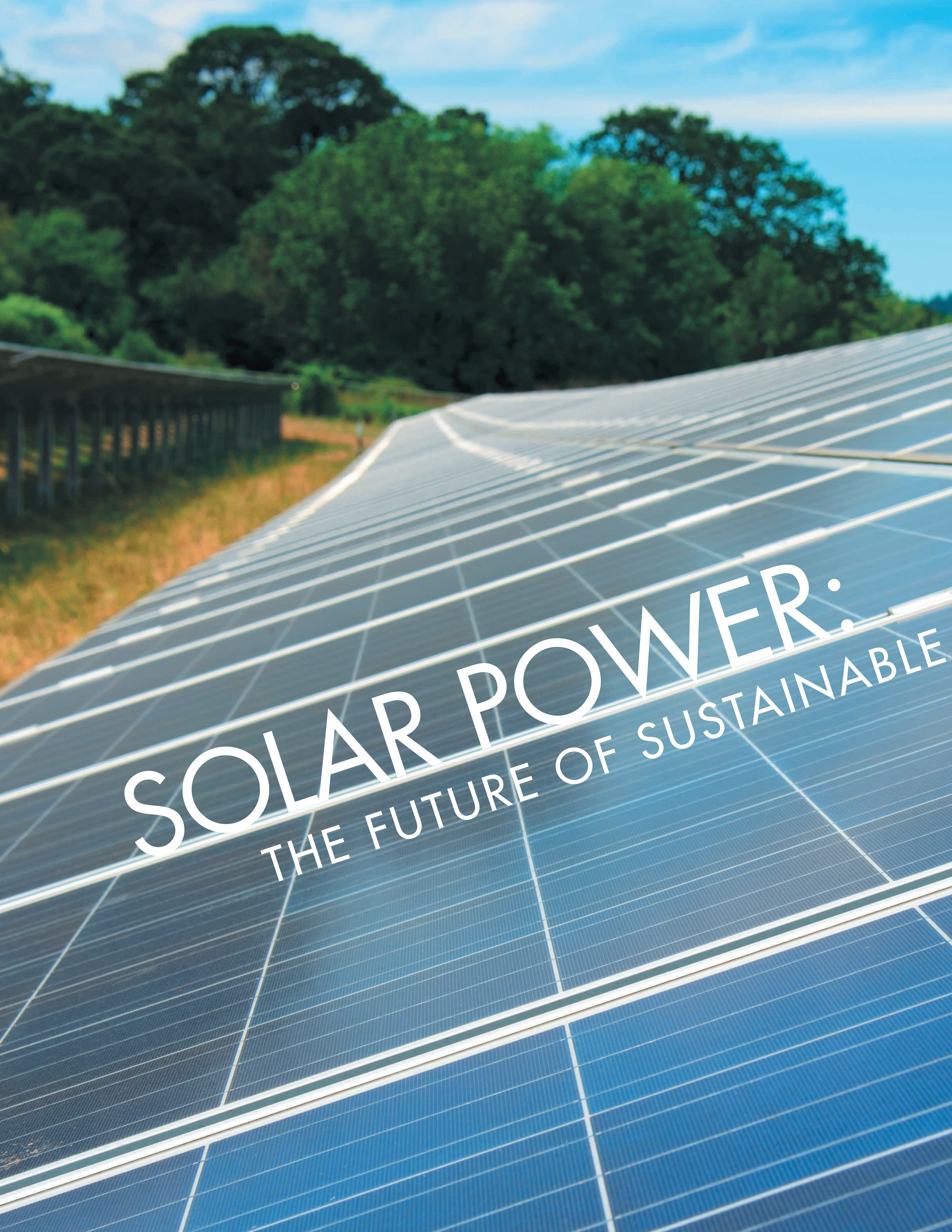

SOLAR POWER:
THE FUTURE OF SUSTAINABLE

Stephen Ward photo

FARMING?

By Chris Branam

As the late afternoon sun bears down on the west side of Oregon State University's Corvallis campus on a cloudless and unseasonably warm spring day, Chad Higgins stops at a bike path and motions toward a small sea of solar panels.

"This is near the spot where we made our very first observations and took the first photos," says Higgins, an associate professor in the Department of Biological and Ecological Engineering who explores the intersection of farming and technology.

A decade ago, this was a sheep pasture. In 2013, the Oregon University System installed five large grid-tied, ground-mounted solar electric arrays on agricultural lands operated by OSU. The 35th Street Solar Array is the largest of the five, covering six acres and producing 1,435 kilowatts. The array sends power to the electrical grid and provides enough power for several large OSU buildings, including the CH2M Hill Alumni Center.

Photo courtesy of Tesla

The 35th Street Solar Array was installed on sheep pastures on the Oregon State University campus in 2013. The array is the largest of five arrays constructed on OSU agricultural lands.

