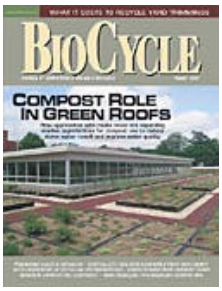

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LANDFILL GIVES BIRTH TO ECOINDUSTRIAL COMPLEX

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New Jersey's EcoComplex is incubating companies that can grow fish inside a greenhouse heated by landfill gas, produce ethanol from local crops, make compost tea and water filtration systems. Part II

Cindy Rovins

RIGHT at the entrance to the Burlington County, New Jersey Resource Recovery Center is Rutgers University's EcoComplex, a sustainable business incubator

housing firms launching innovative enterprises. Further back, there's a flourishing greenhouse heated and powered by landfill gas. One cannot come away from the Resource Recovery Center - described in the first part of this series in December, 2004 BioCycle - without the impression of how well the components carefully complement each other to maximize energy efficiency and reduce/reuse waste.

The primary purpose of the greenhouse facility is to showcase new technologies in “real world” conditions for economic development. Designed by the Bioresource Engineering Department of Cook College, Rutgers University and built by the County of Burlington's Board of Chosen Freeholders, the greenhouse has numerous environmental technologies incorporated into its design. These technologies serve to give the greenhouse a soft footprint on the environment. Operational since 1996, it is one of the largest research greenhouses in the U.S. with over 46,000 square feet of production space and 10,000 square feet of support buildings.

Rutgers University EcoComplex Acting Director Dave Specca is doing his doctoral thesis on aquaponics - the combination of aquaculture with hydroponic plant production. Unlike most research work that is narrowly focused, Specca and the managers of the greenhouse perform a wide-range balancing act with various systems feeding in and complementing one another. In this artificial ecosystem, they have to make sound adjustments to ensure they all function optimally. This is not without its challenges, but by virtue of being a research facility, tweaking the system until it works lays the groundwork for commercial application.

Starting with the heat and power, as described in Part I, microturbines convert landfill gas (LFG) into electricity which is used mostly for the growing lights in the greenhouse. Waste heat is recovered from the turbines and used to heat the greenhouse when ambient temperatures require it. According to Specca, the original system to clear up the LFG for the turbines was insufficient because there was a lot more moisture in the LFG than anticipated. Excess moisture caused problems with the compressor, the siloxane filter that's in the line, and the pressure regulators for the microturbines.

AQUAPONICS SYSTEM

When selecting the aquaponic process to use in the greenhouse, they decided to use that of Dr. Jim Rokacy, whose outdoor unit at the University of the Virgin Islands in St. Croix was the most sustainable. Rokacy's design had low energy

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and management inputs, high water and heat efficiency and didn't rely entirely on a small, individual biofilter. In other systems, if the biofiltration tank crashes, the fish die. Rokacy helped Rutgers design and build an alternative, the first time applied to a greenhouse.

Tilapia are grown in 10-foot diameter, 2,000-gallon tanks, 700 fish per tank. The free ammonia - produced by the fish in high amounts - is toxic to fish. The wastewater proceeds through a series of processes before it is cycled back into the tanks. First it flows into a solids settling tank, where the fish manure and excess food are removed. This solid waste was previously used in the vermicomposting operation in the greenhouse (see TerraCycle report below), but as they are working with other source materials, the fish solids are diverted to the sewage treatment plant. Using the fish solid waste as a fertilizer may be developed later.

The next processing tank is the biofilter, which looks like a stationary tub with water flowing through bird netting. Naturally occurring beneficial nitrifying bacteria, which come in on the fish, convert the free ammonia to nitrate nitrogen, the primary nitrogen source for crops. The water then flows to troughs where hydroponic tomatoes utilize the nitrogen and other plant nutrients. After the plant troughs, the water goes through an aeration step and then drains into a sump that contains a heating coil, and a pump pushes the heated water back into the fish tanks. The pump and the aeration blowers are the only parts which require electricity; the rest works on gravitational flow. The waste heat from the microturbines heats the water for the fish tanks.

