/THE NEW YORK TIMES

By HENRY FOUNTAIN

WASHINGTON — John Hamilton paused from tinkering with the heat pumps, pipes and tanks arrayed before him, the mechanical heart of a small house assembled on the National Mall, to read the electric meter mounted off to the side.

The digital display showed that over the previous two days, the pavilionlike structure, designed by architectural and engineering students from Virginia Tech, had drawn about 20 kilowatt-hours from the electric grid. But during the same period, double-sided photovoltaic cells on the roof had pumped about 60 kilowatt-hours back.

"That's pretty good," said Mr. Hamilton, who was tweaking the house's control systems on Thursday afternoon because his firm, Siemens, is a sponsor. "We rode it hard this morning."

The Virginia Tech team members had been busy with last-minute preparations for the opening of their project, called Lumenhaus, and of the Solar Decathlon, a federal Department of Energy competition to design and build an efficient and livable solar-powered dwelling. The 10-day event includes 20 student teams from universities in the United States, Canada and Europe.

Some groups had been scurrying around even more frantically. Students and faculty advisers from the University of Wisconsin, Milwaukee, were in hard hats, sawing and hammering, and were still working long after the 1 p.m. opening ceremonies. The Virginia Tech house's net production of energy will be worth some points in the competition. But it and the other entries will not be judged by electrical use alone. There are points to be had for architectural design, engineering skill, comfort and marketability — 10 categories in all.

"The idea is to prove to people that solar works, and you don't have to give up your lifestyle to use it," said Richard King, director of the biennial competition for the Energy Department, which gives $100,000 to each team to get the projects started. The event is also meant to get the students to think about solving energy problems in affordable ways — all the projects have to be geared to a specific market, from low to high income.

The houses, which are limited to 800 square feet, are fully outfitted with furniture, appliances and furnishings — even sheets, towels and books. Team members do not live in them, but they have to do household activities like cooking and washing clothes, and are judged on whether their systems can maintain comfortable air temperatures and produce enough hot water. The television has to be left on six hours each day, to demonstrate that there is enough electricity for entertainment.

With the houses lined up in two rows in the shadow of the Washington Monument, the competition resembles a futuristic trailer park. There are innovative materials and designs everywhere — self-adjusting exterior blinds at Team Ontario's house that can also reflect sunlight into the building; a plastic water wall at the University of Arizona's entry that absorbs sunlight and gives off heat; and, at the Lumenhaus, movable translucent panels insulated with aerogel, which allow light through.

Solar panels, both photovoltaic and thermal, adorn the roofs. Some are mounted in the conventional way, tilted so that the sun's rays strike close to perpendicular to improve conversion efficiency. But some have panels flat mounted, or on the sides, like high-tech (and expensive) shingles, or with mechanisms to allow them to be tilted to follow the sun. The competition encourages sustainability, so most of the houses have systems to use rainwater and reuse wash water for plants. Recycled products are found on exteriors (battens made from pressed paper and wood on the University of Minnesota's house) and in interiors (cabinet doors made from pressed sorghum straw in Team Missouri's kitchen).

Many of the interiors are designed to be flexible and adaptable. At the Lumenhaus, for instance, wardrobe cabinets in the center can be slid toward the walls to isolate the bedroom from the living area, and a moveable counter can cover much of the kitchen surfaces or be used as a table.

Mr. Hamilton, the Siemens representative, liked the interior so much that he had an offer for the Virginia Tech students. "I told these guys, I'd live in this house," he said.

The Washington Post

REAL ESTATE

SATURDAY, OCTOBER 10, 2009

For more Real Estate news, Section F

The 2009 Solar Decathlon

PHOTOS BY DAYNA SMITH FOR THE WASHINGTON POST

All's Possible Under the Sun

Twenty student teams take over the Mall to show that **solar-powered** living is more than just a bright idea.

By ELIZABETH RAZZI
Special to The Washington Post

A tidy village dedicated to the future of green, solar-powered living has taken over the heart of the National Mall, where 20 teams of college students are vying to see who can build the most appealing energy-efficient home.

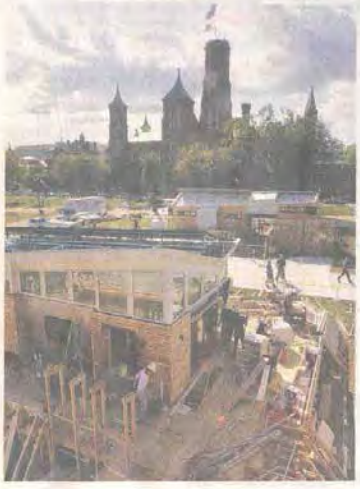
The teams, from universities in North America and Europe, are competing in the Department of Energy's biennial Solar Decathlon, which runs through next weekend. The challenge: design and build a prototype house that can provide the comforts of home while generating all the energy residents need from the sun's rays. Teams get bonus points if they can produce surplus electricity and sell it back to the power company.

The transformation began at 11 p.m. on Sept. 30, when the first flatbed trucks carrying building modules were allowed to roll onto the Mall between the Smithsonian Castle and 14th Street NW. Student-led teams, backed by professional builders, suppliers and advisers, turned the Mall into a feverish construction site from early morning until late each evening, readying the houses for the opening ceremony Thursday. They built sleek pyramids, rusty silos, reclaimed-water gardens, glassy boxes and shaded porches. And each house sports an electric meter that can run in reverse, giving the team credit for each kilowatt it can sell into Pepco's electric grid.

The avant-garde neighborhood is open for free tours daily through Oct. 18, except for Wednesday, when the houses are closed for judging.

A decathlon, of course, consists of 10

See SOLAR, *Page E8*



The Solar Decathlon, sponsored every two years by the Energy Department, is a competition to build the most marketable and energy-efficient solar-powered house. Above is a silo-inspired design by Cornell University students. The houses are open to the public on the Mall through next weekend.

ON WASHINGTONPOST.COM

VIDEO ON THE WEB
For panoramic tours of some of the houses on the Mall in this year's Solar Decathlon, go to washingtonpost.com/realestate.

The 2009 Solar Decathlon has produced 20 competitive entries, judge Sarah Susanka says. "There were no funky ones. Two years ago, there some that were more — how should we put it? — student-like."

Students Aim to Show That Solar's Bright Future Is Now

SOLAR, *From Page E1*

events. These houses are being judged for their architecture, market viability, engineering, comfortable temperature and humidity, hot water production, appliances, entertainment, communication with the public, lighting design, and ability to produce at least as much energy as they consume.

The competition is designed to push solar technology forward — and to train the next generation of architects, engineers and other design pros to create homes that operate with nearly no carbon footprint, according to Richard J. King, who runs the project for the Energy Department.

"We don't know how to do it in the United States; otherwise we'd have solar houses all over the place," he said. In the past three decathlons, students have learned from their competitors and incorporated winning ideas into subsequent designs. "They learn from each other; they learn what really works," he said. "It's a wonderful iterative process of advancement."

He noted that several teams that competed in past decathlons have gone on to form their own energy technology companies. And some technologies used in previous entries, such as structural beams made of fast-growing bamboo, are already starting to be commercialized.

