

By Lissa Myers

# SHINING IN GREEN BEANS CON

**NREL's high-tech parking garage  
showcases energy efficiency.**

The south side of the garage is covered in solar panels.

Even from a distance, the new structure built on the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) campus in Golden, Colo., doesn't look like an ordinary parking garage. It doesn't act like one either. NREL's parking garage proves that large garages can be designed and built sustainably—at no additional cost.

PHOTOS BY DENNIS SCHROEDER.



The 1,800-space parking structure features energy efficiency and renewable energy technologies as well as a design that supports the lab's sustainable transportation strategies.

### **Saving Energy**

"A garage typically uses 15 percent of the energy that the building that it is designed to support uses. Many would say it's only 15 percent of the energy, but we'd say it's still 15 percent that can be improved on. For every watt you save in the building, that's \$33 worth of photovoltaics you don't have to buy when you are targeting net-zero energy,"

NREL Energy Efficiency Research Engineer Jennifer Scheib says.

NREL bid the parking garage using the same streamlined design-build process that was leveraged in the recent construction of the Research Support Facility (RSF) office ([nrel.gov/sustainable\\_nrel/rsf.html](http://nrel.gov/sustainable_nrel/rsf.html)) building on the campus. The team of RNL and Haselden Construction partnered with NREL to build these new energy-efficient facilities.

Making NREL's garage an attractive structure that's both affordable and high performing presented a unique combination of challenges. In the end, the design-build team came up with a structure that is



## FAST FACTS

### Parking Spaces:

- Approximately 1,800.
- 90 preferred spaces for carpooling/vanpooling.
- 90 preferred spaces for low-emitting, high fuel-efficiency vehicles.
- 36 electric vehicle charging stations.

### Energy Use:

Less than 160 kBtu per parking space per year.

### Energy Performance:

90 percent more efficient than ASHRAE 90.1 standards.

### Solar Power:

1.13MW.

### Construction Waste Recycled:

75 percent.

### Cost:

\$14,172 per parking space.\*

\*Cost for typical parking space: \$15,500 to \$24,500

expected to perform 90 percent better than a standard garage built just to code.

Lighting the parking structure was a key focus from the beginning. Fundamental building features such as structure type and bay sizing were carefully considered, in part to reduce the need for electric lighting. This upfront, integrated design allowed the lighting to be reduced by 90 percent compared to code.

“We started by doing a survey of other garages to see how low the lighting density could go, because we knew lighting is one of the biggest energy uses,” Scheib says.

NREL required daylighting to be one footcandle at minimum, even on a cloudy winter day. This means that the garage’s lighting system should be off except at night. To ensure proper illumination, a daylight model was created for the garage. “That’s unique because most people wouldn’t pay to model a garage,” Scheib says. “But to get it right, it had to be done.”

Nighttime is when NREL’s garage looks really different—it’s dark. “At night, when lights are needed, there are occupancy sensors in zones; as you move through the space, the lights turn on for you,” Scheib says. “That is great for energy, and it’s also great for the neighbors.”

To handle the dark, the garage has a lighting control system normally used in office buildings that leverages daylight and occupancy sensors. “By taking these systems and combining them with quick-response LED lighting, we could do it in a way that made the parking garage safe while maximizing the way it saves on power use,” RNL Senior Project Manager Tony Thornton says.

Any concerns people had about a dark garage being dangerous were quickly deemed unfounded, for good reason. “While some might be worried about approaching a dark garage, we’ve heard that some people at the lab now see it as a safety feature,” Scheib says. “If you approach and see lights on, you know someone is in the garage, because otherwise the lights would be off.”

Other energy-saving features include natural ventilation, which saves energy because there are no mechanical systems. The skin of the garage is made of recycled perforated aluminum panels that let light in while keeping





weather out, and can be recycled again. There are also light wells that draw sun into the middle of the structure. Stairs are central to the design; they are well-lit and so convenient that most people don't even realize there are elevators.

Because the south side of the building doesn't need as much protection from the weather, NREL staff and designers had the opportunity to get creative.

"We were investigating using the same aluminum panels, even though they don't have the same job as the north and west sides," Thornton says. "But NREL staff recommended that the south side be covered in solar. It turned out great. It's hard to see the panels on the roof of the garage or the RSF. On the south, where panels will be most visible to the world, we have the ability to extend the message of what NREL is about."

The south-side solar panels are a striking sight that, when added to those on the roof, bring an additional 1.13 MW of solar to the NREL campus and help make the RSF and garage net-zero for energy use. The panels also help offset the energy used by the garage's 36 electric vehicle charging stations.

### **Sustainable Commuting Strategies**

Energy savings associated with the parking garage extend to employee commuting as well. To encourage more sustainable forms of commuting, the program for the garage included 90 preferred spaces for carpool and vanpool vehicles, 90 preferred spaces for low-emitting and high fuel-efficiency vehicles, and preferred bicycle

and motorcycle parking.


"The design of the garage in combination with other commuting benefits that NREL provides, like vanpool vouchers and bicycle lockers and showers, encourages staff to carpool, vanpool, or bike to work, reducing energy use in their daily commute," NREL Director of Sustainability Frank Rukavina says. In addition, pedestrian walkways that connect the centralized parking structure to individual buildings encourage a walkable campus culture.

### **Measuring Success**

The garage is metered, just like other buildings on the campus, so NREL can monitor energy use to ensure that the building meets design goals. When people ask how NREL's buildings are performing, researchers know they will be able to answer confidently.

The metering and the ability to show that buildings can be built to be energy efficient, high-performing, and still affordable is important to NREL's mission to help shape the commercial buildings of the future.

"The big picture is that no matter what, there is room for innovation in the design process to see savings as big as 90 percent over code," Scheib says. "It doesn't matter if it's a parking garage, lab, or office building."

"There's no demonstration piece better than a living, active building," Thornton says. "As designers, we can talk about designs and concepts all day long, but built structures speak to all clients. If you can show them rather than tell them, it makes all the difference." 



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