



Mike Moser, Middlebury's facilities-services director, stands inside the college's \$12-million biomass-gasification facility. (*Chronicle photograph by Lawrence Biemiller*)

By LAWRENCE BIEMILLER

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As climate change threatens havoc on a global scale, more and more colleges are responding by adopting carbon neutrality as a goal, or by asking whether neutrality is feasible. At Middlebury College, that question was answered when the college achieved carbon-neutral status in 2016 — after a nine-year quest that involved students, trustees, faculty and staff members, utility companies, willow shrubs, dairy cows, and a lot of creativity.

Can other institutions match Middlebury's success? Every college faces its own distinct set of carbon-reduction challenges, of course, and each requires a tailor-made set of solutions. Larger institutions face more challenges than smaller ones, and location matters. But Middlebury's experience — it committed to carbon neutrality a dozen years ago, and made public its setbacks as well as its successes — gives a good sense of the challenges faced by even a small college that established what it says was the first undergraduate environmental-studies program in the U.S., back in 1965.

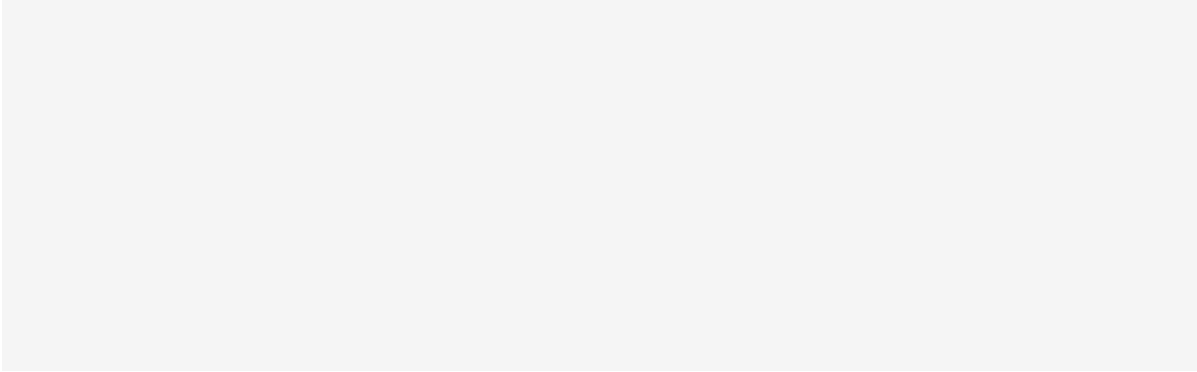
The most important factor in Middlebury's success is a \$12-million biomass-gasification facility. It has allowed wood chips from 10 nearby counties to replace No. 6 fuel oil as the mainstay of the college's steam plant, which also produces 15 to 20 percent of the electricity used on the campus. Fine-tuning building systems and upgrading lights have also contributed by saving energy. And three solar-energy projects have been part of the mix.

Middlebury has saved money, too. Besides cutting the college's carbon footprint nearly in half, the biomass plant is saving enough on fuel bills to pay back its construction loans and cover the salaries of skilled operators who keep it running at maximum efficiency. Other energy-efficiency projects have cost the college about \$1.8 million — counting rebates through a statewide energy-efficiency utility called Efficiency Vermont — but have reduced the college's utility bills by about \$600,000 a year.

The carbon-neutrality effort has been so successful, in fact, that last year students began urging the college to set even more ambitious goals. In January the Board of Trustees adopted a plan called Energy 2028, giving Middlebury a decade to reduce campus energy use by 25 percent, convert to all-renewable energy sources, and phase fossil-fuel investments out of its endowment.

Middlebury isn't alone in having reached carbon neutrality. American University, Bowdoin College, and the College of the Atlantic are among other institutions that have hit the goal, and Colgate University expects to join them this year. Plenty of others are trying, including Cornell University, Dickinson, Oberlin, Pitzer, and Pomona Colleges, and the University of Montana.

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For big institutions, however, carbon neutrality can be harder to achieve. Colorado State University, Vanderbilt University, and the University of Maryland, for instance, have all set their carbon-neutral target date for 2050, with varying intermediate goals. The Massachusetts Institute of Technology is aiming to reduce emissions 32 percent below 2014 levels by 2030, but [a study](#) there found that “larger technical universities have roughly four times the carbon emissions per student” as smaller, undergraduate institutions.

Still, Nan Jenks-Jay, Middlebury’s dean of environmental affairs, is upbeat: “You can do this. The technology is out there. The opportunities, I think, are far beyond what the risk is.”

Jenks-Jay says that she first remembers Middlebury faculty and staff members discussing carbon neutrality in 2001, at an environmental-studies retreat, but that the college initially took only intermediate steps. It was students who got the ball rolling, with a 2003 winter-term course in which they researched ways of cutting carbon emissions. Their proposals so impressed the trustees that the board asked administrators and staff to work with students and faculty members on specific proposals.

