
What the Japan Disasters Mean for PV page 10
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LEADING THE RENEWABLE ENERGY REVOLUTION
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North Carolina Visitor Center demonstrates the comfort and beauty of sustainable design.
SunShot Technologies Target Low-Cost PV page 38
Simplifying Solar Approvals page 42
Innovators: The Brothers Behind SolarCity page 22
SOLAR 2011 Products Preview page 60
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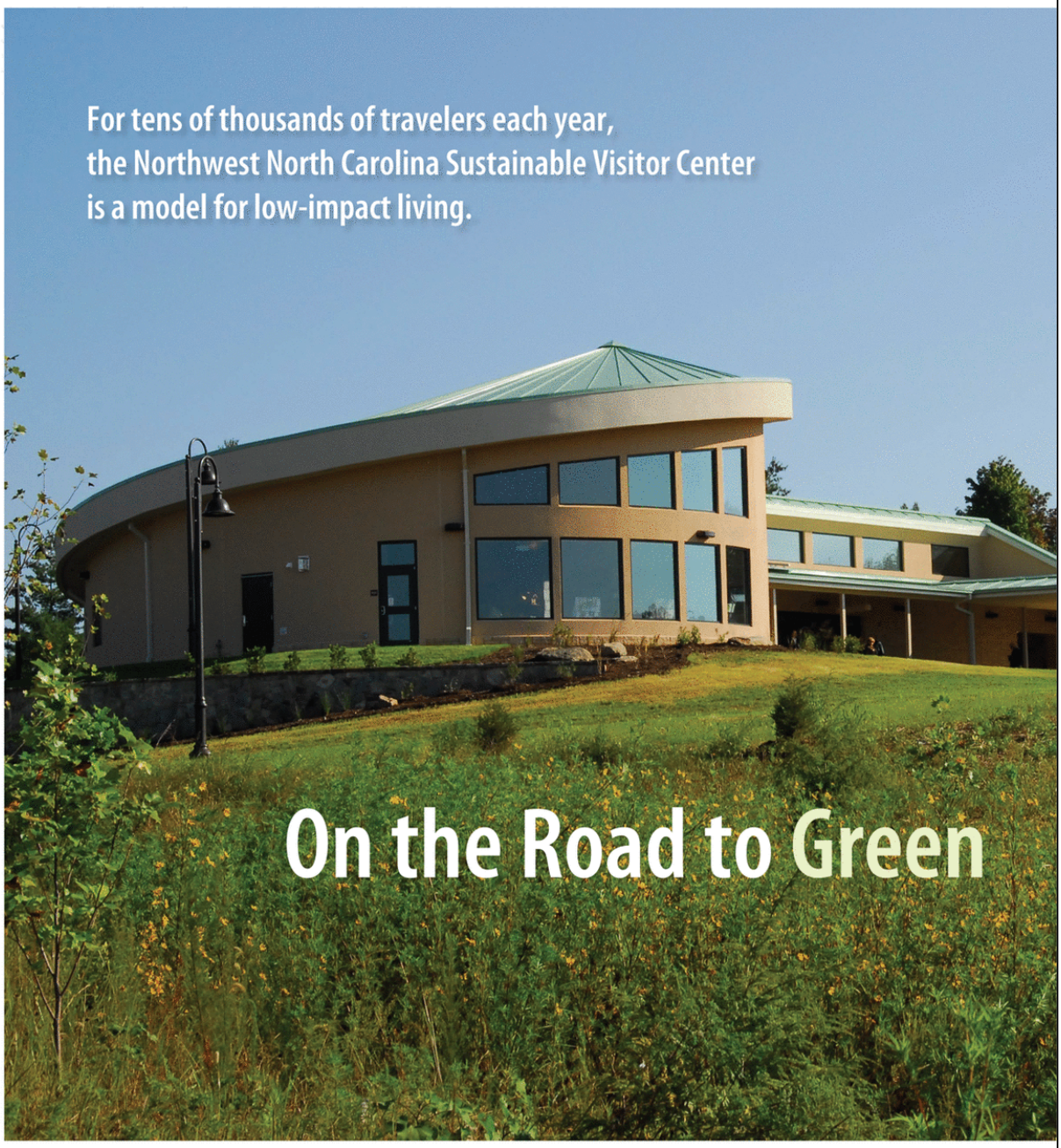
case study



For tens of thousands of travelers each year, the Northwest North Carolina Sustainable Visitor Center is a model for low-impact living.

On the Road to Green

INNOVATIVE DESIGN

In designing the visitor center's unique snail-shell spiral geometry, the design team was inspired by snails found on the ground during site selection. This organism seems an apt symbol for sustainability design in that its habitat represents a delicate balance in nature.