The aquaponics is currently operating as a single layer where the fish are at one end of the greenhouse and the tomato crop is at the other end. Specca's plans to incorporate a double layer, where the tanks are under the plants will maximize greenhouse space. The fish tanks can then become a heat reservoir for the greenhouse - if it is cold in the greenhouse, the fish water radiates heat to the crop. Plants are housed on rolling benches, allowing easy access to the tanks and accessibility for the workers to pick the crop.

So as not to compete with the local market for the renowned Jersey tomato, greenhouse production is limited to the end of October through the end of July. As a side note, greenhouse-raised tilapia are not prone to the same circumstances that cause health concerns with outdoor farm raised fish. Being under cover and protected from bird droppings and other exposures, they don't require treatment with antibiotics, fungicides or hormones.

The tomatoes also fare well. They can go through several tomato crops which don't need any insecticide sprays, until the late spring when the season warms up, and they start to encounter insect problems. One strategy used is to bring in beneficial insects to help keep pests under control.

So where will all this tweaking and environmentally soft footprinting lead the greenhouse? Says Specca, “Hopefully in the end we will have a product that is not only profitable to a company, but tested to the point where other landfills can feel comfortable applying the technology.”

INCUBATOR BUSINESSES

The Rutgers EcoComplex, a part of the New Jersey Agricultural Experiment Station, serves as home to several incubator firms that are developing their businesses with assistance from the EcoComplex via research, facilities use and/or feasibility development. Acrion Technologies, whose siloxane removal system from landfill gas is used in running the greenhouse and the refuse trucks, was featured in Part I in the December, 2004 issue. The other incubator businesses at the EcoComplex are highlighted here.

GARDEN STATE ETHANOL

Development of ethanol is being fueled in part because of increasing levels of water contaminants from fuel additive MTBE. Of the 24 states to use MTBE, 17 have since banned its use. Ethanol can be used either as an additive replacement for MTBE, or in a fuel mix of up to 85 percent ethanol and 15 percent gasoline, known as E85. E85 fuel mix is available in 22 states, mostly in the Corn Belt states of the Midwest, where the majority of the nation's ethanol plants are located. Most cars today can run on five to ten percent ethanol blends, and many of the newer cars can use up to 85 percent ethanol.

For states in the Northeast such as New York and Connecticut that have banned MTBE, ethanol is shipped by rail from the Midwest. The additive is not yet banned in New Jersey, but there is pending legislation. So the time is ripe to look into ethanol production in the Northeast, where virtually no ethanol plants exist. Enter Garden State Ethanol (GSE) - a partnership with the New Jersey Farm Bureau, Rutgers University, the New Jersey Grain and Forage Growers Association and a core group of farmers and other agribusiness professionals. Formed in

September, 2001, the intent of GSE is to build the first ethanol facility on the East Coast. According to GSE project director Henry Capro, there are 100 million bushels of field corn grown within 80 miles of the proposed plant site. This area encompasses New Jersey, Pennsylvania, Delaware and Maryland.

The ethanol plant will produce 40 million gallons of ethanol from 14 million bushels of corn and sorghum annually via dry milling. The by-product distiller grains will be distributed as animal feed. A carbon dioxide partner will be located on-site to take fermentation based CO2 gases. This will be used for flash freezing and carbonated products. Waste heat from the ethanol plants will be used in a greenhouse/aquaculture operation. A biomass boiler fed farm grown and waste wood will run a cogeneration plant that will provide energy for the previously mentioned operations, as well as a plastics recycling facility. This will make it the first low emissions renewable energy ethanol plant. Figure 1 shows a flow chart for these connected operations.

In sharp contrast to the northern part of the state where petroleum refineries line the New Jersey Turnpike (a less than scenic landscape), the ethanol plant site will be in South Jersey, in the heart of most of the state's farmland. The site is located in West Deptford, with direct access to both highway and rail transportation and includes infrastructure that can be incorporated into the ethanol facility. In addition, the location offers the ability to add related agricultural processing production.

