A Watershed Moment

BY THE UNIVERSITY OF MARYLAND SOLAR DECATHLON TEAM

The winner of the 2011 Solar Decathlon offers an educated glimpse at tomorrow's environmentally sensitive, energy-smart homes

The Chesapeake Bay is the largest estuary in the United States. Unfortunately, this beautiful body of water, whose drainage basin has origins in Washington D.C. and five states, is threatened by pollution from storm-water runoff, electricity generation, wastewater treatment, and agriculture.

Using this important yet troubled ecosystem for inspiration, our interdisciplinary team from the University of Maryland (2011.solarteam.org) designed an affordable, net-zero-energy home named WaterShed to compete in the U.S. Department of Energy Solar Decathlon. Our house beat 18 other entries from across the United States and five countries in the biennial event held on the National Mall in Washington D.C. (sidebar facing page).

Our 876-sq.-ft. home is designed around two rectangular, shed-roofed forms. One contains the kitchen and the dining and living spaces, and the other a combination bedroom and home office. These two independent house sections are connected by the bathroom, which creates a focal point of the design. Adding to the drama is the view of the constructed wetlands from the bathroom's floor-to-ceiling windows. The constructed wetland collects water from the two inward-sloping shed roofs and filters gray water from inside the home. The result is irrigation water for the garden and a home with a beneficial impact on the Chesapeake and its ecosystem.

A 9.2-kw photovoltaic array meets WaterShed's energy demands year-round, with excess power sold back to the electric utility. Simi-

Drawings facing page: courtesy of University of Maryland Solar Decathlon Team

WINNER SOLAR DECATHLON 2011

The shed in WaterShed. *A pair of shed roofs funnel rainwater toward the constructed wetlands below. Because they're separated in the middle, the shed roofs resist debris and ice buildup better than a conventional butterfly roof, which is connected in the center.*

The Solar Decathlon challenges collegiate teams to design, build, and operate solar-powered houses that are cost-effective, energy efficient, and attractive.

Since its inception in 2002, the program has involved 15,000 students and 91 homes. Students are awarded up to 100 points for each of the event's 10 contests, which include:

AFFORDABILITY Teams earn the maximum number of points for building homes that cost $250,000 or less. A sliding scale applies to teams whose construction costs range from $250,001 to $600,000.

ARCHITECTURE Homes are judged on both aesthetic and functional elements. Contestants (described as decathletes) must also prepare an audiovisual presentation to reflect the final design.

COMFORT ZONE Teams are charged with keeping their homes' indoor temperature between 71°F and 76°F and humidity lower than 60%.

ENGINEERING Teams are judged on their designs' efficiency, innovation, reliability, and documentation of energy systems.

COMMUNICATIONS Decathletes develop communication plans, lead tours, and produce a website describing their home and its attributes.

APPLIANCES Teams are awarded points for keeping their refrigerators cold, washing and drying loads of laundry, and running a dishwasher. Appliance usage in an average American household provides a basis for comparison.

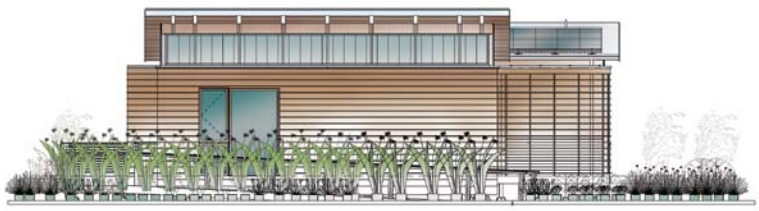
HOME ENTERTAINMENT Decathletes use their homes' photovoltaic system to power lights, a TV, a computer, and a kitchen appliance to boil water.

HOT WATER Hoping to deliver 15 gal. of hot water in 10 minutes, teams use their homes' solar-hot-water systems for shower tests.

ENERGY BALANCE Teams earn points for producing as much power as their homes will use during the week-long event.

