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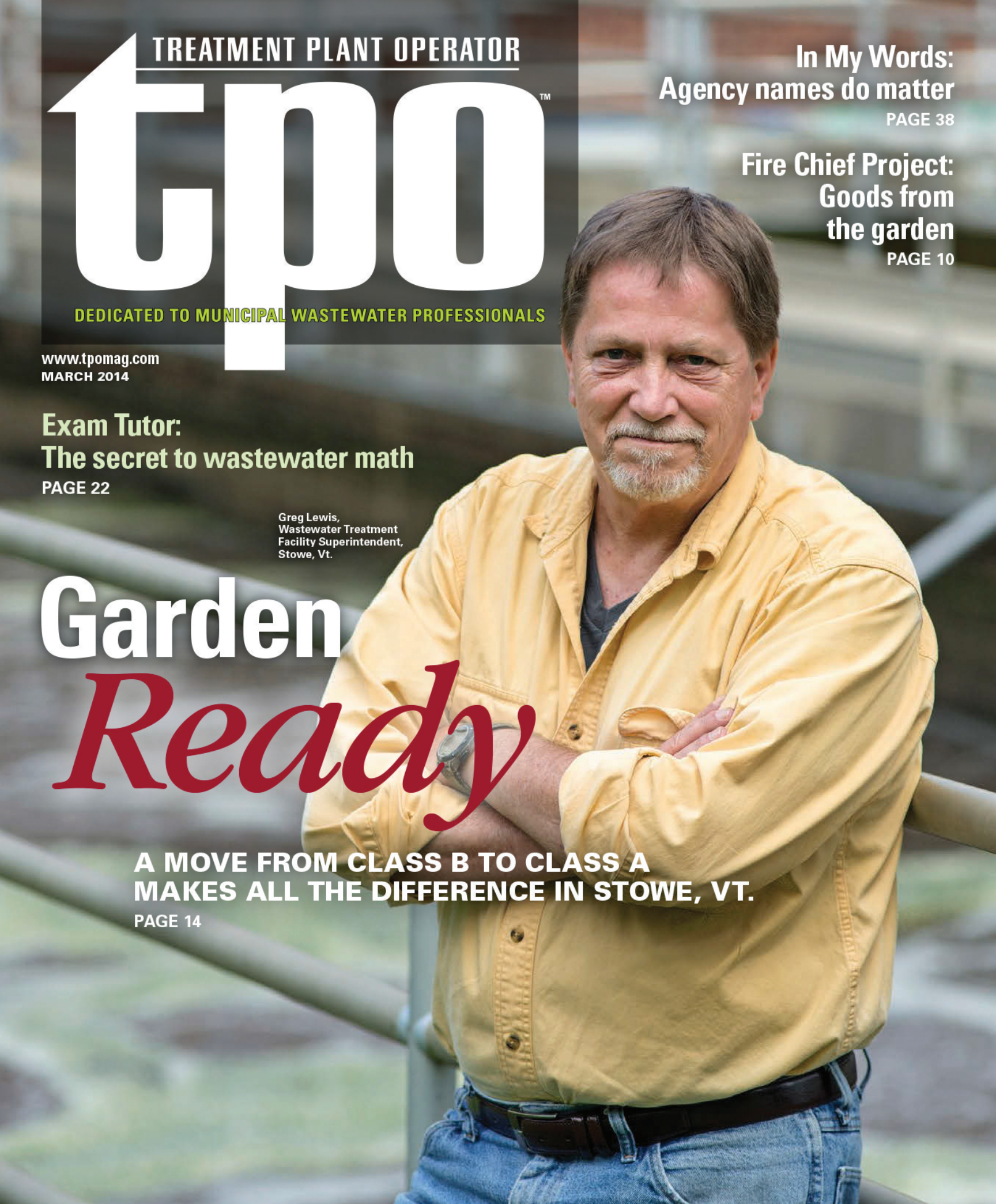

Greg Lewis,
Wastewater Treatment
Facility Superintendent,
Stowe, Vt.

