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Soaking up the Sun

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Soaking up



Imagine attaching solar panels to the breaker box of your home and watching the electric meter run backward.

It can be done. Even in Oregon, with months of liquid sunshine, it's possible to "net zero" on a yearly basis and generate a household's annual electricity, said Jennifer Heath, associate professor of physics at Linfield College.

The sun offers a limitless supply of clean, renewable energy for heat and electricity. And as demand rises,

solar energy is becoming more affordable. The United States solar market grew by 36 percent in 2009 and is expected to increase tenfold by 2014, according to a report by Solarbuzz, an international solar energy research agency.

At Linfield, few understand the potential of the sun better than Heath, who spent last year absorbed in solar energy research. She earned a \$33,000 grant from the American Chemical Society Petroleum Research Fund to support a sabbatical at the National Renewable Energy Laboratory (NREL) in Golden, Colo.

There, she and other scientists are helping to push the technology to the next level. NREL not only works with individual companies to solve short-term problems associated with increasing solar in the marketplace, but the agency looks long-term as well, developing new technology for the solar industry. Heath's research focuses on identifying and understanding limitations to solar cell performance.

"Generally speaking, most solar companies are small, and the instrumentation and expertise required to analyze their solar devices is expensive," Heath said. "To have a lab as a resource where they can get technical assistance is tremendous for the industry."

At NREL, Heath created hundreds of images – similar to photos but made with electrons instead of light – showing the microscopic detail of solar cells. First, she broke cells resembling DVDs into small pieces and then studied the different layers under a scanning electron microscope. Some layers are about 100 times thinner than a strand of hair. Ideally, the wafer is textured, with peaks and valleys that trap light, increasing the efficiency of the solar cell. The images can be used by the manufacturers to find ways to enhance design.

"We can learn how electrons will travel across the junctions," she said. "You want your solar cell to generate electricity, and for this to happen, the electrons must be moving."

Heath, who was drawn to solar research as an undergraduate at Whitman College, found the topic blended her passions for physics and the environment.

"I wanted to do something that was applicable to helping solve important problems on our Earth," she said. "I was very concerned about what the future would look like and the impact humanity was having on the Earth. Solar seemed like a good fit."

The industry has been completely transformed since Heath began studying it in 1998. In recent years, hundreds of start-up companies have begun manufacturing photovoltaic materials.

"It might be that one of these emerging technologies turns out to be a breakthrough," she said.

The next generation

For Heath, the year-long sabbatical at NREL rejuvenated her approach to science.

"I see everything with new eyes," she said. "You get new ideas, and you're talking to new people, you're in a new environment and learning new things. I see the endeavor of science and my role in it, and my students' potential role in it, in a different way. I'm excited about all the things that are possible."

As a professor at a small college, Heath has the opportunity to conduct specialized research as well as have a broad impact on students. In her class, Energy and the Environment, Heath prompts students to consider the impact of energy uses.

"It's been exciting to do that – to not just have my own research, but to involve the next generation and get them thinking about these issues," she said.

One of Heath's students, Katie O'Brien '11, a physics and math double major, is exploring simple ways to test solar cells for her senior thesis.

"It's been helpful to go through the research process," said O'Brien, who has a strong connection to the environment and solar possibilities. "It's important to value what's around us. I don't want to destroy our natural resources."

the sun

Looking to the future

Industry experts are optimistic about the future of solar energy. The production cost of silicon solar cells is falling, according to Mowafak Al-Jassim, principal scientist and one of Heath's colleagues at NREL. One approach to lower the cost is to increase the efficiency of the solar cell. That's where NREL scientists – like Heath – come in.

“Currently the cost is in the \$2-3 range per watt,” Al-Jassim said. “It is expected that the cost will drop to nearly \$1 per watt within the next five years. As the cost of solar electricity keeps going down, we will see a significant increase in installations.”

Energy savings tips

www.energysavers.gov

Low and no cost:

- Lower the thermostat and put on a sweater
- Air dry dishes instead of using dishwasher dry cycle
- Change light bulbs to CFL or LED
- Plug home electronics into power strips and turn off when not in use
- Wash only full loads of dishes, clothes
- Lower the thermostat on hot water heater to 120° F
- Add weather stripping to doors and windows
- Caulk air leaks
- Put barriers under doors
- Add storm windows or heavy drapes

Higher cost:

- Add insulation
- Install a programmable thermostat
- Plant deciduous trees on the south and west sides of your home for shade in the summer and sun in the winter
- Install light tubes for natural lighting
- Select energy-efficient appliances
- Replace windows
- Upgrade to an energy-efficient furnace

Jennifer Heath, associate professor of physics, discusses circuits and electronics with Yingshi Guo '12.

Solar in the home

In the meantime, what's a homeowner to do? Because adding solar panels is a large investment, Heath suggests homeowners first save energy by conserving electricity and weatherizing homes. (See sidebar.)

“It's less expensive to save the electricity than to generate it with solar panels,” she pointed out. “So the first thing you can do is waste less energy. We have an older home, so we're upgrading windows, insulation, appliances and the furnace.”

To save electricity, install energy-efficient appliances and limit their use. Appliances with heating coils – clothes dryers, water heaters, hair dryers, space heaters and the like draw a relatively large amount of electricity, as do refrigerators.

In addition to implementing weatherization tactics, Heath also recommends using passive solar energy when possible. Using the heat and light of the sun directly, as is done in a solar hot water heater, is less expensive than converting it to electricity. Passive solar techniques to keep a house cool include overhangs, windows with reflective coatings, reflective coatings beneath exterior walls and light-colored roofs.

Once homeowners have weatherized and considered passive solar options, only then does Heath recommend adding solar panels. 🌱

– Laura Davis