This year's contestants, chosen a year ago from 40 entries, were each awarded $100,000 from the Department of Energy to build the prototypes. That funding was supplemented by team fundraising and corporate sponsorships. From this point on, the teams are competing simply for bragging rights.

The teams have taken wildly different approaches to their designs. Some reflect how environmental conditions differ from Ontario to Arizona. But others reflect the teams' distinct priorities. Several focus on cutting-edge technology, while others have tried to take off-the-shelf technology and produce a home that could be taken to the mass market quickly and affordably.

One example of the cutting-edge approach would be Team Spain's entry, built by Universidad Politécnica de Madrid. Unabashedly modern, the house sits under a large inverted pyramid that contains solar-electric panels and solar-heating water collectors. The pyramid is attached to the roof with a ball-and-socket mechanism that pivots the pyramid to track the sun. The sides of the pyramid also reflect sunlight into the house through skylights.

Virginia Tech's house incorporates sliding-glass walls on the north and south faces. The walls can be opened and closed automatically by an in-house computer linked to indoor climate sensors and an outdoor weather station. The walls can also be operated by iPhone.

The house designed by Technische Universitat Darmstadt in Germany — the school that took top honors in the last decathlon, in 2007 — is outfitted with an 11.1-kilowatt photovoltaic system designed to produce twice as much energy as the house consumes. The shiny, black, two-story structure is covered with single-crystal silicon solar panels on the roof and abut 250 thin-film solar panels on all four sides.

By contrast, the University of Illinois and University of Louisiana at Lafayette teams have focused on designing homes that could be put into production quickly by modular-home builders and that hearken back to traditional architectural styles native to their areas.

The Illinois entry looks almost like a Shaker design in its simplicity. The exterior siding was reused from an old barn in northern Illinois, but indoors it features engineered bamboo laminate board that replaces traditional wooden studs to support the walls. The fast-growing bamboo, a type of grass, is a greener alternative to pine and other woods typically used in construction. The house is powered by a 9-kilowatt photovoltaic system.

The prototype built by the University of Louisiana at Lafayette is designed to be a practical modular home that can withstand the strong storms, like Hurricane Katrina, that hit the Gulf Coast. It reflects traditional Cajun housing style by way of a "dogtrot" that cuts through the heart of the house. A dogtrot is a covered breezeway, long used in Southern architecture, that keeps the hot kitchen separate from the cooler living and sleeping areas. This dogtrot is updated with transparent sliding doors that can enclose the area when residents want it for an indoor space or open it up to the breeze when they want to use it as a porch. The home is also designed to withstand sustained winds of 140 mph. Extruding parts, such as rooftop solar panels, can be tied down or stored if a major storm approaches and residents need to evacuate. During a storm, fresh rainwater is collected into a cistern. After a storm, residents would be self-sufficient with electricity generated by their own 7.8-kilowatt photovoltaic system and have their own supply of fresh water.

One other way the Louisiana house reflects the local culture: Cajun musical group BeauSoleil, a team sponsor, will perform a free concert on the porch from 5 to 7 p.m. on Friday.

Cornell University's house stands apart from the other entries with its agrarian-looking design. The house consists mainly of three rusted, corrugated steel cylinders intended to reference the grain silos on upstate New York farms. The house is powered by an 8-kilowatt photovoltaic system and features a custom-made computer driving the entertainment center.

One of the judges is Sarah Susanka, architect and author of "The Not So Big House" and other books that advocate multi-use spaces and high-quality materials. Based on an early review of house plans, she said she was "blown away" by the creativity of this year's entries. "There were no funky ones. Two years ago, there some that were more — how should we put it? — student-like," Susanka said in an interview before touring the prototypes. When they tour the homes, she said, she expects visitors to see that smaller homes can be pleasant.

"I don't think many people have had the opportunity to tour well-designed smaller structures," she said. "That's a real revelation to a lot of people."

Gabby Sachnoff installs a "water wall" in the University of Arizona's solar house.

Tyler Jorgenson, an architecture student at the University of Arizona, cleans a window equipped with a thermally activated shading device.

Meet the Solar Decathletes

- Cornell University
- Iowa State University
- Ohio State University
- Penn State University
- Rice University
- University of Illinois
- University of Kentucky
- University of Louisiana at Lafayette
- University of Arizona
- Team Alberta (University of Calgary, SAIT Polytechnic, Alberta College of Art + Design, Mount Royal College)
- University of Minnesota
- University of Wisconsin at Milwaukee
- Virginia Tech
- Universidad de Puerto Rico
- Team California (Santa Clara University, California College of the Arts)
- Team Boston (Boston Architectural College, Tufts University)
- Team Germany (Technische Universitat Darmstadt)
- Team Missouri (Missouri University of Science and Technology, University of Missouri)
- Team Ontario/British Columbia (University of Waterloo, Ryerson University, Simon Fraser University)
- Team Spain (Universidad Politécnica de Madrid)

TUESDAY, OCTOBER 13, 2009

Los Angeles Times

latimes.com

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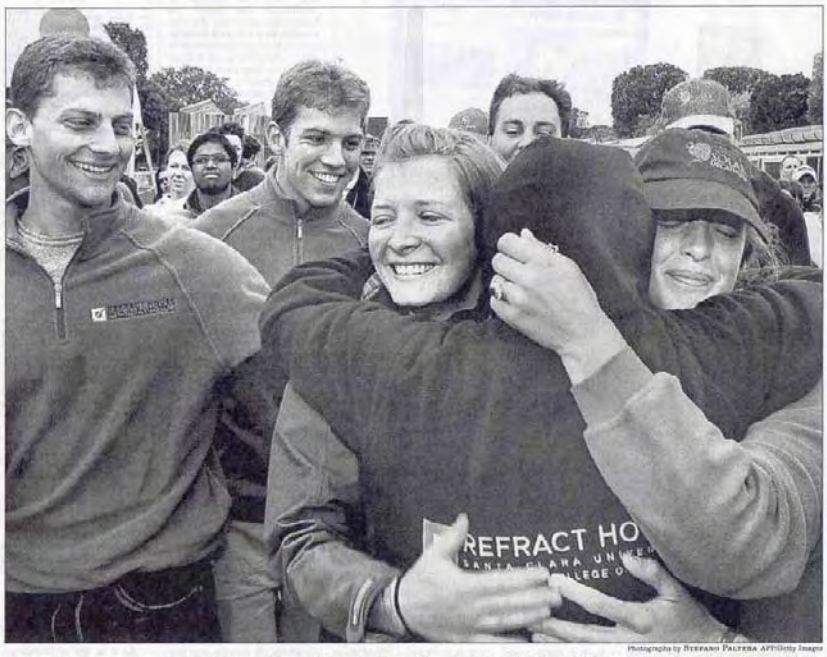
THE NATION



Photographs by STEFANO PAULTERA AFP/Getty Images

A LOT TO SMILE ABOUT: Annessa Mattson, left, and Allison Kopf hug advisor Jim Reites after Team California took the lead in the Solar Decathlon.