Garden *Ready*

A MOVE FROM CLASS B TO CLASS A MAKES ALL THE DIFFERENCE IN STOWE, VT.

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Pittsfield combined heat and power building. (Photos by David Lamb Photography)

Good Timing

ENERGY EFFICIENCY PLANS LINED UP WITH A 2009 FEDERAL GOVERNMENT ECONOMIC STIMULUS PROGRAM TO BRING A MASSACHUSETTS PLANT CLOSE TO NET NEUTRAL ENERGY

By Doug Day

It was a happy coincidence. As officials in Pittsfield, Mass., were working on an ambitious energy efficiency plan for the wastewater treatment plant, the federal government came up with a plan to distribute about $830 billion to stimulate the economy. The plant tapped into some of that money for an upgrade that will reduce the use of purchased energy by at least 90 percent.

Wastewater treatment has a history of being "off the grid" in Pittsfield since the original plant was built in 1902. With no natural gas service, the plant generated its own power through a combination of No. 2 heating fuel and biogas as it grew, according to Carl Shaw, plant superintendent.

That ended with an expansion in 1976 when the on-site generators were turned off and used only for backup power. Electricity bills rose as the plant (17 mgd design flow, 12 mgd average) went through improvements to better serve the 50,000 residents of Pittsfield and a few nearby towns.

Aeration basins at the Pittsfield treatment facility now use 150 kW turbo blowers (HSI Blowers) and fine-bubble aeration (Sanitaire).

Seeking to reduce costs in 2009, the city began planning a series of energy projects. In that same year, the American Recovery and Reinvestment Act (economic stimulus program) came along, with more than $13.5 million to pay for three projects completed in 2010-11:

- $2.5 million for a new combined heat and power (CHP) system
- $3 million for an update to the aeration system
- $8 million for a photovoltaic energy plant

"We were already engineering these projects before the money was offered," says Shaw. Upon completion of the work, annual energy spending dropped from about $800,000 a year to about $500,000, even though the CHP system isn't yet running at full capacity.

USING THE GAS

"A lot of the biogas we were making was just being flared," says Shaw. "The only thing we used it for was heating in winter." That changed with the CHP system, which includes three 65 kW microturbines (Capstone), purchased from design-build contractor CalPower and installed by BioSpark. "We now have the capacity to handle 120,000 cubic feet of methane per day," says Shaw. That provides room for growth, as daily biogas production runs from 60,000 to 80,000 cubic feet.

CHP output has been limited since the system went online, but that is beginning to change. "We put in a new transformer and a small motor control center [MCC] for some of the upgrades," explains Shaw. "It wasn't until we started hooking up new equipment to the old MCC that we realized the system was way overloaded." A new MCC being installed this year should increase annual electricity savings to about $150,000.

Waste heat from the microturbines is also captured to maintain the two anaerobic digesters at 95 to 100 degrees F. "That should heat the digesters for at least six months of the year," Shaw says. Biogas also fuels a boiler for winter building heat, displacing expensive No. 2 heating fuel. A new SCADA system controls the process: the emphasis is on generating electricity in summer and heat in winter.

AERATION EFFICIENCIES

On the liquid side, a fine-bubble aeration system (Sanitaire) cut energy use for that process in half. Two old mechanical aerators had only two speeds, and a third was used only when necessary because

it had a single-speed blower. "If the dissolved oxygen dropped to 2 mg/L, the aerators would kick to high," says Shaw. "Once the DO got above 4 mg/L, they would kick into low. It was a simple system to run, but there was no control over it, and it used a lot of energy."

The three 45 hp blowers were replaced with three 150 kW turbo blowers (HSI Blowers) and an 800 kW engine (Caterpillar). "Even in the dead of summer with low flows and the highest oxygen demand, we're only running one blower," Shaw says. The system was overbuilt to make sure there was enough capacity to support denitrification in the future.

