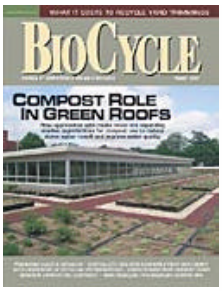

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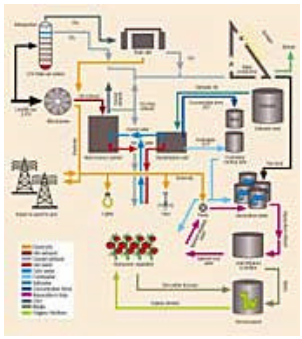

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The Burlington County, New Jersey Resource Recovery Complex combines the day-to-day workings of waste management facilities into a unique partnership with Rutgers University's sustainable business initiatives.
Part I

Nora Goldstein

IT'S NOT OFTEN you follow a garbage truck into a landfill and discover a whole, new world of ecoentrepreneurism. But turn into the Burlington County, New Jersey Resource Recovery Complex and you'll find just that, starting with the Rutgers University EcoComplex right by the entrance, which houses a sustaina

ble business incubator. Further back in the complex, you'll discover a 46,000-sq. ft. greenhouse heated and powered by landfill gas. “When we developed the Master Plan for the Resource Recovery Complex in the late 1970s, it was always the county's intention to co-locate all of its solid waste processing, treatment, resource recovery and recycling facilities at the same location as the landfill to take advantage of potential synergies - even though we were not sure of the full nature of the possibilities,” recalls Robert Simkins, Director of the Burlington County Resource Recovery Complex. Over the years, other solid waste operations have indeed co-located at the landfill, including a cocomposting facility, a household hazardous waste facility and a wood recycling operation. But the resource recovery park has evolved into something much broader - a home for innovation and entrepreneurship, research, education and technology development, all within a framework of a partnership between Burlington County and Rutgers University.

The history of the Resource Recovery Complex (RRC) starts with its siting. “Burlington County is located in the New Jersey Coastal Plains with strata of either clay or sand outcrops,” explains Simkins. “The county limited its site selection to the clay outcrops for added groundwater protection.” Another important consideration was highway access to the site since the Complex was servicing all of Burlington County, which is 827 square miles. “The most suitable clay outcrop, the Woodbury clay, paralleled the New Jersey Turnpike and Interstate 295,” he adds. “Interestingly, the Transcontinental Gas pipeline runs along the New Jersey Turnpike. Out of eight identified sites, two were located on the Woodbury clay. Ultimately, the county selected the site we are at today because of its close proximity to an exit off I-295, superior subsurface clays and the potential for future resource recovery projects that might involve the natural gas pipeline.”

Coincidentally, in 1975, the U.S. Department of Energy had a funding program for commercialization of anaerobic digestion technology. A study was undertaken in New Jersey to find two sites that could be eligible for the funding. One was in Hackensack, New Jersey (in the Meadowlands, home to the New York Giants football team); another was at the RRC location. “There was a small landfill here,

and a company involved in sewage sludge management had bought the landfill, with the intention of purchasing additional land and bidding on some major biosolids management contracts," adds Simkins. "That project didn't go forward, but it got us to thinking - while we were doing the Master Plan - that perhaps the county may do anaerobic digestion in the future, and having access to the pipeline would be important."

Ultimately, Burlington County purchased the 522-acre site, and began the process of building a landfill with the capacity to receive about 1,500 tons/day of solid waste. The landfill opened in 1989. By that time, plans were underway for the first co-located facility, a biosolids cocomposting plant. Amendments to the state's solid waste act, adopted in 1977, recognized that management of sewage sludge and solid waste was "inherently compatible." As such, New Jersey counties had to include biosolids in their solid waste plans. "Our intent, early on, was to separate organics out of the waste coming into the landfill, and compost those materials with sewage sludge," notes Simkins. "While that may still happen at some point, we ended up establishing a wood recycling operation adjacent to the landfill. Wood shredded in a Diamond Z tub grinder is used as the bulking agent for biosolids composting." (A complete article on the biosolids composting facility, which uses the IPS/USFilter composting technology, will appear in an upcoming issue.)