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By **MIKE NICKLAS, FAIA**

My architectural firm, Innovative Design in Raleigh, N.C., takes great pride in designing energy-efficient, environmentally sound buildings. But in our 33-year-history, we've rarely had a client that faced such challenges:

- "Though we will only need about 8,500 square feet (790 square meters), we expect more than 40 visitors per hour, 24 hours a day, all year long."
- "Other facilities in North Carolina like this one consume 146,900 British thermal units (Btu) per square foot per year and hundreds of thousands of gallons of water annually."
- "Half the building will require 100 percent outdoor air, parking and roads will cover half the 22-acre (9-hectare) site, and there will very likely be hazardous chemical spills — but we really do want to be green."

The client that brought these challenges was the North Carolina Department of Transportation. It was NCDOT's first attempt at pursuing a more sustainable design strategy in constructing one of its roadside rest areas and visitor centers. The facility, now LEED Gold-rated, is the Northwest North Carolina Sustainable Visitor Center, located in Wilkes County, N.C. NCDOT is now pursuing green strategies at its other facilities and, more importantly, utilizing the Northwest Visitor Center as an experiential learning opportunity for visitors.

NCDOT Secretary Gene Conti highlighted the department's increased emphasis on sustainable design at the opening ceremony for the building in October 2009. "People think DOT's color is either yellow from our trucks or orange from our construction cones," he said. "Today, DOT has a new color — green."

The facility serves dual purposes as a highway rest area as well as a visitor center. Located at the lower foothills of the Northwestern mountain region of North Carolina, the facility is 30 miles (48 kilometers) from the mountain resort areas of Boone and Blowing Rock. It serves as a tourist gateway for visitors from the major metropolitan areas in the center of the state.

The building sits at the top of the hill facing true south and opens gently to the views of the lower mountains ➢

Mike Nicklas is the president of Innovative Design (innovativedesign.net), an architectural firm and pioneer in sustainable building design with more than 4,750 solar buildings to its credit. Nicklas has served as the chair of the American Solar Energy Society (ASES) Board and the North Carolina Solar Energy Association (NCSEA) as well as president of the International Solar Energy Society (ISES). He is a recipient of the highest awards of ASES, NCSEA and ISES and is a Fellow of both ASES and the AIA.

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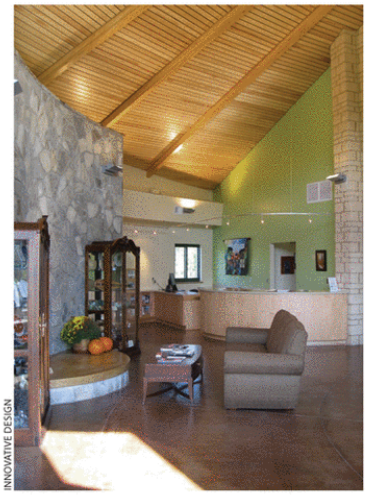
case study

INNOVATIVE DESIGN

The Northwest North Carolina Sustainable Visitor Center serves as a tourist gateway for visitors from the metropolitan areas in the center of the state. The building opens gently to the views of the lower mountains through its canopy-covered walkways and large windows.



INNOVATIVE DESIGN

Daylighting provides two-thirds of the annual demand for lighting during daylit hours of the year.

INNOVATIVE DESIGN

A 14-module, 3.22-kilowatt photovoltaic system is installed on the roof of the walkway canopy. Projected to generate 4,381 kWh per year, the measured annual contribution is 4,550 kWh.

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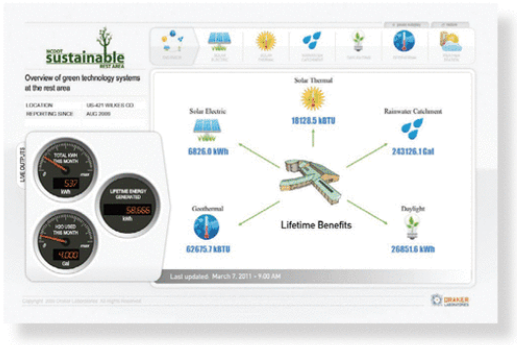

Two LCD screens in the visitor center provide real-time monitoring of the facility's major sustainable systems. After examining the energy, water and CO_2 savings provided by each system, visitors can observe the actual sustainable design component just a short walk away.

Sustainable Visitor Center Building Performance

Compared to an ASHRAE base case building, the facility is 47 percent more efficient.

