JEREMY GILDRIEN STANDS next to solar panels in one of his Middlebury farm's greenhouses. The panels provide solar generated radiant heat to a germination chamber to extend the growing season.
Independent photo/Trent Campbell

Middlebury farm grows solar-energy technology

By ANDREW STEIN

MIDDLEBURY — Take some solar panels, radiant heat tubing, a raised bed of soil and the innovative mind of Jeremy Gildrien; put them all together; and — voila! — you have a "solar germination chamber."

Moving into its second year of full operation, Gildrien Farm off of Middlebury's Halladay Road is testing the boundaries of renewable energy-powered agriculture. Farm owner Jeremy Gildrien — a conservation biologist turned farmer — is aiming to extend the farm's growing season on both ends by germinating seeds in a solar-powered chamber.

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In the fall, Gildrien hopes to germinate seeds for winter crops. Using the warm chamber should accelerate the germination process and hopefully keep summer crops like tomatoes growing in the greenhouse longer. In the late winter and early spring he will germinate seeds inside before the ground outside is thawed. It won't necessarily start earlier than other farmers in the area, but it will mainly use power from a unique solar energy system.

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With state funding from the Renewable Energy for Agriculture Grant Program (REAP), Gildrien is able to put his vision into practice. By running radiant heat tubing underneath soil enclosed by standard polyethylene row cover, Gildrien creates a blanket of hot air and a soil temperature adjustable to the conditions of whatever seeds need germinated.

"The row cover doesn't have much insulated value," Gildrien said, "but the still air has great insulated value."

Since the greenhouse protects the germination chamber, this air blanket avoids exposure to disruptive elements like wind.

Last week, Gildrien set the soil temperature to 50 degrees for crops like spinach, and it will soon be raised to 70 degrees for tomatoes and eggplants. Controlling the air blanket temperature from the soil temperature is something that he has just begun to experiment with.

While some farmers attempt using solar to heat their entire greenhouse, Gildrien is not. He's concentrating energy from flat plate solar collectors in a 384-cubic-foot chamber, rather than trying to heat the entire 8,232-cubic-foot greenhouse that surrounds the chamber.

Why not heat the whole greenhouse? Gildrien is testing whether this design might just be more energy and cost effective.

His radiant heat design operates much like a household radiant heat system, but its power supply is a bit different than most.

HOW IT WORKS

A solar hot water system heats up three loops of water: the solar panel loop, the hot water tank loop, and the radiant heat tubing loop (under the soil in the germination chamber).

Water inside the solar panels heats up as it circulates through a series of tubes. The temperature of this water can be very hot, and the system is currently set to turn off when the temperature exceeds 200 degrees. The highest temperature Gildrien has recorded is 140 degrees.

JEREMY GILDRIEN EXPLAINS the solar-generated radiant heat system that he built on his Middlebury farm with the help of a state grant. The system allows Gildrien to farm more sustainably by using sun and water rather than oil and propane.

Independent photo/Trent Campbell

The hot water tank acts as an intermediary between the solar panels and the radiant heat tubing. When the temperature of the water in the tank drops below 9 degrees of the solar panel water, a simple computer that regulates temperature automatically activates a device called a heat exchanger, which transfers heat from the solar panel water to the tank water until equilibrium is reached. No water is exchanged between the solar panels and the water tank — only heat.

When the soil temperature drops below a given temperature, hot water from the tank replenishes the radiant heat tubing with fresh hot water until the given soil temperature is achieved. The hot water sits stagnant in the tubes providing heat to the soil and the chamber until the water cools down and is again replaced by hotter water.

The greater the difference between temperatures outside and inside of the solar panels, the more ineffective they will run. In order to reduce this temperature difference, Gildrien decided to place the panels inside the greenhouse. Although he loses about 15 percent of available light from the greenhouse's plastic and frame sheathing, he believes that his system will operate more effectively inside.

In the future, Gildrien will likely shift the electronic devices that regulate his system to photovoltaics, which convert solar radiation into direct current electricity. Presently, these devices borrow a bit of electricity from his home.

"The whole system uses approximately 275 watts to operate," says Gildrien. "That's similar to the electric consumption of a blender."

THE GRANT AND THE PLAN

The REAP grant that enabled Gildrien to create and implement his project is administered by the Vermont Agency of Agriculture with funds allocated from the Vermont Clean Energy Development Fund. The grant helps provide business, technical and implementation assistance to Vermont farmers and agricultural producers looking to test the viability of a biomass, solar or other renewable energy technology. The overall purpose of these grants is to test the economic and energy feasibility of a proposed agriculture technology using renewable energy. Most of these grants offer up to $10,000 in funding.

The grant program requires Gildrien, like other farmers in the program, to document his projects closely. Gildrien is not permitted to sell or copyright any of the material created from his grant, and he must publicly share his findings and design so that other farmers can learn from and use elements of his system. The grant funds the implementation of a farmer's own design, but ensures that if his or her design is cost and energy effective, it can be replicated by farmers across the state.

Gildrien is conducting a cost-benefit analysis, and he's closely documenting the total energy gained by the system and its carbon offset.

"So far it seems to be working well," he said. "Although it's manmade, philosophically the system still just uses sun and water to grow plants."

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