GLOBAL CRIME THREAT DETAILED

JOSH MEYER
REPORTING FROM WASHINGTON

An aggressive global response is needed to counter organized crime syndicates, which are increasingly teaming up with terrorist networks and drug traffickers, U.S. and international law enforcement officials said Monday at a conference in Singapore.

Deputy U.S. Atty. Gen. David Ogden and some of his counterparts, speaking at the 78th general assembly of the global police agency Interpol, acknowledged that they needed to cooperate better on many fronts.

Of particular interest, they said, are emerging money-laundering pipelines that are enabling crime syndicates to flourish in terrorist hot spots such as Pakistan and Afghanistan and other strategic locations, including Europe, Africa and Latin America.

Ogden told delegates that they needed to act more forcefully to combat transnational organized crime groups whose proceeds now comprise up to 15% of the global gross domestic product.

In his speech and in a recent interview with The Times, Ogden said the criminal groups'

Innovation's day in the sun

Students unveil their 'green' homes in the Solar Decathlon. Team California shines.

ALEXANDER C. HART
REPORTING FROM WASHINGTON

The village on the National Mall looks like something out of science fiction: dozens of unusually shaped buildings with solar panels protruding from their rooftops.

The temporary homes are entries in the Solar Decathlon, a biennial contest designed to spur college students to pursue careers in science and engineering, encourage the development of green technologies and raise public awareness of energy efficiency issues.

Hundreds of undergraduates worked as long as two years to plan, design and build the solar-powered houses. Then they brought them to Washington for a week and a half of public exhibition and judging in 10 categories, such as comfort and how much energy they produce relative to how much they consume.

Most teams are from U.S. schools, but groups from Spain, Germany and Canada also are competing this year in the decathlon, which is run by the Energy Department.

Team California — made up of students from Santa Clara University and the California College of the Arts — focused on building a practical house that did not skimp on comfort.

"We wanted to blend form and function," project manager Allison Kopf said of the house, which has a wooden exterior and large deck. "We wanted to show that green living is not a compromise."

IN WASHINGTON: Team California's 580-square-foot house is eco-friendly and comfortable. "We wanted to show that green living is not a compromise," Kopf said.

Many of the 580-square-foot home's eco-friendly features are not readily apparent. Its 48 solar panels are carefully angled so as to be nearly hidden from view. But despite the cloudy skies Monday, they still produced 75% of the energy needed to run the house, Kopf said. On a sunny day, the house's solar panels generate 150% of what is needed.

Teams taking part in the decathlon built their homes around different themes.

For the students from the University of Illinois at Urbana-Champaign, that emphasis was "conserve, conserve, conserve," said team member Ryan Abendroth.

Their design, which from the outside resembles a barn, has been certified as using 90% less energy than the average home. The goal was accomplished by heavily insulating the house and making it almost airtight to keep the warm air inside and the cold air out.

Competing in the decathlon can be expensive. Teams receive $100,000 from the Energy Department after submitting their plans, but the real cost of building can be much higher.

Team California's house, for example, cost about $450,000, said Kyle Belcher, who graduated in May with a degree in architecture. But plugging that monetary gap was part of the learning experience, he said.

"We were asked to do a lot of things that you aren't usually asked to do while you're in school," Belcher said of the approximately 200 students who worked on the house. They had to persuade companies to sponsor them, make presentations to community groups, and undertake the design and construction of the project.

Inspiring and teaching students is the purpose of the event, said decathlon director Richard King. The decathlon centers "all around education," he said, noting that students get hands-on experience with engineering concepts they have only learned about in textbooks before participating.

As of Monday evening, Team California was in the lead. The judging concludes Friday.

alex.hart@latimes.com


THE SELF-RELIANCE ISSUE
Disaster-Proof Your House, Your Car, Your Life
Popular Mechanics
6 Wild Emergency Car Repairs
PLUS
Science Automotive Technology Home Outdoors
POPULARMECHANICS.COM | OCTOBER 2009
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HOW TO LIVE THROUGH ANY DISASTER
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THE SELF-RELIANCE ISSUE

The Race to Zero

For the Solar Decathlon, 20 teams of college students strive to build the most technologically savvy sun-powered house. This October their homes go head to head in a contest to consume the least energy.

7

By Harry Sawyers
Photographs by Christopher LaMarca

ON A HOT AND BRIGHT CALIFORNIA DAY, THE red steel frame of a half-built house, its footprint a jagged stamp on the landscape, glints in the sunshine beaming down on Santa Clara University. Crawling around the crescent-shaped structure, workers holler measurements, fasten sheathing and snap chalk lines. They're wearing hard hats and tool belts, and the noise of steel swatting plywood sounds unmistakably like a job site. But this is hardly a construction crew out of central casting. Swinging a sledgehammer in this gravel lot somewhere between the quad and the cafeteria, a student volunteer with arms as skinny as the tool's handle tries in vain to pound a steel spike into the ground. He swings, misses and repeats, while the crew snickers. Each stroke gets more and more desperate, until, finally, a cartwheel swing sends the kid headlong. His oversized hard hat flies off and the crowd cracks up, prompting structural and construction manager Dan Ruffoni, a 22-year-old senior at Santa Clara, to intervene. Ruffoni sinks the spike in a few clean blows and progress resumes, but the sledgehammer slapstick has cost the rookie contractors 7 precious minutes. They really don't have 7 minutes to spare.

The students have been working 100-hour weeks all semester, running to the job site after class and doffing hard hats to take midterms. So far, they've managed to finance the project and file 138 pages of engineering drawings on deadline—not to mention pass their exams. But the big deadline, though still months away,

Students juggle homework and hard hats at Santa Clara University, where they're out to prove that smart design and solar technology can power a net-zero house today.

is approaching fast. That's when the half-clad structure now rising from the campus will have to function as a super-efficient, sun-powered home of the future at the Solar Decathlon, in Washington, D.C. Sponsored by the U.S. Department of Energy this fall, the competition will pit 20 teams of college students against each other in an international showdown of innovative engineering. Team California's young roster tops out at age 23, whereas some schools attract Ph.D. candidates, or students Ruffoni describes as "old enough to look like they're already in the homebuilding business." As team project manager Allison Kopf puts it: "We don't have a construction background. We're undergrads—we have no background, period." But the students don't see that as a serious impediment; if anything, it has increased their drive to win.

Like many of his teammates, 21-year-old Preet Anand says he "works on the project full-time and does school on the side." While workers whistle to "Layla" from a dusty boombox, Anand, the team's water systems leader, gestures to a rectangle of blue sky visible through the ceiling beams in the asymmetrical structure. "We're putting solar photovoltaics and flat-plate solar thermal collectors on the roof," he says, "and clerestory windows will provide simple daylighting. Our architecture is not only performance-driven, we want the house to look good." He describes his team's strategy as a "young, daring Silicon Valley approach"—and it's not without its challenges. Window shutters with thin-film solar collectors along the louvers had to be axed because of safety concerns. Certain products have proven to be so obscure that it was unclear whether they could be shipped to the U.S. For other prototypes, students have had to prove that new materials are up to code.