	Btu/square foot/year
ASHRAE Base Case Building	**87,975**
Northwest North Carolina Sustainable Visitor Center	**46,785**
Monitored Systems (actual 2010 performance)	
Daylighting (excluding cooling savings, 17,705 kWh)	8,021
Photovoltaic (4,550 kWh)	2,061
Solar Water Heating (3,514 kWh)	1,592
Geothermal and Efficiency	29,516

Design Team

Architecture: Innovative Design, innovativedesign.net
Mechanical, Electrical and Plumbing: Padia Consulting, Cary, N.C.
Soil, Groundwater, Environmental Science, Landscape Architecture Consultant: Landis, Raleigh, N.C.
Civil Engineering: B & F Consulting, bandfconsulting.com
Structural Engineering: Lysaght & Associates, Raleigh, N.C.
Road System, Soil and Water Engineering, Site Lighting: North Carolina Department of Transportation, ncdot.org
Commissioning: Elm Engineering, elmengr.com
General Contractor: Vannoy Construction Co., jrvannoy.com

through its canopy-covered walkways and large windows in the main visitor center hall.

In designing the visitor center's unique snail-shell spiral geometry, we were inspired by snails found on the ground during site selection. This organism seems an apt symbol for sustainability design in that snails on this site inhabit an ecosystem where two natural features come together at the creek edges — water and land. In this way, the snail's habitat represents a delicate balance in nature, one shaped by water and the other shaped by land.

Sustainable Site Strategies

Like all roadside rest areas and visitor centers, the design of the 22-acre site was, to a significant degree, dictated by the need for safe access and exit ramps and extensive parking for cars, buses and trucks. In addition to the main building, which consists mainly of a visitor center and restrooms, the facility includes several conditioned outbuildings for storage, maintenance and the rainwater-harvesting equipment. The orientation of the main building is due south and has perfect solar access as well as great views to the foothills of the mountains.

In order to mitigate the impact that storm water could have on adjacent streams, runoff from the roadways, parking and other hard surfaces flows through bio-swales to a bio-retention area with engineered soils and plants designed to reduce off-site nitrogen impacts. The runoff from the truck-parking area, where hazardous spills could occur, is directed to a special catchment basin designed to filter chemical contaminants.

Additionally, all rainwater falling on the 11,660-square-feet (1,083-square-meter) building and walkway roof area flows into 27,800 gallons of rainwater storage. It is later used for toilet and urinal flushing.

Other sustainable site-design elements include xeriscape strategies utilizing native plants, a 0.8-mile walking trail, the elimination of any site irrigation and the re-forestation of 4.5 acres near the access and exit ramps.

The energy strategies employed in the design focused primarily on efficiency, passive heating and daylighting and secondarily on geothermal, solar water heating and photovoltaics.

Real-Time Monitoring, Interpretive Signage

While the entire building energy consumption has not been metered or monitored separately, the facility does feature a real-time monitoring system for key renewable energy components. With the aid of on-site displays and web links, the system allows visitors to see how each component is performing and how the savings translate into CO_2 reduction. (See ncdot.technology-view.com/wilkes.) All major sustainable energy- and water-saving systems are monitored:

- Daylighting (electricity savings, excluding cooling benefits);
- Solar water heating (Btu saved);
- Photovoltaics (electric utility savings);
- Geothermal system (electric utility savings); and
- Rainwater harvesting (municipal water savings).

The monitoring system also incorporates a weather station, which is mounted on the roof ➢

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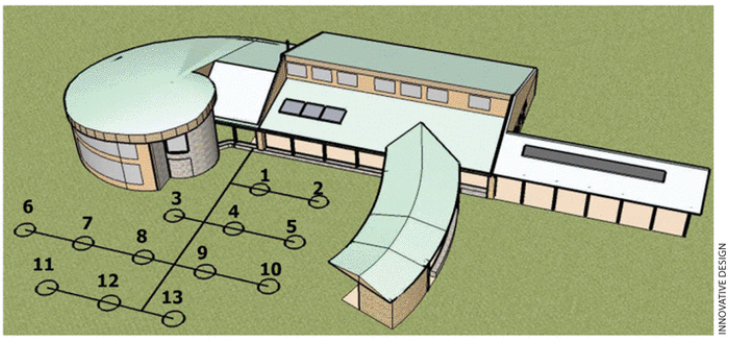
"People think DOT's color is either yellow from our trucks or orange from our construction cones. Today, DOT has a new color — green."

— NCDOT Secretary Gene Conti at the opening ceremony, October 2009



INNOVATIVE DESIGN

A geothermal heat pump system, employing 13- to 300-foot-deep (4- to 91-meter-deep) wells, provides the heating and air conditioning for the main building.

and provides real-time data on temperature, pressure, wind speed and precipitation.

All data collected by the monitoring system is constantly displayed at the visitor center's main hall tower. There, two LCD screens provide the real-time information on savings as well as more detailed information on each specific system's operation. That allows the public the opportunity to better understand how each system works and the savings provided by each system. Then, just a short walk away, they can observe the actual sustainable design component.

To enhance NCDOT's goal of educating the visitors, interpretive signage throughout the building and site graphically depicts the operation of each sustainable design element.