ENTER THE LANDFILL GAS

When the landfill opened in 1989, the county had a limited system in place to manage the landfill gas generated. During the first five years, it didn't appear to be an issue, as staff were not detecting any landfill gas odors. Then, in 1996, while Burlington County was in the process of going out to contract to have wells installed to capture methane, the odors hit. "They came fast and furiously," says Simkins. "That is when we had the wake-up call on landfill gas generation and management and knew we had to get more serious and aggressive about it." Flares were installed, but Simkins notes, it had always been part of the county's plan to recover the energy from the landfill gas. Discussions began in the early 1990s about building a cogeneration plant that would use the landfill gas to produce electricity (to be discussed in Part II of this article). But Burlington County had other ideas as well, he explains. "When we were preparing the Master Plan, everyone agreed that the Complex would be a great place to do research, and a great place to teach students of all ages and the public at large about recycling, energy recovery, composting, and so forth. In addition, we had always wanted to develop a research and education relationship with Rutgers University, the state university."

An opportunity to collaborate with Rutgers arose shortly thereafter. The university had a small greenhouse on campus. Researchers had been working on a single cluster hydroponic tomato production system that had the potential to boost plant production in a shorter growing cycle. The university was looking for a place to demonstrate the production system and had been considering a location at a power plant, in order to take advantage of the waste heat. Robert Shinn, a former Burlington County Freeholder (county legislator) who had participated in development of the solid waste master plan, was serving at that time as a state legislator. "Mr. Shinn heard about the greenhouse project and spoke with the people at Rutgers," says Simkins. "After learning the details, he thought that would be an innovative project to bring to the Burlington County Resource Recovery Complex, using the landfill gas to heat and light the greenhouse."

The Burlington County Board of Freeholders agreed to have the greenhouse constructed, using funds from landfill tipping fees. Rutgers designed the 46,000-sq. ft. facility, which opened in 1996. The boiler initially was fueled by propane until a gas line was run to the greenhouse. The landfill methane fueled the boiler, which in turn provided heating for the greenhouse. The single cluster (truss) tomato plants are grown at a high population density to maximize facility production. (Plants are topped-off above the first cluster of flowers, forcing the plant to channel its energy into the remaining cluster, yielding larger and more flavorful fruit.) Through an agreement with the Occupational Training Center (OTC) of Burlington County, the greenhouse provides employment for people with disabilities. (The OTC was already operating the county's curbside recycling program, including collection and management of the MRF.)

A goal of the greenhouse program was to transfer the technology to growers. At the time it was constructed, it was estimated that there were more than 140 biogas generation sites in New Jersey that would be suitable for greenhouse operations. About two years ago, four 30 kW Capstone microturbines were installed outside of the greenhouse. The microturbines convert landfill gas into electricity that is used in the greenhouse, e.g. for growing lights. Waste heat is recovered from the turbines and used to heat the greenhouse when ambient temperatures require it. (Additional details will be provided in Part II of this

article, to appear in the next issue of BioCycle.)

ENTER THE ECOCOMPLEX

As it turned out, the collaboration with Rutgers University on the greenhouse was just the beginning of a partnership that has blossomed into a full-fledged research and education facility and business incubator owned and operated by Rutgers and located at the RRC. The Rutgers EcoComplex is part of the New Jersey Agricultural Experiment Station. “We refer to the EcoComplex as an environmental research and extension center,” explains David Specca, acting Director of the EcoComplex. “A traditional experiment station/extension center does applied R&D for farmers, who then can benefit from the technology transfer. Being close to the landfill allows us to do research around the resources available at a landfill, exploring agricultural and environmental opportunities. We also have a business incubator to provide assistance to start-up, environmentally based companies.” Because Burlington County has restrictions on its tax-free bonds used to construct the landfill and other solid waste facilities in the RRC, all private sector activities are done through the Rutgers EcoComplex.

The seed for the EcoComplex concept was planted during development of the greenhouse. Dr. William “Rod” Sharp, at that time Dean of Research at Cook College (where the New Jersey Ag Experiment Station is based) at Rutgers University, was exploring the concept of joining forces with other universities in the region to research and then scale-up environmental technologies. The business opportunities around the greenhouse - both for agriculture and for utilization of landfill gas - led Sharp, Shinn, Simkins, Harry Janes (Department of Plant Biology & Pathology at Rutgers) and others to the concept of the Rutgers EcoComplex. (Sharp left Cook College a few years ago and is currently involved in a project in Brazil to start an EcoComplex, which could work in tandem with the Rutgers EcoComplex.) Initially, the Rutgers EcoComplex was created as a “soft-walled” research center in 1996, and focused much of its work on using landfill gas as an energy source.