All this before crossing the last major hurdle: simply showing up at the competition. The members of Team California (which also includes students from California College

Preet Anand, far left, dismantles a mockup of the house framing. He says Team California's project can prove that renewable energy and efficient design are "a necessity, not a luxury." Above right, sophomore Allison Kopf makes cuts after class while freshman Victoria Watson holds the sawhorses steady.

of the Arts) must dismantle the house once they finally complete it and transport the pieces in three wide loads on a meticulously planned, 2848-mile journey across the country, only to reassemble the structure in just six days upon arrival at the National Mall. Then, they must move into their house for the duration of the competition. In the end, they're not just building a solar-powered home—they're proving that people can live in solar-powered homes, comfortably and without sacrifice. Teams have to shower in their houses, watch TV, do laundry and even host other teams for two dinner parties and a movie night.

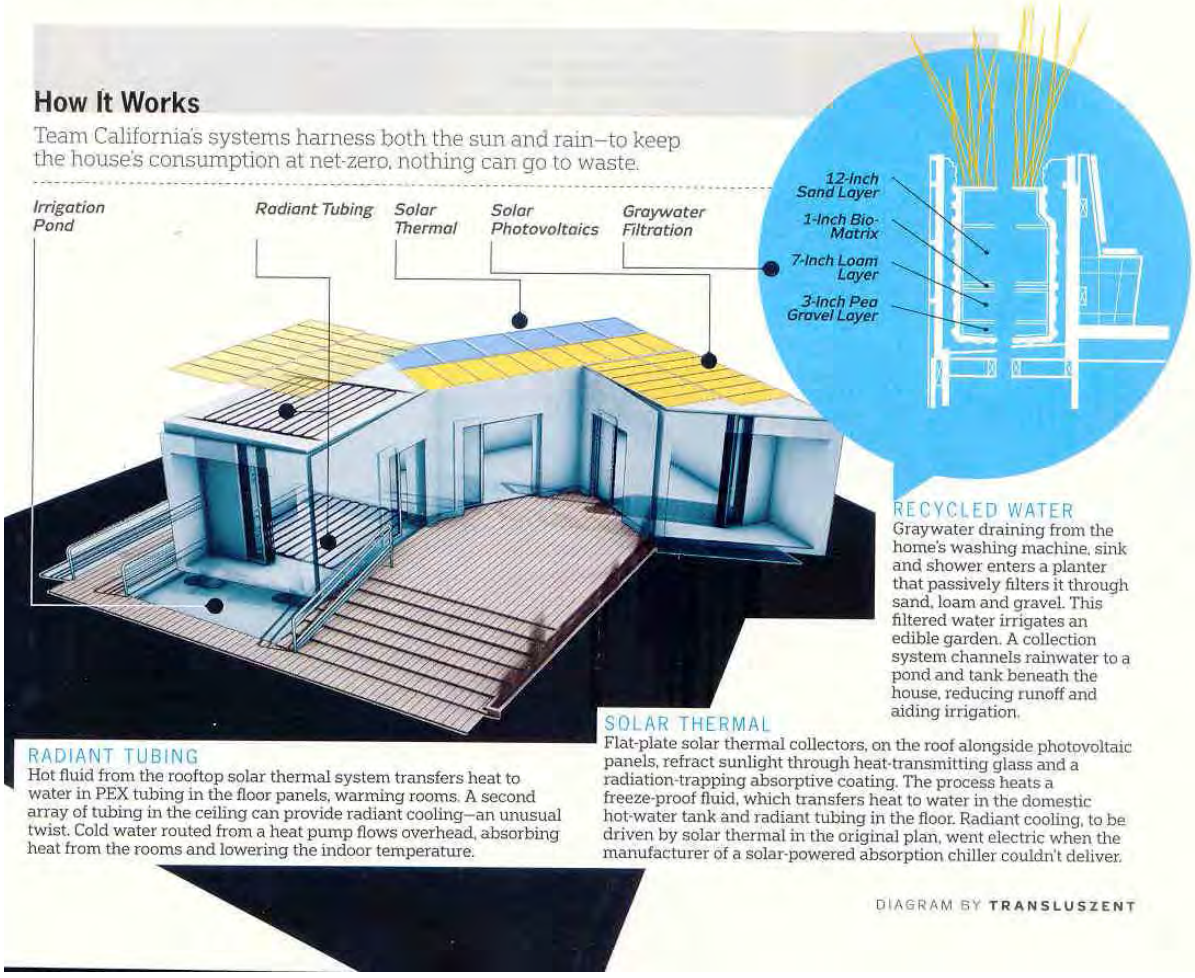
During the competition, the DOE will open the solar village's 20 homes for public tours from Oct. 9 to 13 and Oct. 15 to 18. On Oct. 14, expert judges in 10 categories—including architecture, engineering and market viability—will comb through each home, scrutinizing details down to the placement of the lighting. This year, there's an added twist: The houses will be plugged into the Potomac Electric Power Company's grid, where real-time meters will monitor both the amount of energy consumed and the power each home feeds back into the system. Nationally, meters like these could help utilities respond more quickly to power outages or prevent rolling brownouts. At the Solar Decathlon, they will keep score—50 additional points go to houses that generate more energy than they consume.

Team California's heating and cooling system may help the house hover near that perfect zero. "Doing all the heating and cooling with electricity would take a lot of power from our solar panels," 23-year-old thermal design leader Tim Sennott says. So the students drew up an elaborate system in which solar thermal collectors heat and cool the house through radiant tubing in the floor and ceiling. An energy-recovery ventilator maintains a constant indoor temperature and humidity, further reducing HVAC demands. "What we designed is a whole ton more complicated than something we would ever put in a residential home," Sennott says. "We're trying to do stuff with technology that's not mainstream yet." The tactic can be risky. In July, the supplier of the cooling system's solar-powered absorption chiller pulled out, leaving students scrambling for an alternative.

The Solar Decathlon has a precedent of such edgy approaches, according to its director, Richard King. Students in years past have adopted solar technologies that were

How It Works

Team California's systems harness both the sun and rain—to keep the house's consumption at net-zero, nothing can go to waste.



RADIANT TUBING

Hot fluid from the rooftop solar thermal system transfers heat to water in PEX tubing in the floor panels, warming rooms. A second array of tubing in the ceiling can provide radiant cooling—an unusual twist. Cold water routed from a heat pump flows overhead, absorbing heat from the rooms and lowering the indoor temperature.

SOLAR THERMAL

Flat-plate solar thermal collectors, on the roof alongside photovoltaic panels, refract sunlight through heat-transmitting glass and a radiation-trapping absorptive coating. The process heats a freeze-proof fluid, which transfers heat to water in the domestic hot-water tank and radiant tubing in the floor. Radiant cooling, to be driven by solar thermal in the original plan, went electric when the manufacturer of a solar-powered absorption chiller couldn't deliver.

RECYCLED WATER

Graywater draining from the home's washing machine, sink and shower enters a planter that passively filters it through sand, loam and gravel. This filtered water irrigates an edible garden. A collection system channels rainwater to a pond and tank beneath the house, reducing runoff and aiding irrigation.