The following year, the board voted to reduce carbon emissions 8 percent from 1990 levels by 2012, and in 2006 it approved building the biomass plant. Students then began pushing a 10-year plan for achieving carbon neutrality, and the board agreed in 2007, but specified that buying carbon offsets — an important component of many colleges’ carbon-neutrality plans — be a last resort.

“We spent the next nine years pursuing carbon neutrality in many ways we would

never have imagined,” says Jack Byrne, director of sustainability integration. At that time, the college had a carbon-emissions footprint of about 30,000 metric tons a year, he says. (For comparison, MIT’s footprint last year was 204,000 tons.) “Any source of carbon that we own or control 50 percent or more of, we count as our carbon. But when we have food delivery from some food supplier, that’s their carbon. We don’t count that in our footprint, because we don’t own their truck.”

An important partner has been Efficiency Vermont. “They assess buildings and HVAC equipment and lighting and make recommendations, like replacing an old three-speed electric motor with a variable-speed drive that uses only the electricity that’s needed,” says Byrne. The college also replaced old-style light bulbs with new ones that use less energy, and it hired engineers for “recommissioning” — testing a building’s systems to make sure they’re working as efficiently as possible. “We cut consumption by about 4.5 million kilowatt-hours a year over 10 years — that’s about 15 to 20 percent of our baseline,” Byrne says. The college’s electric utility is Green Mountain Power, which he says now gets about 60 percent of its electricity from renewable sources.

Large institutions face different barriers to becoming carbon neutral, but can still learn from Middlebury’s experience.

The college has made less progress changing users’ habits. “Pretty much everyone on campus supports energy conservation,” says Van Barth, a sophomore who is part of the college’s Sustainability Solutions Lab. “Not as many feel that they have the ability to influence it, that they as individuals can have an impact.” The single biggest way students waste energy, he says, is opening windows when their rooms are too warm, rather than figuring out how to turn the heat down.

An experiment in one residence hall used iPads to display smiles when electric use was down and frowns when it wasn’t, and that cut electric use about 6 percent, Byrne says. But most campus buildings aren’t individually metered, so it’s impossible to show occupants when they’re affecting energy use one way or the other. In the 226,600-square-foot science building, Bicentennial Hall, college officials are trying a different approach — cutting back on the hours of full-occupancy heating, cooling, and air

circulation. In a building that big, scaling back at 8 p.m. instead of 10 p.m. “has made a significant difference,” Byrne says.

The biomass plant came online in 2009, but several years of testing different kinds of wood chips and different operating practices took place before the plant reached optimum performance. In the meantime came some of the setbacks. Twice there were fires in the baghouse, where particulates are filtered out of the smoke before it goes up the stack. Led by Mike Moser, the facilities-services director, a crew devised — and patented — a method to shut down the system when sensors detect the conditions that made the fires possible. A more public setback came when a much-anticipated plan to burn fast-growing local willow shrubs failed because the willow turned out to be too wet.

Even so, the biomass plant has been more successful than expected, Moser says. “The original plan was that 20,000 tons of wood chips a year would displace a million gallons of No. 6 fuel oil,” out of two million gallons that the college was then burning annually. But once the plant was running smoothly, the college used 23,000 tons of chips and only 600,000 gallons of oil a year. The chips are delivered around the clock by truck from a sawmill eight miles away — about 1,000 truckloads a year, Moser says.

The college has since switched to burning natural gas in the non-biomass half of the plant, in anticipation of being able to move from a conventional gas supply to renewable natural gas. But that’s been another setback. “Between increasing efficiency, the solar projects, and biomass, we got ourselves about two-thirds of the way to carbon neutrality,” says Byrne. The other third was to come from working with a nearby 1,000-cow dairy farm whose owner planned to build a digester that would convert manure and food waste into natural gas. But he failed to get financing for it. Now a company in the renewables business has bought the project, and the college is negotiating with it to buy renewable gas “if and when they build it,” Byrne says.

Meanwhile, Middlebury is making up the emissions difference with the trustees’ last resort, offset credits — which, in fact, it’s buying from itself. Several years ago, the college negotiated a conservation easement for forest land on its Bread Loaf campus,

and included provisions allowing officials to quantify how much carbon the forest was sequestering. Middlebury ended up with about 25,000 tons' worth of credits a year until about 2024, of which it is now buying about 10,000 annually. Those it doesn't use it can put up for sale on the open market.

Also on the list of possibilities is generating electricity at Otter Creek Falls, right in the middle of the town of Middlebury, which has been used to generate power in the past. But a disagreement over who owns the rights to the water has stalled planning.

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An unexpected issue now is that the definition of carbon neutrality keeps changing, says Byrne. Ten years ago, wood was considered a carbon-neutral fuel, but now that's being debated. "The logic was that trees take CO² out of the air, and when you burn the trees, you're just putting back what they took out," he says. But what if you're using up trees faster than they're growing? Are you still better off burning wood than No. 6 fuel oil? "The fundamental difference is that you've gone out of the geologic fossil-fuel cycle into the biogenic cycle, so you're talking about a much shorter period of time where that carbon is reabsorbed."