Energy-Saving Features

The energy strategies employed in the design focused primarily on efficiency, passive heating and daylighting and secondarily on geothermal, solar water heating and photovoltaics.

Daylighting and Passive Design. The daylighting strategies, facilitated by a good southern exposure, were simple and focused on the main visitor center spaces as well as the restrooms. The goal, which the monitoring system has shown to be realized, was to implement a strategy that would result in daylight providing two-thirds of the annual demand for lighting during daylit hours of the year. To ensure the performance of the daylighting, we implemented dimming controls coupled with motion sensors to reduce the electrical lighting requirement. Because of the usage requirements of the spaces within the main visitor center, it was also possible to integrate dual-function passive strategies

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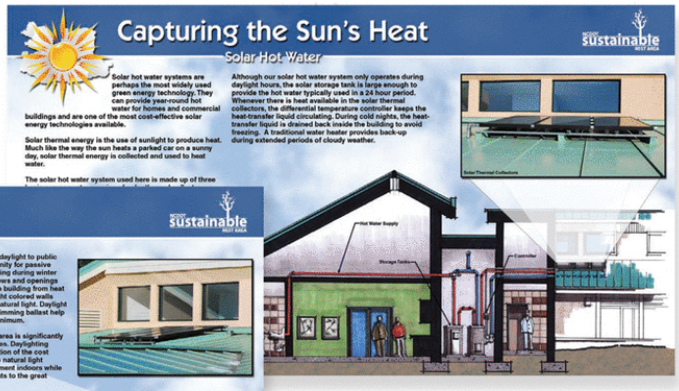

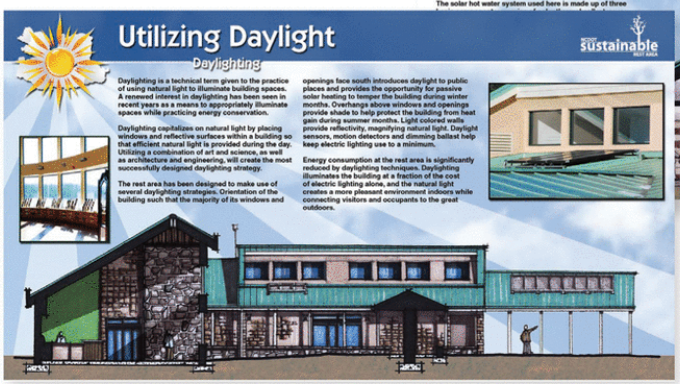

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that employed south-facing glazing, colored concrete floors, extensive interior exposed wall mass and overhangs. These not only provide heating advantages but also contribute to lighting the space.

The measured annual daylighting contribution, excluding any associated cooling benefits, is 17,705 kilowatt-hours (kWh), or the equivalent of 8,021 Btu per square foot, per year.

Efficiency. In addition to the daylighting and passive design strategies, the key building design elements included ultra-efficiency measures. These include high insulation values for the exterior, high-mass masonry and stone walls, roof assemblies with radiant barriers; low-E glass in the low-view windows; operable windows to take advantage of the many days that the facility could benefit from natural ventilation; a light-colored roof membrane and an airlock entry into the main visitor center.

Geothermal. A geothermal heat pump system, employing 13- to 300-foot-deep (4- to 91-meter-deep) wells, provides the heating and air conditioning for the main building. To overcome the potential loss of energy from the extensive toilet exhausts, the facility includes energy recovery ventilation systems.

Solar Water Heating. Three thermal collectors have been installed, and the recorded energy savings per year is equivalent to 3,514 kWh, or 1,592 Btu per square foot. The drain-back system provides hot water for the lavatories in the restrooms.

Photovoltaic System. A 14-module, 3.22-kilowatt photovoltaic system is installed on the roof of the walkway canopy. Projected to generate 4,381 kWh per year, the measured annual contribution is 4,550 kWh, or the equivalent of 2,061 Btu per square foot.

A Model of Sustainability

The sustainable technologies and design techniques employed at the Northwest North Carolina Sustainable Visitor Center are all readily available options. Yet the results are remarkable.

For comparison, an ASHRAE base case building, excluding the extensive site lighting and other outbuildings, would consume 87,975 Btu per square foot per year. The 7,734-square-foot (719-square-meter) visitor center/rest area building, also excluding non-building loads, consumes 46,785 Btu per square foot per year — a 47 percent reduction. See a breakdown in the table on page 35.

The real benefit of this facility won't be the 47 percent savings, however. The real benefit will be derived from the tens of thousands of visitors to this facility every year, most not initially even knowing or caring about the sustainable features, who will be exposed to opportunities they can incorporate today in their own homes and businesses. When describing the facility's biggest return for the state, Jimmy Parrish, NCDOT representative for the project, didn't need to consult the financials. Certainly, he said, it was the net effect from visitors seeing firsthand how they could "apply the technologies to their own lives." ST

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