SOLAR POWER

Looking to generate more energy, and with plenty of available land, the Pittsfield team decided to install a 1.58 MW fixed solar photovoltaic array (Nexamp). The 7,500 solar panels in the 5-acre system save the plant about $200,000 a year. "We sell the energy and get green and renewable energy credits," says Shaw.

While the solar plant is not directly connected to the plant, it still serves the facility's electrical needs. It connects to the grid just upstream from the treatment plant's incoming power lines through a net metering agreement with Western Massachusetts Electric Company. The utility wanted it designed that way so that the company can access the electrical output if the plant doesn't need it.

SAVINGS DOCUMENTED

The solar and aeration projects have already proven themselves in saving energy. CHP savings will continue to improve this year and into the future.

Estimated electrical energy usage (MWh/yr)

Historic average utility electricity usage	**4,446**
Generated by CHP (when new MCC is complete)	(1,572)
Reduced by aeration efficiency	(919)
Generated by photovoltaic system	(1,500)
Subtotal generated and reduced	**(3,991)**
Theoretical net utility electricity usage	**455**
Overall reduction	**90%**

As part of the new CHP motor control center, two 750 kW diesel engine-generators (Caterpillar) are being added for emergency power during outages. That will also allow the plant to enroll in the local electric utility's load management program. By agreeing to shut off utility power to the plant during times of high demand on the grid, the plant gets incentive payments from the utility.

"When the utility calls us, we'll be going off the grid," explains Shaw. "Right now, we can't run the full facility on emergency power, so we'll have to go into emergency bypass power mode and change some operations. When the MCC is complete, we'll be able to operate the same way all the time, whether or not power is available from the grid."

For now, those generators will run off No. 2 heating fuel, but Shaw is exploring extending natural gas service to the plant and converting the generators, thus increasing the economic benefit by using a less expensive fuel.

BRIGHT FUTURE

Shaw says a fourth microturbine is a possibility, based on optimizing the digesters to produce more methane. Accepting high-BOD waste is being explored as a way to increase biogas volume. Shaw is also considering an inline hydroturbine for the plant's outflow pipe to the Housatonic River.

At the same time, he sees energy demand increasing with the EPA-required addition of about $40 million in phosphorous and aluminum removal technology. So energy efficiency will remain a concern. **tpo**

FROM COMPUTERS TO CLEAN WATER

Carl Shaw was about to finish his associate degree in computer science when life took an odd turn. While superintendent of the Pittsfield wastewater treatment plant was not the career he planned, he's happy helping keep the environment clean and serving the public. He was just six credits shy of the degree at Berkshire Community College when doing real computer work convinced him he was in the wrong field.

"I was doing data entry and programming, sitting in an office every day, and I hated my job," he says. "I was contemplating how to explain to my father that I didn't want to do this for a living."

Then came an offhand remark from Paula Ely, a friend of his wife, Liza. Ely happened to be a lab technician at the Pittsfield plant and suggested Shaw become a wastewater operator.

"I didn't know what wastewater was, I didn't even know this plant existed, and I had lived here my entire life," Shaw recalls. Liza talked him into touring the plant, and he found it interesting. He had always liked technology, chemistry and biology. So, rather than finish the course work for his degree, he went out and got his wastewater operator license. He was hired at the plant in 1996.

"I started as an operator," he recalls. "I just fell in love with it. Eighteen months later they promoted me to shift supervisor." He became chief operator in January 2010 and plant superintendent in February 2013.

"I love my job and look forward to coming to work every day," he says. "It fascinates me." While he'd like to finish his computer science degree, his real passion now is clean water.

"The public really needs to know what goes on down here," he says. "They don't realize what a gem we have, what happens with water when it leaves their home, and what's involved in cleaning it up. You can't get more green than a wastewater treatment plant."

The combined heat and power system uses three 65 kW Capstone microturbines.