

New use for sewage: Producing heat and electricity

January 30 2014

The orange flare along I-95 near Castor Avenue isn't lit anymore.

It used to burn off excess methane produced at this Philadelphia sewage treatment plant. But with the completion of a \$47.5 million project, the gas now is transformed into heat and electricity, putting the plant front and center in a sewage paradigm shift.

These days, the stinky sludge, the stuff of our toilets, has a new future. Experts see not an abomination, but a resource.

"We are just at the beginning of what we can do with sewage," said Allison Deines, director of special projects at the Water Environment Research Foundation, a Virginia-based nonprofit for wastewater and storm water issues.

She and colleague Lauren Fillmore, senior program director for energy, lauded Philadelphia as an early adopter.

"It takes a long time just to get a few supporters of innovative technology," Fillmore said. "I definitely want to credit Philadelphia with being a leader."

When municipalities started piping sewage away from residential areas, the receiving facilities were known as [sewage treatment plants](#). They did little but settle out the solids.

In the 1980s, in the wake of national clean-water legislation, they became "water pollution control plants."

Today, "we're moving toward a new name," said Philadelphia Water Commissioner Howard Neukrug. "The industry is calling them 'water resource recovery facilities.'"

At Philadelphia's Southeast plant, a system recently was installed to recover the heat in the sewage stream, which is about 60 degrees in winter, 75 degrees or more in summer.

The York County, Pa., plant has a process that recovers phosphorus - a fertilizer in limited supply worldwide - for processing and reuse.

Some day, Neukrug and others say, it may be both technologically and economically feasible to mine sludge for other nutrients and heavy metals.

At the city's Northeast plant in Bridesburg, Pa., the resource is "biogas."

There, sewage solids are separated and sent to eight 2.1 million-gallon tanks, where bacteria digest the material and reduce its volume. In the process, they give off a flammable gas that is roughly 63 percent methane.

Christopher Crockett, Water Department deputy commissioner for planning and environmental services, likens the process to that in the human stomach, gas and all. Stuff arrives; microbes digest it.

"This is just a larger, industrial-size scale," he said.

The remaining solid matter used to go to a landfill. Now, it's sent to a plant near Philadelphia International Airport, to be converted into pellets

to fertilize golf courses and farms, or fuel cement kilns.

But back to the gas.

It is piped to the new biogas "cogeneration" facility on the site of the Northeast plant.

In essence, cogeneration is the simultaneous production of electricity and heat from a single fuel source, according to the U.S. Environmental Protection Agency, which endorsed the technology.

After treatment to remove moisture, hydrogen sulfide, and "siloxanes" - residue from the decomposition of soap, shampoo, and other personal-care products - the gas is burned in four massive reciprocating engines.

The result is 43 million kilowatt hours of electricity a year, enough to power more than 4,000 typical homes - or, more pertinent to the project, enough to meet 85 percent of the power needs of the sewage treatment plant.

The combustion also produces heat. Much of it is captured and returned to the digesters, where it helps keep the sludge mix at 95 degrees, the optimal temperature for microbes to do their job.

"Very simple," said Paul M. Kohl, Water Department energy program manager. What's not simple, he said, is getting there - the miles of piping, the heat exchangers, the monitors, computers and other instrumentation, all in communication.

All told, the process captures more than 80 percent of the available energy for heat and electricity, according to the Water Department. In contrast, a coal-fired electricity generating station is about 35 percent efficient.

The plant's carbon emissions have been reduced by about 22,000 tons a year - the equivalent of taking 4,833 cars off I-95, or planting 5,390 acres of pine forest, by Water Department calculations.

Department officials had mulled a biogas cogeneration plant for a while. But, ironically, electricity rates were low enough that the project would not be economically feasible.

Recently, however, rates increased to a point where it made financial sense.

The city partnered with Ameresco Inc., a Massachusetts-based company that specializes in energy efficiency and infrastructure upgrades for facilities across North America.

Financing came from Bank of America, which technically owns the facility; the city is leasing it for 16 years, with an early buyout option.

The project also qualifies for an investment tax credit of about \$14 million and a \$3.9 million state energy efficiency rebate.

The plant gets praise not only for producing electricity from waste, but also for producing it on-site, avoiding the electricity losses from transmission.

The next goal: producing all the plant's electricity needs, to create a net-zero facility.

The beauty of it, in Kohl's view, is that the plant's core mission - "to treat (wastewater) and discharge high quality effluent and cost-effectively use the solids" - isn't compromised by the newbie operation.

Capturing waste methane and putting it to work, Kohl added, is "a

bonus."

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Citation: New use for sewage: Producing heat and electricity (2014, January 30) retrieved 24 April 2024 from <https://phys.org/news/2014-01-sewage-electricity.html>

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