

Penn State

The Penn State team members see their house as leading the way in affordable and durable housing with energy-efficient solutions, while introducing a new day for sustainable design within global communities. The team built two homes for the Solar Decathlon—one for the competition, MorningStar Pennsylvania, and one for a community, MorningStar Montana. The MorningStar concept was tested with the competition's sister home, MorningStar Montana, built in June/July 2007 on Chief Dull Knife College, Lame Deer, Montana. Widespread implementation of this highly marketable venture is currently being successfully implemented with the Northern Cheyenne community as the future of building homes on the reservation.

What's Different?

- An independent, dedicated DC/LED lighting power system eliminates conversion losses from AC to DC by inverters. Power for the DC/LED system is provided by solar slates on the east and west facades of the living space and stored in a sealed lead-acid battery bank.
- The Energy Dashboard is a digital interface between the home and the occupants; it informs them of their energy usage and production patterns and how their lifestyle choices affect energy usage.
- Multiple arrays provide power from the roof, east, and west facades where the power is diverted directly to the loads, therefore storing only the excess energy.
- The team's Web site is designed to allow for easy translation by native speakers to view the pages in Spanish, French, and German for those inhabitants of the world who do not speak English as their first language.
- House tours in Spanish will be offered daily to promote the Solar Decathlon to diverse communities.

Architecture and Interior Comfort

- The MorningStar concept is a “house next door” prototype that addresses the requirements to sustain life in a three-part approach: (1) the living space (heart of the home) is an open plan bathed in natural light in strategic locations and contains the dining/living room and bedroom; (2) the technical core (the brain of the home) is a prefabricated-systems unit for transportability and contains mechanical, kitchen, and bath; and (3) the breezeway (the lungs of the home), the area for movement based on its axial east/west orientation between the technical core and the living space, contains the entryways.
- The layered southern façade on the MorningStar Pennsylvania is an occupant-operated mobile energy membrane between the interior and exterior living space.
 - o Exterior: Sliding panels are composed of local recycled steel and white oak, sustainably harvested from Penn State; triple-glazed, argon-filled windows have low-e coatings; and Pennsylvania black slate is attached to structural insulated panels.
 - o Interior: Thermal blinds are a cellular, quilt-like fabric that electronically adjusts to cover windows; a milk bottle wall, composed of local recycled steel and glass bottles, slides in front of the glazing for effective light diffusion.
- Supporting the concept of adaptability, the competition home develops a vernacular architecture through “materials of opportunity” characteristic of central Pennsylvania: Pennsylvania black slate (which historically influenced U.S. architecture; Pennsylvania bluestone (a nationally sought-after material); Pennsylvania recycled steel (represents PA's steel industry); native hardwoods (celebrates PA's forests and skilled craftsmen); and a milk bottle wall (displays the significance of dairy to the state).
- An interior “moveable wall” in the living space provides spatial adaptability between the bedroom and the dining/living room by shifting east/west to adjust the size of each room based on occupant preferences.
- Sustainable site design demonstrates how technologies are critical, both as integral facets of an energy-saving residence and as a nurturing and enriched ecosystem. The site presents homeowners with several alternatives to the energy-consumptive turf lawn, including: rain garden, meadow garden, Audubon garden (attractive to wildlife), and bio-intensive vegetable garden.

Heating and Cooling Systems

- The MorningStar concept includes passive solar by incorporating high thermal mass to reduce heating and cooling loads.
- A radiant floor and shower wall system allows for efficient delivery of heat for the MorningStar Pennsylvania's largest energy load.
- A ground source heat pump heats and cools while scavenging for waste heat.

- Advanced direct digital controls allow for optimized performance and adaptability to study different building control strategies.

Lighting (including Daylighting)

- Daylight enters the home through the clerestory windows on the north side, the long vertical windows on the south side, and through the three skylights that create a north axis.
- An independent, dedicated DC/LED lighting power system eliminates conversion losses from AC to DC by inverters. Power for the system is provided by Solar Slates on the east and west facades of the living space and stored in a sealed lead-acid battery bank. The LEDs are linked to streaming weather data and housed within polycarbonate glazing panels to glow based on the next day's weather predictions.
- Full-height vision glass enables occupant interaction with the interior and exterior of the home with the natural environment and full distribution of daylight.
- A radio-based lighting control system installed in the living space provides ease of operation, flexibility, and energy efficiency and can be controlled manually or remotely via the Internet.
- A variety of energy-efficient luminaires are featured: LED strip and spot fixtures, low-voltage decorative pendants, surface-mounted linear fluorescent up-lighting strip fixtures, and an LED desk lamp.

PV and Solar Thermal

- The fixed PV array provides the main source of energy for the MorningStar homes. An adjustable PV array allows for seasonal adjustments of a smaller array on the MorningStar Pennsylvania home.
- The unique Solar Slates, which clad most of the east/west facades of the living space, provide power for the dedicated DC/LED lighting power system for all LED lights.
- An evacuated-tube array generates hot water for domestic use.

Communications

- The Web Site is the prime vehicle for distributing media content: video tours, a photo album, and downloadable documentation, drawings, and renderings of the two homes. The team created an interview that each core team member completed, to establish a more personal connection between themselves and Web site visitors.
- Handouts are postcards made of 100% recycled cardstock and soy-based inks that are manufactured using wind power and that feature an integrated, detachable seeded paper cutout of the home.
- The house tour concludes with a station for all those bursting with questions, where knowledgeable Decathletes can provide answers.

Budget

- Internships and courses projects: \$200,000
- Construction, including materials and transportation, of MorningStar Pennsylvania: \$350,000.
- Actual cost of constructing MorningStar Montana: \$110,000.

Future Plans

- The competition home will return to Penn State to be integrated with current efforts to "green the campus." The permanent facility is located on the 9-acre Center for Sustainability site adjacent to the new minor league baseball stadium (Medlar Field) and 400 yards from Beaver Stadium.
- The home will then serve as a renewable energy laboratory and educational facility to provide useful information to Pennsylvania residents and visitors to Penn State regarding the economic feasibility and energy effectiveness of various technologies.

Kid's Corner

- A LEGO model of the MorningStar Pennsylvania, the competition home, and a miniature fuel cell toy car will be on display and used as an added incentive for the children at the Educational Kiosk.

Team Information

Web site: www.solar.psu.edu

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