DIAGRAM BY **TRANSLUSZENT**

Solar Scholars

Remarkable ingenuity defines every Solar Decathlon house. But these three standouts employ fresh technology and radical architecture to solve specific challenges.

BOSTON

Team Boston, comprising Boston Architectural College and Tufts University, wanted to keep its house's market price below $300,000. So students opted for a modular $200 Enphase micro-inverter—which converts DC into AC power—rather than a $3000 converter that typically handles the whole photovoltaic array. Ross Trethewey, the team's solar thermal engineer, also specified flat-panel thermal collectors at a third of the price of comparable evacuated tubes. "This isn't as flashy, but it's going to be affordable," Trethewey says, "and that's sustainable."

VIRGINIA

Sensors on the concrete floor inside Virginia Tech's house and a weather station on the roof detect temperature changes inside and out; a series of sliding panels, inspired by functional shutters, move across the front of the structure to adjust the interior climate accordingly. "The 'responsive architecture' strategy allows the user to easily manipulate shade and insulation screens to block harsh weather conditions, as well as open the house up when the weather is good," team leader Alden Haley says.

ARIZONA

The sun doesn't hit the top of a house at quite the same angle in Duluth, Minn., as it does in, say, Tucson, Ariz. So the University of Arizona's house has a pivoting hinge that can adjust the one-piece southern wall and roof assembly to catch rays at the optimal angle. An airflow channel and a layer of insulation beneath the panels lowers their temperature. "Rooftop surface temperatures around here can get up to 150 F or 160 F," project manager Matt Gindlesparger says. "PV panels are rated to tolerate even higher temperatures. But they're a lot happier when they're cooler."

"hardly even heard of at the time," King says. The competition gives the public a chance to see these new technologies work together as a system—some, like California's radiant cooling, for the first time.

Santa Clara's 2007 Solar Decathlon house, its boxy frame crowned with solar panels, stands a short walk from the current job site. In its sunny living room, sitting in a chair made from reclaimed wine-barrel staves, Anand pulls a tape measure from his back pocket and points to handsome bamboo joists along the ceiling. The 2007 team wanted to develop bamboo-based structural materials, he says. That idea caught the eye of the company Teragren, which sent unfinished bamboo for the students to test in a Tinius Olsen machine—a massive contraption that stresses I-beams to evaluate tensile strength and shear-load capacities. That year, underdog Santa Clara took third place. The students' joists, now certified under multiple international building codes, will soon be on the market.

"It's one thing to manufacture a product, but it's another to have it installed in a building that meets code," says Tom Goodham, Teragren's vice president of operations. "The beauty of putting products into an actual building is that it helps people understand it's not just conceptual. This is a material that's ready to be used, that can be integrated into design today." Working with Santa Clara on this year's house, Teragren revised the joist to create open-web floor trusses. The elegant, trestle-shaped bamboo beams have openings to run conduit, simplifying installation.

But really, all the cutting-edge technology eclipses the core challenge—building a house isn't easy. Try doing it on top of a full college course load. Despite the occasional decision Ruffoni describes as "so embarrassingly wrong that only students would do it," his teammate Anand credits their team's inexperience as a major asset. Unfamiliar with the sobering constraints of actual construction, he says, "The only thing we had to apply was creativity." **PM**

The Economist

OCTOBER 24TH–30TH 2009 Economist.com

Baosteel, the partly state-owned firm that is China's biggest steelmaker, paid A$286m for 15% of Aquila Resources, a producer of iron ore and coal. Most notably, Chinalco, a state-controlled aluminium firm, bought 9% of Rio Tinto last year.

But when Chinalco subsequently agreed to raise its stake to 18% as part of a $19.5 billion deal to bolster Rio's finances, the Australian firm balked at the last minute thanks to recovering commodity prices and hostility from shareholders. Instead, Rio and BHP agreed to merge their iron-ore operations in the Pilbara through a joint venture, creating just the kind of titan that China had feared when it opposed BHP's ultimately unsuccessful attempt to take over Rio last year.

Even before BHP and Rio decided to team up, China had been trying to undermine the pricing power of the big iron-ore firms. For decades the annual price-setting negotiations between the big suppliers and leading steelmakers had been dull affairs: prices rose only gradually. But China's sudden emergence as a big buyer of iron ore (it now snaps up more than half of all exports) pushed prices up fourfold between 2002 and 2008.

In past years the price agreed between one of the mining giants and the first big Japanese or South Korean steelmaker to strike a deal became the benchmark for all other buyers and sellers. In 2005, as a mark of China's importance, Baosteel took over as the principal negotiator. But it was still forced to swallow a succession of big increases in prices—72% in 2005, for example, and 96% last year for Australian ore.

In an effort to counter what China regards as the undue power of the mining giants, negotiations this year were handled by the China Iron and Steel Association (CISA), a trade body that supposedly represents the country's entire steel industry. CISA made it clear early that it wanted a cut of around 40% to reflect the toll taken on steelmaking by the economic turmoil. But increasingly acrimonious talks dragged on past a succession of deadlines until South Korea and Japan pre-empted China and agreed to a cut of just 33%.

Meanwhile cracks had already appeared in Chinese solidarity. As the economy perked up steel mills bought ore first on the spot market and later from the big three at a "provisional price" that exceeded what CISA was demanding.

Further grist was added in July with the detention of Stern Hu, the head of Rio's marketing operation in China, and three Chinese colleagues. They were eventually charged with obtaining commercial secrets, although Rio maintains that they were merely collecting commonplace commercial data. The arrests were widely interpreted as a signal that China was fed up with the miners' intransigence over prices and as a rebuke to Rio for pulling out of the Chinalco deal.

As negotiations over next year's price begin, China faces a bigger threat: the end of the benchmark system altogether. BHP has long wanted to replace the annual changes in price with quarterly ones, based on the spot market. Rio has recently come round to BHP's view, doubtless because it agrees that prices will rise steadily in the coming years and a quarterly system will allow it to increase prices more often. China, meanwhile, will find itself with even less sway over the price than when it began its campaign. ■

The rise of thin-film solar power

Leaner and cheaper

WASHINGTON, DC

The future of solar power is not only bright but also thin

THE modernist box that won this year's Solar Decathlon, a contest for solar-powered houses sponsored by America's Department of Energy, had solar panels of the conventional, crystalline sort on its roof. But the walls were covered in solar cells made with thin coatings of silicon and other materials in the place of expensive slices of crystal. Thin film, as this technology is known, is still less popular than crystalline cells and its move to the mainstream has been a year or two away for a decade. But its time may have come at last.

There are many exotic ideas involving thin film, from the solar shingles recently unveiled by Dow, a big chemical company, (a roof's worth costs $27,000) to experimental prototypes of power-generating clothes, roads and cars. But most thin film comes in the form of panels that resemble crystalline ones. They are roughly half as efficient (meaning that a panel must be twice as big to generate the same amount of power), but a third cheaper, watt for watt. So in places where there is no shortage of space, they are the natural option.

