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Cover Story: Trash Talk

Striding across the campus of the Lawrenceville School, Priscilla Hayes mutters darkly. A committed environmentalist, a woman who has always had saving the world at the very top of her agenda, her lowered tone may reflect her ambivalence at uttering a recycling heresy. "Recycle plastic?" she says, with a what's-the-point shrug. "And what do you get, a bottle?"

Hayes, coordinator of the New Jersey Solid Waste Policy Group, a grant-funded organization headquartered at Rutgers University, is not opposed to recycling plastic - far from it - but she has bigger ambitions for waste. She is currently zeroing in on the half-eaten pork chops, lasagna casseroles, and Caesar salads that get tossed into the trash in homes across New Jersey every day. She is also keen on putting expired salad bar fare, past-prime cabbage, and un-served restaurant dinners to work - along with plate scrapings from prisons, prep schools, and institutions of all kinds. On this day, she is at the Lawrenceville School to observe its food separation efforts. The school is close to the point where it will be able to recycle its food waste, and she is providing advice on doing so.

Food waste makes up a full 25 percent of the weight of the country's waste stream. It is often thought of as harmless, because, after all, it's organic. It will just decompose and return to the earth, right? Well, only sort of. First of all, it needs a place to go, and landfills across the Tri-state area are more full than a typical buffet aficionado after his third pass by the steam tables. Some landfills have closed, and others are reaching capacity.

Even food waste able to squeeze into a landfill is not completely benign. For one thing, it leaches out, potentially harming nearby streams and soil. And as it rots, packed down and deprived of oxygen, it also produces flammable methane gas in quantities large enough so that landfill operators often need to burn it off, a process that pollutes the air and promotes global warming.

Use that gas, Hayes urges. While recycled plastic can just make more bottles, the methane from recycled food waste can power our cars and trucks, thereby, she points out, delivering all of us from dependence on foreign oil - or indeed on any oil at all.

The discarded food can also be turned into compost or fertilizer that will enrich our state's badly depleted soil.

The Solid Waste Policy Group, formed in 1996 and fueled by grants, is working to put last night's leftovers to work. It is trying to persuade institutions of all kinds to separate food waste and to ship it to companies that are turning it into useful products - including dinner for the state's pigs. At the same time, it is providing assistance to start-ups with plans to build profitable businesses around food waste. "It's 90 percent outreach," says Hayes. "It's door to door."

It's not easy work, and problems keep sprouting up. Hayes, an attorney who graduated from Princeton in 1975 and earned her J.D. from Duke, has been with Rutgers for some 10 years. She was with the New Jersey EPA before that, and appears worn down from trying to make something positive from the mounds of garbage accumulating throughout the state.

Really, it is always something. Right now, a problem is mad cow disease - and it's a typically vexing, largely nonsensical problem.

"Envirofeed in Perth Amboy was having problems with permits, but it was mad cow that killed it," says Hayes. That start-up, an off-shoot of a larger company, was one of only a small number of businesses which would accept "mixed" food waste, that is, waste from which meat has not been separated from vegetables. The company turned food waste into pellets and sold them to animal feed wholesalers. "But then people didn't want to buy animal feed containing plate waste," says Hayes. "They didn't want to take a chance." This, in Hayes' view, is crazy. "That food had already been served to humans," she points out.

One of the very few options now is to ship plate waste to pig farms. Both Rutgers University and Princeton University do this. "Princeton has money," says Hayes. "It puts the waste in a refrigerator." Rutgers may not have as much cash at its disposal as does Princeton, but it has commitment to spare. "Rutgers has been doing it for ages," says Hayes. "They have a guy there, Jim Vernere, who has been doing it forever. He bought a piece of equipment that pulps it and squeezes a lot of water out. Water is not good for the pigs."

The universities pay the farmer to take the food away, but the cost for disposing of it this way is less than they would have to pay a garbage hauler to take it to a landfill.

The farmers add vitamins to the student leftovers, and produce a tasty, nutritious meal for their porcine charges.

It sounds like a win-win, but in Hayes' world there tend to be dark clouds aplenty. In this case, it's the disappearance of pig farms. Once an announcement of the northeastern border of the Garden State more potent than any billboard could ever be, the pig farms that perfumed the northern end of the Turnpike long ago gave way to venues for the New York Jets and Giants, and their numbers continue to decline. Hayes says that the number of pig farms in the state - potential recyclers of plate scrapings - has dropped from 30 to 19 in just the past few years.

But there will be new ways to turn food into useful products. Hayes is working with Trenton Fuel Works on its plan to turn an abandoned industrial facility in Trenton into a plant for the production of vehicle fuel (see page 15). Adding food waste to an alternative fuel mixture cuts the use of ethanol, a relatively expensive product that is made from corn. And, of course, food waste does not need to be sown and harvested, which also saves energy.

Hayes is working to help all of the Trenton Fuel Works of the state to get up and running through everything from networking to lobbying. She has been meeting with legislators and says "I want to meet

with the governor." She is pushing for financial incentives and rebates to encourage food recycling "like the rebates and grants for solar."