What potential savings remain for the college? David Provost, executive vice president for finance and administration, says Middlebury is taking a close look at how it uses the buildings it has, and will think twice before adding more. "We have 2.7 million square feet of space," he says. "Some would suggest that is gluttonous. Do I need an office this size? I could fulfill my role here with a smaller footprint."

Travel is the other big factor that hasn't been addressed so far, Byrne says. "As the heating-and-cooling portion of the footprint has shrunk, the travel portion has become proportionately higher. It's a hard one." The college is considering a carbon tax that will soon get a pilot test. "Department by department, you get an average of your last three years of carbon-related travel, and that's your cap. So every year you need to drop 2 percent below that, because Energy 2028 is a 25-percent reduction. If you exceed your cap, then you pay a tax, which goes into a fund that would be used to support carbon reduction, renewable energy, or energy-reduction projects."

And Jenks-Jay, the environmental-affairs dean, cautions that an institution can't just achieve carbon neutrality, check a box on a form, and move on. All kinds of changes — new buildings, different uses for existing buildings, different schedules for summer programs or even team practices — have to be accounted for. For instance, she says, "We have a warmer climate, and we are a 12-month campus, so we have a greater dependency on air conditioning than we did when we started this project." With a goal as complex as carbon neutrality, she says, "you have to keep monitoring it, measuring it, tracking it, evaluating it."

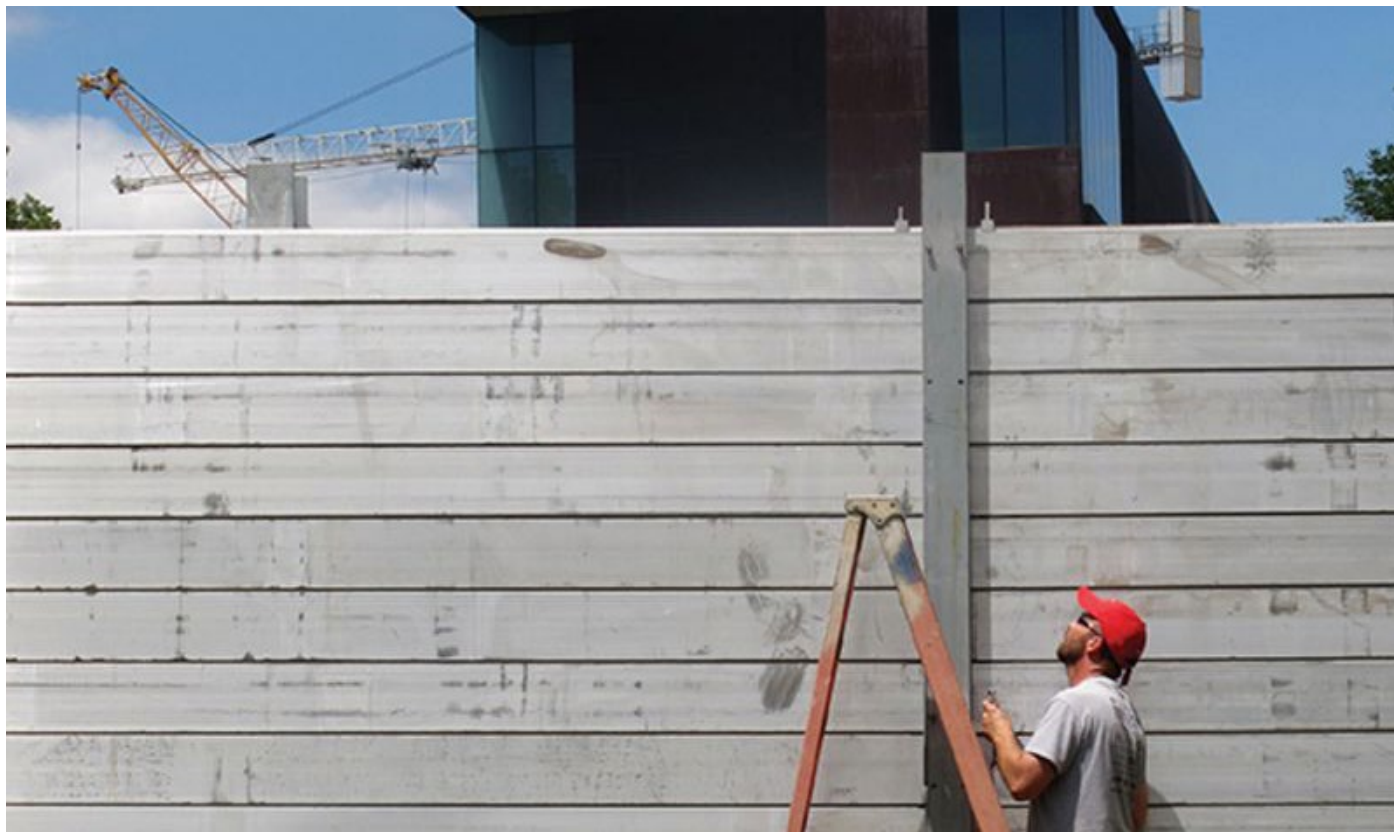
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