A bend in the mode

Thin-film cells are also more versatile, since they can be mounted on a variety of materials including flexible plastics and fabrics. Like all solar cells, they are becoming more efficient: the decathletes of Team Germany, who designed the winning house, bragged that its north façade was covered in panels that could convert even indirect sunlight into electricity.

Over the past year or so, thanks to a crash in demand tied to the recession and falling subsidies in big markets, the price of crystalline panels has fallen by 30-40%, undermining thin film's relative advantage. Nonetheless, thin film's share of the market has continued to rise: it is now almost half, compared with just 10% in 2004.

The biggest force in the industry is a firm called First Solar, based in Arizona, a sunny American state. Like that of virtually all alternative-energy firms, its share price has suffered in the recession. But it has nonetheless performed considerably better than Standard & Poor's clean-energy index over the past three years. Its gross margins in the first half of the year were over 50%, on sales of $944m. This month the firm was added to the S&P 500 stock-market index of America's biggest firms.

First Solar looks likely to continue to grow. Last month it signed a memorandum of understanding with China to install two gigawatts' worth of panels in Inner Mongolia—a place with plenty of space. That is enough to power 3m homes. Installation is due to begin next year and finish in 2019. That and other projects should consume all its output for several years to come.

First Solar's rivals are much smaller. But technological advances may yet catapult one to the fore, says Steve Milunovich, an analyst at Bank of America Merrill Lynch. First Solar makes its cells from a chemical called cadmium telluride. But firms such as Nanosolar, which is building factories in California and Germany, believe that a combination of copper, indium, gallium and selenium known as CIGS will prove cheaper to produce on a mass scale. Researchers at the University of California, meanwhile, hold out great hopes for cells made of organic chemicals.

For the moment, however, the cheapest form of solar power is none of these, but the less glamorous solar-thermal power, which involves heating water with sunlight to make steam. Utilities are also keen to use lenses to increase the amount of sunlight hitting solar panels—a technique known as concentrating solar power. They still need subsidies or a high price on carbon emissions to make investments in any sort of solar power profitable. But the gap between solar and conventional power sources is becoming, well, thinner. ■

Everything Under the Sun

Newsweek

October 16, 2009

By Daniel Stone

Energy Secretary Steven Chu argues that incentives for private-sector innovators are key to achieving breakthroughs in energy efficiency.

It's a statistic that the Department of Energy likes to hammer home: Forty percent of energy in America is consumed in homes and buildings, more than what is used by either transportation or industry. That number is the primary reason for the DOE's Solar Decathlon contest, a biannual competition on the National Mall that calls on groups of college students worldwide to meet a simple (or at least simple-sounding) challenge: with two years and $100,000, construct a fully operational house powered by nothing but the sun. There is only one winner each year, judged on more than a dozen criteria, from comfort to market viability, who receives substantial bragging rights.

The contest, which began in 2002, is a sign of an important shift. Since the mid-1970s, the task of figuring out how to use energy in the future has fallen to the National Renewable Energy Lab in Colorado and the handful of other DOE labs around the country. But a climate bill up for debate by the Senate would substantially shift incentives, rewarding *private*-sector thinkers for coming up with new ways not just to create energy, but to maximize its effiency. Energy Secretary Steven Chu thinks that government labs and public universities will always be valuable research centers, but that the ingenuity of innovative thinkers who don't work for the government will shape the future. During a break from touring the new batch of Solar Decathlon homes, Chu sat down with NEWSWEEK's Daniel Stone. Excerpts:

What impresses you most about these students' housing designs? To have students get into the idea of doing something that stretches their ingenuity is ultimately good for everybody. I would hazard to guess that projects like these have more educational value than your standard class.

What does it mean that these enhanced innovative models have begun to come from private people—from students and people outside of government labs? What it means is that we're going to have another generation of engineers who can actually design things. Housing of the future is going to be very high tech, things that take full advantage of sensors and technology and computers. We've seen it in cars, how computers are constantly tuning up the car, deciding what the engine needs, when you fire the spark plug, or how much fuel you need. But you can really go to town on a house. As we begin to look at what you can actually do both in the home and in the business in terms of managing energy use and efficiency, and even having design tools, you can imagine, within five years or even less, having tools for buildings that have automatic energy analysis embedded in [them] to calculate energy use for you.

The National Renewable Energy Lab does a lot of this work, but now, some of this work is being done by whoever has enough ingenuity or drive to ask new questions. Are there implications of shifting research centers? Good ideas [on energy efficiency] come from a wide range of sources. We have a National Renewable Energy Lab and we have universities. Today in the universities, it's not unusual to have a curriculum and a set of courses or researchers actively engaging on energy efficiency and researchers actively trying to build the next generation of photovoltaics and sensors. But the fact that other groups, like these students [competing in the Solar Decathlon], get together with good ideas speaks well to the entrepreneurial spirit of the United States. These are the people [who], in several years, I can see starting companies and making renewable energy their business.

As little as 10 years ago, there weren't many public incentives to start those kinds of companies. That's true, but I think we still need federal funding in universities and national labs. What you're seeing is people beginning to realize that this could be a business. It not only can be a business, it will be the business going into the future. We will need a new industrial revolution. We've already had one. The next one needs to give us that same prosperity, but in a carbon-free way.

In the context of the climate bill the Senate will soon be discussing, what do you see as the top priorities to reach that new breakthrough? We need a comprehensive energy bill, and that means several things. We want more energy efficiency. And for most Americans, we want to make this as painless as possible. We want to create a structure where there are credible contractors [to help maximize efficiency] who will actually help you save money. The second part is that you want to give incentives so that companies will develop a new generation of wind turbines and photovoltaics. If we're going to continue to use coal, we'll have to find a way to capture that carbon. The third part is very important and is a long-term signal. As we learn more and more about climate change and its catastrophic effects, we'll need to tell the world that there has to be a cap on carbon and it has to ratchet down. It's a long time horizon. So the most important part of a comprehensive energy bill is that long-term signal.

Do you see those signals as the best way to push people toward new projects and energy efficiency research? I think once you send these long-term signals, there's an incentive for new businesses to make money. That's a powerful incentive. If you know you can not only be gainfully employed, but employed in something you deeply believe in and something which will help save the planet, that's quite an incentive. Oh, and by the way, you can get rich, too.

NationalJournal.com

Solar Decathlon Shows Off Bright Ideas
National Journal.com
Wednesday, October 14, 2009
By Emily Vaughan

As energy policy stands poised to be the next big fight on the Hill, a competition to design a piece of its future is playing out a few blocks away on the National Mall.

In the Solar Decathlon, a competition sponsored by the Department of Energy, teams from 20 universities in four countries build houses powered entirely by the sun. The contest is designed to prove that solar houses have moved beyond the ugly 1970s stereotype and to educate homebuyers and builders about solar's potential to create energy-efficient and livable houses, said Director Richard King. "We wanted to challenge the architecture on how to build a beautiful home," he said. "There are still a lot of homeowners associations that say, 'We don't want that in our neighborhoods.'"

The Department of Energy aims to have marketable zero-energy homes ready by 2020, and solar is going to be a big part of reaching those goals. "It goes with a house so well," King said. "Sunlight is free out there, but once it hits the ground, it's gone.... A house is a perfect collector."