"Low long can we buy overpriced oil?" she asks.

Hayes is nothing if not intense. Saving the world is not a hobby for her, nor is it a new interest. The graduate of a "weird little high school in New Mexico" (graduating class size, 12), she began her career as a civil rights lawyer for the state before switching to environmental law with the NJ EPA. After chasing polluters, she went to Rutgers to work on the underpinnings of the state's Right to Farm law.

And why should such a law be necessary in the Garden State? "People have an idea of a Fischer Price farm, she says. "Two cows, and a chicken. Very pretty."

But when suburbanites, having bought a house because of the charm of living next door to such a bucolic venture, discover that farms emit noise at all hours and don't always smell like a meadow in summer, they sometimes try to shut down the operations and rarely give in to its expansion.

Laws needed to be tightened to protect the farmers from their neighbors, and Hayes did the analysis to make it happen. "I'm very proud of that accomplishment," she says. But asked to talk about just what changes her analysis prompted, she says that language was tightened up, but beyond that, she doesn't know exactly. Her demeanor leaves no room to question the reason for this lapse. "I always have so many projects," she says.

Not hard to believe, in part because she took a lengthy cell phone call from one of the start-ups she's helping as she walked to lunch and stopped by at the office of the headmaster of the Lawrenceville School on the way back from lunch to check on details for an environmental conference she is putting together for this year's Princeton University reunions.

Oh, and there was also a call from her younger son, Doug, a student at Notre Dame High School. "I like to know when he's gotten to where he's going," the world saver says. She and her husband, Peter Patterson, a plant pathologist with the NJ DEP, have another son, Dan, a freshman at Princeton University.

She grew up all over the world as her father, Stuart Hayes, pursued teaching jobs from the American Southwest to islands in the Pacific. "I spent my senior year in high school in Guam," she says. Right after that, the family, including her mother, Louise, a home-schooling teacher, moved to Lawrenceville, where her father taught for many years at the Lawrenceville School.

There have never been an easy victories in Hayes' work, just a two-steps-forward, one-step-back kind of progress. But she understands the big picture, sees the big goals, and has a good idea of how to reach them.

What's more, she has achieved something which has eluded the vast majority of 21st century working people. Says Hayes, "I have loved every single job I have ever had."

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Follow the Leftovers To the Money Trail

The good thing about food recycling is that it can make you money coming and going. Money comes from fees paid by waste haulers at the front end, and from sales of recycled products at the back end. Given the rising cost of disposing of food waste in landfills, making a business of turning over-ripe berries and brown bananas into new materials is starting to make economic sense. But the road from rotting food to riches is not a smooth one.

Eastern Organic Resources (www.eorcompost.com), owner of the Woodhue Composting Center in Wrightstown, is a company so confident that there is a business in doing well by doing good that it is getting ready for a major \$40 million expansion of its recycling facilities. But its Burlington County neighbors, like garbage dump neighbors everywhere, are increasingly disgusted by the odors emanating from Woodhue, and are threatening to close down its operations and thwart its expansion.

On its way to creating a multi-site food recycling operation in several states, Eastern Organics has been assessed some \$700,000 in fines by the DEP for everything from inadequate odor control to failure to submit a plan for installing ground water monitoring wells. Richard Kish, general manager, says that the fines were reduced to about \$200,000 in exchange for site improvements, and that the expansion - which will do away with the odor - is on track. Still, Burlington County residents are less than thrilled with having a garbage collection facility in their backyards - despite the fact that it is turning waste into useful products - and vow to battle on.

Headed up by David Goodemote, a Boston resident who is on his second career, Woodhue receives 200 tons of vegetative waste at its 160-acre Wrightstown facility each day and turns it into compost that is used for everything from wetlands restoration to enriching dead soil at Toll Brothers' housing projects so that new residents will be able to grow grass. Contractors, landscapers, and garden centers are the company's biggest customers.

Goodemote, who commutes home every weekend to see his family, is heading up operations at the Wrightstown operation, of which he is a part owner, for a Boston consortium of real estate developers "who wanted to do something with solid waste." He is an enthusiastic supporter of the Rutgers Solid Waste Policy Group, where he enjoys networking with others in his relatively new business niche.

Prior to joining Eastern Organics, Goodemote, an RPI graduate (Class of 1972) and an environmental engineer with more than 30 years experience, was part owner of Sea Consultants (www.seacon.com), a multi-location New England-based company that designs landfills, transfer stations, picking stations, and general public works projects. He left Sea Consultants to help form Eastern Organics, a three-year-old company, because, he says, "I wanted to operate, not just design."

At present, Eastern Organics operates an open-air landfill that is the only New Jersey facility allowed to accept food waste. It's hard to get rid of food waste, Goodemote points out. Landfills are expensive, and, in some part because of odor problems, there are fewer pig farms. "Farmers plow some food waste into the ground, but it's hard to control and not all that environmentally sound," he says.