With the site design and location under its belt, GSE is seeking investors to fund the land purchase and facilities construction. Between $90 million to $100 million will be needed, all to come from private sector investors. The New Jersey Department of Environmental Protection's site inspection process also will be undertaken. The site approval process may take a year, but it is unknown how long it will take to obtain the total funding. In the meantime, the EcoComplex has played a key role in their establishment.

TERRACYCLE

Manufacturing a vermicompost tea plant food, bottled in used soda bottles with spray lids that are overruns, TerraCycle's product is touted as having a “negative environmental footprint.” Founded in 2001, the company grew out of a project by two Princeton University students. Now on “indefinite sabbatical” from Princeton, company founder Tom Szaky, 23, explains that the company is motivated not by environmentalism, but by profit.

TerraCycle does the bottling and manufacturing of the compost tea in a Trenton, New Jersey facility. Vermicompost is received from several suppliers, after testing for best plant growth results depending on the original material being composted.

TerraCycle's research is based at the greenhouse at the EcoComplex. This also serves as a demo site for educational tours for schools and other groups. Here it researches use of the plant food in a variety of applications such as liquid fertilizer, foliar spray and hydroponics. It also tests various materials and mixes for optimum plant growth. Some wastes tested for vermicompost potential are cow manure from local farms, clean paper sludge diverted from the landfill for a carbon source, and coffee grounds, beer hops and corn silage. The company also sees the potential for using preconsumer food wastes from spoilage.

While its waste-into-profit strategy is unconventional, so too is the marketing strategy. Its marketing base is firmly planted in the community within which they operate. TerraCycle offers a school educational/fundraising program where schools can select from several options: an educational assembly, worm boxes for classroom use, banners for children to provide environmentally-themed art work, tours of the vermicomposting demo at the EcoComplex greenhouse, or fundraising through plastic soda bottle collection for TerraCycle - enabling the students to see their efforts end up in a finished product on store shelves.

So far, TerraCycle's diligence has paid off. In addition to many retailers nationwide, it supplies product to Home Depot's on-line sales division and Wal-Mart Canada. Its streamline operation based on waste has allowed them to get a stronghold as a start-up company on a shoestring. Every piece of furniture in its office was salvaged from dumpsters. The gallon containers for hydroponic product are misprints. The cardboard boxes are overruns or recycled.

Just as it experiments with the right mix of compost to stimulate plant growth, TerraCycle tests fertile ground for company growth. It plans to expand to another facility to conduct its own vermicompost manufacturing, develop a product for the leftover vermicompost solids from the tea manufacturing, develop a product label from corn polymers and experiment with new sources for compost such as preconsumer supermarket waste.

HYDROGLOBE

HydroGlobe is the first “graduate” of the EcoComplex. Purchased by Graver Technologies in November, 2004, it is now based out of Graver's headquarters in Delaware. HydroGlobe manufactures material for water filtration systems. Although other materials filter out heavy metals, HydroGlobe is unique by removing lead and arsenic in both its naturally occurring states. The material is used by small and large scale water filtration systems, from kitchen filtration products, to whole house filters, to municipal water treatment.

Born out of a technology developed at Stevens Institute of Technology in Hoboken, New Jersey, HydroGlobe got its start in 2001 in a technological incubator there. According to HydroGlobe's President and CEO John Schroeder, “When Steven's incubator program shut down, we could have remained at the facility since the technology was developed there.” But the closing of the incubator also dried up other resources available to them. It was serendipity when Schroeder then was introduced to the EcoComplex.

HydroGlobe moved into the EcoComplex in November, 2003, where it utilized office and lab space and had access to administrative staff. The owners used their new facilities to host conferences along with presentations by EcoComplex personnel. By virtue of being in a building with other companies and organizations focused on environmental issues, they were able to gain new perspectives and connections. Certification of the product was facilitated since New Jersey Corporation for Advanced Technologies, which works with the New Jersey Department of Environmental Protection to certify environmental technologies, had its office in the building.

Since the U. S. Environmental Protection Agency has ordered that by 2006 all water systems meet drastically reduced arsenic levels (to ten parts per billion), removing arsenic and other heavy metals from water supplies has become a top priority of municipalities, small community water systems and individual consumers. HydroGlobe's outlook looks crystal clear.

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