This is the fourth Solar Decathlon; the first was in 2002. Teams made up of undergraduate and graduate students convene on the Mall to create a "solar village" that's open to the public for 10 days in October. The teams put their homes through a series of tests, such as doing loads on laundry and cooking meals, and go through rounds of judging on 10 different aspects, from engineering and lighting design to market viability and communications. King called the competition "part beauty contest, part performance."

For the first time, this year's houses are bi-directional: They feed into Washington's power grid when they're producing more energy than they need, and they draw on the grid when sunlight isn't as abundant. The goal, King says, is to come out net zero at the end of the day. Commercial homes would work the same way: The give-and-take depending on the available sunlight should yield net-zero use at the end of each month. For the competitors, any surplus energy the houses create ups their score.

The contest has drawn lawmakers down from the Hill to support schools and students from their districts. On Tuesday, Rep. Mike Arcuri, a Democrat whose upstate New York district is near Ithaca, toured Cornell University's "Silo House" to see how the students captured the region's aesthetic. Sen. Daniel Akaka, D-Hawaii, also stopped by Silo House, whose team has three Hawaiian students.

The exhibition "has opened my mind to the practical uses of solar," Akaka said. He noted the multipurpose design of Silo House, such as the bed that can be raised to the ceiling to create more floor

space during the day. Solar energy would be very applicable in a sunny state like Hawaii, he said. "This is the year of alternative energy," he said.

Arcuri was equally impressed, if less optimistic about solar power's national application. "There are limitations to solar in upstate New York," he said. "You don't get that kind of sun." Plus, he said, the technology is still not cost-effective enough.

Some teams tried to address the cost issue, the most effective being Rice University, whose "Zerow" house will find a permanent home in Houston's poverty-stricken Third Ward after the competition. Zerow was the least expensive house, costing just $140,000 to construct. With pre-fabrication, production costs can be reduced by 40 percent, said team member North Keeragool, an architecture graduate student. The team's goal was to look at what a real homeowner could afford, he said. Rice came in second in the market viability category.

Team California's "Refract House" leads overall by a slim margin, having won for architectural design and communications and placing third in market viability. But with only half of the competition's 1,000 points awarded, it is still anyone's game, King said. The overall winner will be announced Friday morning.

Solar Decathlon Promotes Sunnier Future

SciAm.com

October 8, 2009

By David Biello

Homes are rising on the National Mall in Washington, D.C. No, it's not a return of Hoovervilles thanks to the Great Recession. These are solar homes competing in the U.S. Department of Energy's Solar Decathlon, which starts October 8.

From Cornell University to Virginia Tech, 20 student-run teams have designed homes that will be judged on 10 fronts: from lighting to how energy efficient the cooking can be—as well as the washing up afterwards.

The homes incorporate the latest technology: an iPhone app to control windows described to me by Team California co-leader Allison Kopf. Smart energy meters that can communicate with the grid employed by returning 2007 champions Technische Universitat Darmstadt.

I'm personally rooting for Team Missouri. It's where I grew up and it's not typically known for its solar technology.

The winner will be announced Friday, October 16, but in many ways it doesn't matter who takes the glory. Homes eat up 20 percent of U.S. energy use and companies are donating their products to the students to prove their real world energy efficiency. The true winners will be the homeowners putting some of these energy efficiency and solar technologies to work tomorrow.

Shine some sunshine on gambling
DailyKos.com
October 12, 2009
By A. Siegel

Members of Congress bet all the time as the U.S. Congress is often the site of friendly (sometimes not so friendly) wagering, when rival teams meet each other in important events.

This occurs around University football games, World Series, the Superbowl, March Madness, and other competitions. Right now, there is a 20-team competition underway almost literally in the shadow of the US Congress and, yet, there seems to be nearly zero attention from Members of Congress and, as far as can be told, no friendly (or less than friendly) wagering going.

The Decathletes from around the United States (and Spain, Germany, and Canada) are serious in their endeavors, creating top-notch products competing across 10 different categories from electrical power generation to architectural design. This is an event attracted 100,000s of thousands of visitors, a number of on-scene people that easily rivals the sports events that generate that Capital Hill wagering.

In contrast to those sports events (and despite mythic views of sports), The Solar Decathlon has the potential for truly changing lives and America's future prospects. It is an event meriting attention and focus from Members of Congress.

As we look to paths to confront the challenges and seize the opportunities created by Climate Change, and attempt to set a path forward where America is a leader and winner (rather than follower and economic loser) in the green energy revolution, The Solar Decathlon is the sort of event and environment that merits significant attention -- attention that Members of Congress simply don't seem to be giving it.

Multiple searches of the U.S. Senate website, for example, showed zero references to the 2009 Solar Decathlon. In 2007, Senator Bernie Sanders (I-VT), whose state did not (and does not this year) have a contesting team, visited the Decathlon. (Nothing from Bernie yet this year, but it would be surprising if

he didn't take a stroll down to the Mall to do some house site seeing. A question to ask: Who will join Bernie?)

Sticking with the Senate, there is serious discussion about climate legislation (with the introduction of the Kerry-Boxer Clean Energy Jobs and American Power Act) with many (far too many) Senators sitting on the fence, evidently unconvinced that actions to mitigate climate change won't only reduce risks but create new (and exciting) economic and social opportunities.

Perhaps some attention to events on The National Mall might help them readjust their thinking.

Could Senator Kerry (Team Boston) ask Senator McCain (Arizona) to join him for a stroll on the Mall? (Perhaps making a wager as to having to wear the team t-shirt for a day dependent on which ends out ahead.)

Could Senator Boxer (Team California) send a Twitter note to Senator McCaskill (Team Missouri) making a boast that California's solar production will top Missouri's this week?

Perhaps Senator Kerry (Team Boston) could challenge Senators Webb and Warner (Virginia Tech), wagering some clam chowder against crab soup.

There are teams from Ohio, Wisconsin, Illinois, Kentucky, Massachusetts, Virginia, Louisiana, California, Missouri, Texas, Iowa State, Minnesota, Arizona, Pennsylvania, and New York. The range of betting pool opportunities, with ten different competitions, are pretty staggering in numbers.

To be honest, encouraging gambling habits isn't a normal practice but this is a case where it would be great to see some heavy (and heavily publicized) betting going on.

Sadly, there are many excellent Decathletes whose Senators are essentially irrelevant to this conversation. David Vitter (R-LA) certainly won't and Mary Landrieu (D-LA) likely won't support meaningful action and 'beautiful sun' ('BeauSoleil') likely won't affect them. (Though note that Senator Vitter visited BeauSoleil on Oct 8.) Does any truly expect John Cornyn or Kay Bailey Hutchison (Rs, TX) to stand up for the planet and humanity's future prospects. Thus, Rice University's excellent house might not get a Senatorial visit. Jim Bunning and Mitch McConell (R-KY) are even less likely to work for sensible energy policies, thus S*KY Blue won't get the Senatorial attention it merits.