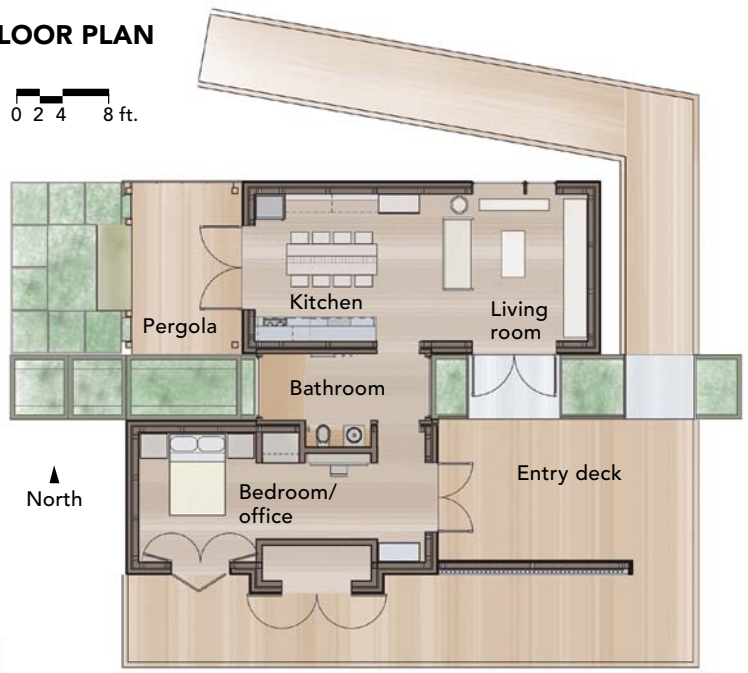
MARKET APPEAL Even the best-designed solar home won't be successful if it can't be sold, so teams are evaluated on their homes' livability, marketability, and constructability.

NORTH ELEVATION



EAST ELEVATION

FLOOR PLAN



larly, the evacuated-tube solar-thermal system produces hot water for inside the house at the same time that it forms a wall that gives privacy to the outdoor space. Two patent-pending liquid desiccant waterfalls use lithium chloride to absorb excess humidity directly from the air without a compressor and refrigeration cycle. This reduces the load on the already highly efficient minisplit-heat-pump heating and cooling system. Excess thermal energy from the solar thermal collectors heats the liquid desiccant outside the building and releases the excess moisture to the outdoors.

The home's 13-in.-thick building envelope and unique structural framing system look great without sacrificing thermal efficiency. Reinterpreting traditional stick-frame construction, WaterShed replaces 16-in.-on-center single wall studs with triple 2x6 framing 4 ft. on center. This reduces thermal bridging, or heat loss through framing members, by creating longer spans of interior spray-foam insulation. With two additional layers of extruded polystyrene insulation on the exterior, WaterShed's walls have an R-value of 44. The roofs have an R-value of 48, and the floors are R-33.

Good design is only one of the challenges. These homes from across the globe must consist of 600 to 1000 sq. ft. of conditioned space. They're disassembled, transported to the nation's capital, and reassembled in eight days before going on display to the public.

The Solar Decathlon consists of 10 contests, judged and measured over a 10-day period. Design and industry professionals subjectively judge four of the contests: architecture, engineering, communication, and market appeal. An affordability contest, in which WaterShed's cost was estimated to be around $335,000, ensures that the designs are

One bath in between. *The home's two shed-roofed main forms are connected by the bathroom. Floor-to-ceiling windows look out on the constructed wetland that treats the home's gray water and roof water. The water is collected for irrigation and other nonpotable uses.*

A flexible floor plan. *WaterShed's wide-open interior allows homeowners to age in place and entertain comfortably. Finishes and details are modern, but traditional elements, such as the exposed framing, are mixed in.*

Hot water from the sun. *A 42-tube solar collector produces heat for domestic hot water, and a pair of liquid-desiccant waterfalls control humidity in the house. The patent-pending dehumidifiers were developed at the University of Maryland by its 2007 Solar Decathlon team.*

Mission control. *Solar-thermal, photovoltaic, and HVAC systems are monitored and adjusted inside the especially tidy and quiet mechanical room.*

A tight shell. *WaterShed's R-44 walls have 4 in. of rigid insulation outside the framing and 5½ in. of spray polyurethane on the inside. The studs are spaced 4 ft. on center for less heat loss through the framing.*

practical in today's market. Additionally, five measured contests—ranging from comfort to home entertainment—are devised to test the livability and performance of the houses.

Our team placed first in architecture and finished in the top four in all the juried contests. Our house achieved net-zero energy use despite the unusually cloudy skies and a *Fine Homebuilding* editor who turned on every light in the house during a photo shoot. WaterShed also placed first in energy balance and hot water, second in appliances, and third in comfort zone and home entertainment.

While our team is proud to take home a first-place honor, we are even more proud that we can share our design with the world. We hope the exposure will allow us to educate the public further and encourage homeowners, builders, and designers to build energy-efficient, beautiful homes with a minimal impact on the natural world. □

The 2011 UMD Solar Decathlon team includes 200 students from more than a dozen disciplines. Photos by Patrick McCombe.