Shortly after it was installed, Higgins and some colleagues were strolling past the array and noticed green grass growing in the shade of the solar panels. In May 2015, they installed microclimate research stations alongside and under the solar panels that recorded mean air temperature, relative humidity, wind speed, wind direction and soil moisture. By August of that year, the instrumentation revealed the areas under the solar panels maintained higher soil moisture throughout the three-month period.

The result was striking, Higgins says. The areas under the array produced double the amount of plant material than the unshaded areas, including an increase in the plants' nutritional value. The researchers also noted a significant increase in late-season plant growth.

In 2018, Higgins and his research team published the results in a paper they titled "Remarkable agrivoltaic influence on soil moisture, micrometeorology and water-use efficiency." The concept of co-developing the same area of land for both solar photovoltaic power and conventional agriculture is known as agrivoltaics and dates to the early 1980s. But the solar arrays installed and operated by OSU weren't intended to grow crops, which is typical of solar panels installed on farms.

The array was installed in the pasture because the space was available, sheep are compatible with solar arrays, and the array is close to the power lines on 35th Street, said Brandon Trelstad, OSU's sustainability officer who helped plan the site.

Higgins' research team recently published a new paper that finds that solar power has the highest productivity when panels are placed over agricultural lands, and if only 1% of ag land was converted to agrivoltaics, it would be sufficient to offset global energy demand.

"When you think about it, what's so different between solar panels and leaves? In both cases they are harnessing the power of the sun. Leaves like plenty of sun, gentle winds, flat land and a temperature that is not too hot. It turns out that 8,000 years ago, farmers found the best places to harvest solar energy on Earth."

Pragmatic Research

Higgins grew up in rural upstate New York, in a town that is surrounded by dairies. His mechanic father taught him how to fix things from an early age. He graduated from nearby Cornell University with a bachelor's degree in agricultural and biological engineering, and he holds advanced degrees from Johns Hopkins University in mechanical engineering.

"Agrivoltaics is an important first step toward making agriculture more sustainable."

Chad Higgins studies the intersection of farming and technology. His research team has published two significant papers on agrivoltaics in the past year.

Stephen Ward photo

Shortly after the 35th Street Solar Array was installed, Chad Higgins and his colleagues noticed that green grass was growing under the panels.

Oregon State researchers are studying the effects of solar panels on the development of lambs that graze in the solar array and those who graze on regular pasture.

Higgins has been at OSU since 2011 and he directs the Nexus of Energy, Water and Agriculture Laboratory, also known as NEWAg, in the College of Agricultural Sciences. The purpose of the lab, he says, is to understand the connections of energy, water and food to avoid unintended consequences that cause net harm and promote consequences that provide net benefits.

He brings a pragmatic approach to his research. Every problem starts with the basic question: What is the biggest impact that can be made with the least amount of effort?

"It's much easier to make an easy change," he says. "Something that makes money. Something that makes people's lives easier. I want to solve a problem instead of creating one. It all starts with looking at a system and avoiding the 'Wouldn't it be cool if...?' trap."

"Ultimately the goal is to find ways to extend the available resources of food, energy and water into the future so we don't run out," he says. "Right now, all I'm trying to do is make the efficiencies higher. I want to push them to a point where some other smarter person can fix the problem for good."

The 35th Street Array still serves as a resource for Higgins' agrivoltaics research. He's collaborating with Serkan Ates, an assistant professor in the Department of Animal and Rangeland Sciences, on an experiment to determine if lambs benefit from grazing in the pasture with the panels. They are measuring the lambs' stress levels, water intake and weight, among other things.

The results could provide information for installing arrays in pastures not just to grow crops but to feed livestock. "Anecdotally, the sheep seem to like the grass under the shade more," Higgins says, "but we won't know for sure until we get the data in a scientifically controlled study."

Following the initial agrivoltaics study, his team has been testing the effects of solar panel placement on tomatoes at the OSU Vegetable Farm and nursery plants at the North Willamette Research and Extension Center.

Also, one of Higgins' graduate students, Maggie Graham, is studying the presence of solar panels on apiaries at a commercial solar installation in southern Oregon, and whether they could serve as habitat for pollinators or disturb pollinator behavior.

Farm of the Future

Agrivoltaics is an important first step toward making agriculture more sustainable, Higgins says.

But it's not the only one.

The solar-powered farm of the future features electric equipment — diesel-fueled tractors could become museum pieces. Chemical fertilizer would be replaced with electrically produced fertilizer. An agrivoltaic system in Oregon could harvest rain runoff from the panels and use the water for irrigation throughout the entire growing season.

Higgins wants to create a sustainable demonstration farm of the future, here in Oregon. He's calling it the Staterra Center; the name means "balanced Earth."

"I've come to think of solar panels as farm equipment," he says. "We have an irrigation system to manage our water and a tillage system to manage our soil and a fertilizer system to manage our nutrients. We should have farm equipment to manage our sun." | OAP