Now, one Senator has chosen to pay attention to events on the Mall and issue a challenge. Senator Robert Menendez (D-NJ) has issued A Challenge to Universities. He opened with a strong statement of praise and support for The Solar Decathlon.

Every two years at this time of year, an exciting thing happens on the National Mall in Washington D.C.: the Department of Energy's Solar Decathlon. It is a competition in which universities from around the globe compete to design, build, and operate homes powered solely by the sun. This year's competition,

like every past competition, features no representation from New Jersey universities. As a leading supporter of solar power in Congress, I know well that our state is a world leader in solar technology. That's why I think it is high time that our state's renowned educational institutions show that they too are world leaders in solar technology.

The deadline for applications for the 2011 Solar Decathlon is coming up fast, 17 November. Senator Menendez lay down a marker for NJ's educational institutions:

I hereby issue a challenge to New Jersey's universities and colleges to enter the 2011 Solar Decathlon.

If there is a New Jersey Decathlon entry in 2011, it seems clear that Menendez will be laying down some bets.

The nation would be better off with more attention to the Decathletes -- and some betting might help foster that attention.

Thus, come on Senators, PLACE YOUR BETS ... time is running out.

20 Teams Build High-Tech Houses in “Solar Village” Competition

Popular Science.com

October 16, 2009

By Rebecca Boyle

The National Mall was transformed into a futuristic commune for the past two weeks as 20 teams from four countries erected solar-powered homes

Team California's "Refract House" *Stefano Paltera/U.S. Department of Energy Solar Decathlon*

The bright future of green living has been on display for the past two weeks at the National Mall in Washington, D.C., during the Department of Energy's 2009 Solar Decathlon. The biennial contest, which wraps up this weekend, brings hundreds of university students from around the world to a temporary solar village for two weeks, where spectators can walk through student-designed houses and marvel at the latest green tech.

These solar homes have it all, including things that aren't commercially available yet -- like self-activating curled-metal shades; walls made of plants, both living and recycled; and roofs that tilt at the sun, making them efficient sun-catchers from Phoenix to Fargo. Worried about efficiency while you're away? How about an iPhone app that controls your entire house?

Teams include engineering, architecture, graphic arts and marketing students, who typically wouldn't work together until they reach the workforce.

Team Germany's "surprising" design took first place overall, partly because their house performed so well in the net metering contest, which measured how much net energy the house produced and consumed throughout the competition. The house had solar panels on the walls as well as the roof, which improved its performance even with cloudy conditions. Team Germany scored 150 of 150 points in net metering, catapulting them over the University of Illinois at Urbana-Champaign to win the title.

Aside from being an unrivaled educational opportunity, the decathlon is a proving ground for a new generation of energy-efficient products and designs. Some, like floor heating tubes warmed by the sun, seem so obvious it's a wonder every house doesn't already have them; others are most certainly modern.

A few stand-outs:

- Team Arizona's hinged roof, which moves to match the angle of the sun's rays
- Team Missouri's eco-roof and wall materials, harvested from crops grown in the state, including sorghum and oak
- Team California's instantly-hot showers, which work by circulating water through a heat pump activated by a bathroom motion detector
- Team Boston's micro-inverters, which power a few solar panels each and cost a fraction of the price of a regular photovoltaic electricity converter
- Team California's and Virginia Tech's use of iPhone apps to control the homes' solar-electric, entertainment, heating and lighting systems
- Team Boston's windows, developed with Hunter-Douglas, which combine gas, gel and air layers to form a heat-absorbing wall when the sun hangs low in the winter; heat radiates throughout the house when the sun sets.

"You learn skills like communicating, team-building, executing, all these things -- we call it Startup 101," said Preet Anand, a senior at Santa Clara University in Santa Clara, Calif., who is the lead water engineer on Team California's Refract House. "What we have learned ... you can't compare that to any other college experience."

Part of the decathlon's mission is to speed up delivery of emerging technology to the marketplace. Several teams worked with companies in their home states to invent new materials or products, some of which are awaiting new patents.

Valence Energy, a company comprised of Santa Clara University alumni who participated in the 2007 contest, helped Team California design a whole-house control system that can be operated via an iPhone app, Anand said. Lighting, entertainment, heating and water systems, even the window shades all connect to a master computer users can access remotely.

"They helped make everything talk to each other. So you can be on the iPhone or the Web site, and you can change the temperature of your house from the car on the way home," he said.

Iowa State University's team worked with a firm called AccuTemp Energy Solutions and with Pella, the window and door manufacturer, to create a better-insulated door for its Interlock House.

Timothy Lentz, a mechanical engineering graduate student at Iowa State, said the door uses vacuum insulation panels to reach an insulation value of R40 -- the level of a typical ceiling, and an unheard-of rate for a door.

"This makes it almost a wall," Lentz said.

Incidentally, many homes are so well-sealed that special ventilation systems also had to be invented. Team Alberta, comprised of students from four post-secondary schools in the Canadian province, designed a hot and cold air exhaust system that saves as much energy as possible. An energy recovery ventilator, which is basically a box fan covered in a special material, allows heat transfer between outgoing and incoming air.

"In old homes, you don't need to worry about mechanical ventilation because the homes were so leaky. That is not really true in newer, high-performance homes," said Michael Gestwick, who is pursuing a master's degree in environmental design from the University of Calgary. "Our system is highly integrated, where many other systems that you'll see are kind of decoupled -- you have one system to do the heating, and a separate one for the cooling, and a ventilating machine on top of all that. We took all these pieces and put them together and wrote control logic to make it work together."

The teams all spent about two years designing, planning and building their homes. Each house had to be assembled at its respective university, taken apart to be trucked to Washington, and re-assembled on the Mall before the competition began. The houses all feature the latest energy-efficient appliances and home entertainment systems -- teams must cook, do laundry and host movie night, among other typical household activities. The 10 categories are meant to prove that solar homes can not only be cool and efficient, but comfortable and livable.

Some teams took the latter to heart, knowing many eco-conscious consumers might not want to live in a house resembling something out of the Jetsons.

"The other houses, while they are really cool and have all the bells and whistles, they kind of look like a spaceship. They wouldn't really fit in areas that we think of, like mid-size Iowa towns," Lentz said.

The Iowa State house resembles a ranch-style home sliced in half, with a roof that slants toward the sun. Others took it even further -- the University of Minnesota and University of Illinois Urbana-Champaign teams designed homes with traditional-looking gabled roofs, even opting to sacrifice energy-collection capacity for the purpose of aesthetics.

Form versus function is always cause for debate in architecture; Jeff Stein, dean of Boston Architectural College, part of Team Boston, said the decathlon provides a new way of thinking about both. He noted that in Western society, people spend an average of 72 minutes a day outdoors.

"Buildings are hugely important, and they are way more important than the amount of attention we've been giving them in the last generation. Now, here comes a different way of thinking about them, and the solar decathlon is a trigger for making that (transformation) come into play," he said.

Plus, it will help students find jobs. Lentz, from Iowa State, said he wants to work in the realm of building and energy efficiency.

"There is a lot of room for improvement there," he said. "I've met a lot of people who donated products or services who keep asking, 'When do you graduate?'"