In 2001, a 32,000-sq. ft. facility was opened, which houses the county's solid waste and recycling offices, the business incubator, research laboratories, and a 180-seat auditorium. Companies in the incubator include Acrion Technologies, Inc., which developed a carbon dioxide wash system to clean up landfill gas for multiple uses; Garden State Ethanol, a consortium of farmers building a corn-to-ethanol plant in southern New Jersey; HydroGlobe, a water filtration company specializing in arsenic removal; and TerraCycle, a company that makes liquid fertilizer out of vermicompost tea.

Bill Brown, cofounder of Acrion Technologies, met Bob Simkins at a New Jersey tradeshow on landfill gas technologies in 1996. “Bob saw our display of smoking dry ice and thought our technology would have application at the greenhouse,” recalls Brown. “The EcoComplex was only a concept then. Bob invited me to take a tour of the landfill and the greenhouse, which had just opened. We were in the process of selecting a landfill site for our first demonstration. While that demonstration project didn't work out in Burlington County, Bob and Dave Specca never lost enthusiasm for our system.”

Acrion's technology removes siloxane contaminants from landfill gas to below a detection limit of 5 parts per billion. Siloxane compounds deteriorate rotor blades, spark plugs and other engine parts when raw landfill gas is used without cleaning it. The CO2 wash process removes hydrogen sulfides, VOCs and siloxane and produces a food grade liquid CO2 and methane. Clean landfill gas can be used in fuel cells, as well as converted to liquid or compressed natural gas.

In the late 1990s, Acrion submitted an application for a U.S. Department of Energy (DOE) Small Business Innovation Research grant to demonstrate its technology using raw landfill gas that would generate clean methane and food grade CO2. Acrion received the grant. The EcoComplex facility, which was to house the equipment for the research and an Acrion office, was still under construction. “We moved equipment there in 2000, ahead of the building's completion,” says Brown. “Then, in the summer and fall of 2001, we ran the equipment to generate the data required under the DOE grant. We were the first ones at the EcoComplex - before the toilets even worked - and we have been there ever since.”

In 2002, Acrion began working with Mack Trucks, which supplies the majority of trash collection trucks in the U.S. The two companies, in conjunction with a DOE office in Brookhaven, New York, worked out a pilot test, where two new dedicated natural gas Mack trucks manufactured for Waste Management would run on liquid natural gas made from clean landfill methane. Chart Industries supplied the fueling station and liquid methane storage tank for installation at the

EcoComplex. Landfill gas is fed into the Acrion unit, which is located in the technology transfer laboratory of the EcoComplex. The clean methane is condensed using liquid nitrogen (supplied by Air Products & Chemicals), which yields liquid natural gas. The two trash trucks go out on their collection route, tip their loads at the landfill, then refuel at the EcoComplex building. The pilot ran from August through December 2004; Mack Trucks and Acrion are exploring continuation of the pilot project next spring after a brief winter shut down.

Brown reports that Acrion and its partner firm, Green Energy in Irvine, California, have started developing a commercial-scale project at the Franklin County Landfill in Columbus, Ohio. The project has contracted to take at least 3 million cubic feet/day of landfill gas and convert it to methyl alcohol, producing about 15,000 gallons/day. "Methyl alcohol is a commodity chemical," he explains. "It can be used as a fuel, and in fact, is being considered for fuel cells as it is a good carrier of hydrogen."

GROWING OPPORTUNITIES

The original landfill at the Burlington County Resource Recovery Complex closed in 1998. The second landfill was constructed and is operated as a bioreactor landfill, recirculating landfill leachate and recycling water and wastewater from other operations in the RRC. Between the closed landfill and the bioreactor cell, about 4,000 cfm of landfill gas is generated. That quantity is expected to increase as additional bioreactor cells are opened. The 7 megawatt cogeneration plant, which is planned for construction, is expected to use about 2,300 cfm of landfill gas, leaving about 1,700 to 2,000 cfm for other uses.

At the greenhouse, the research and innovations continue. In addition to testing microturbines, plans are in the works for installing a fuel cell to provide electricity, heat and carbon dioxide for operations. In the near future, a pilot-scale anaerobic digester will be installed right outside the greenhouse, processing food residuals from a local assisted living facility and plant waste from the greenhouse. Digester gas will be piped to the microturbine. Inside the greenhouse, an aquaponics operation is in full swing, growing tilapia for sale to area fish markets. Wastewater from the fish tanks is used to fertilize hydroponic plants; the plants remove nutrients in the water, allowing the water to be reused in the fish tanks.

Part II of this article will provide more details on the bioreactor landfill, activities at the greenhouse, and other companies in the business incubator, including TerraCycle and its liquid fertilizer production operation, and the evolving ethanol plant. It also will report on initiatives in Ohio and Brazil to create additional EcoComplex facilities.

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