At his facility haulers bring in source-separated, pre-consumer vegetative waste - no meat and no dairy. "A good portion comes from area grocery stores," says Goodemote. He receives food waste from all of the major chains in New Jersey, and some in Pennsylvania and New York.

Another big supplier is Ready-Pac, a Florence company that puts together pre-made salads. "Forty-percent

of the greens in salads are disposed of," explains Goodemote, "the outer leaves, etc. It has to go somewhere. It can go to a landfill, but we're less expensive."

Still, getting waste generators to sign on is not easy. "Supermarkets are the toughest sell," says Goodemote. "They run on such a low margin." They also tend to have high personnel turnover, making training a challenge. But Goodemote does have a powerful hook to use with supermarkets. "Saving money is important to them," he says.

Landfill rates in New Jersey run between \$75 and \$100 a ton. In New York the rates are \$125 to \$150. Eastern Organic charges haulers about 30 percent less.

The loads that haulers drop off cannot contain fish, meat, metal, glass, or plastic. "We call all of that contamination," says Goodemote. "If it's more than 1 percent contaminated, we reject the load," he says. "Haulers can take it away or we will - for the normal tipping fee plus the landfill fee." This becomes an expensive proposition, and, says Goodemote, "it doesn't take too many of those trips to get people to comply."

Napkins, by the way, are fine. In fact, paper products, including shredded cardboard, are added to the composting process. One benefit is that they cut down on odors, so Woodhue is using even more paper now in an effort to mollify its neighbors.

The food waste materials, broken down by naturally-occurring microbes, and churned to allow oxygen to help with the process, are now turned into compost in about 10 to 12 weeks through aerobic, or oxygen-aided, digestion. At the end of the process carbon materials, including wood chips, leaves, and shredded cardboard are added. Some of the compost is enriched with clean soil and turned into topsoil. Both the compost and the topsoil are sold only in bulk, by the truckload, 25 to 30 yards at a time. Some goes to garden centers, which sell it to consumers, but most goes to contractors, who use it for everything from capping landfills to landscaping roadsides for the state.

"We sell everything we make, and if we could make more, we could sell it," says Goodemote. "Last year we sold 100,000 yards of compost and topsoil."

Eastern Organic hopes that soon it will be turning a lot more food waste into not only compost and topsoil, but also into methane gas, which is destined to power McGuire Air Force Base and to heat its water.

The company is financing its new facility through New Jersey's Environmental Infrastructure Trust, to which it has applied for a \$35 million low-interest loan, and through a \$4 million grant from the Board of Public Utilities (BPU). This will provide the capital to build a 10-acre enclosed facility on its 100-acre site. The new facility, which is expected to be under construction in July, will convert waste into energy and into compost through anaerobic digestion. In other words, the foodstuffs will be broken down in a controlled, heated, oxygen-free environment.

This method has a number of advantages over open-air composting. "Because it's completely enclosed, we capture all the air, which allows us to run it through bio-filters. That takes out all the odor," says Goodemote. "We can control the heat and moisture - no rain. That makes a good habitat for the bugs." Those would be the single-cell microbes that do the work of breaking down the food waste. They like a hot environment, and an enclosed facility provides it. Because conditions are so good for the microbes, the process proceeds much more quickly than it would outdoors. Only five to six weeks, rather than 10 to 12, are

required to break down the waste. The enclosed environment also expands the types of waste than can be recycled.

"Once it's totally enclosed, we will be able to bring in plate scrapings," says Goodemote. "That's when life becomes really interesting." The food waste his company receives now must be separated - vegetables from meat. "It's expensive," he says. But when plates can simply be scraped into a garbage pail, "there is very little labor." Even more significant, this vastly increases the pool of potential waste suppliers. The facility will be able to take in food waste from "prisons, colleges, schools, casinos, and large cafeterias. He has already signed on the 60 McDonald's restaurants in the greater Trenton area.

Goodemote explains how anaerobic digestion will break down waste at the new, enclosed facility, which will be able to process 650 tons per day. "In the first phase, we add water, and everything goes through a grinder pump to create a slurry. We keep tanks at a constant temperature. Gas rises to the top and solids sink to the bottom." The methane gas is siphoned off and piped into McGuire Air Force Base, where it will be processed and then used to generate power. The solids sink to the bottom and go into a compost building where they are mixed with carbons and put in 300-foot bins with mixing units on top. "They ride the rails," says Goodemote. "Water is added to the mix to keep the bugs happy."

Materials that don't belong in the mix are removed at several stages of the process. Specially-made bag grabbers take out any plastic bags in the mixture, metals sink to the bottom, and a final screening is done with a 3/8-inch strainer that, says Goodemote, "removes whatever is left."

The technology to turn food waste into something useful "has been out there for a long time," says Goodemote, "but now it's economically feasible." His company is "just barely at break even now," but expects to move well into the black when the enclosed recycling facility comes on line. Its Woodhue facility employs 20 people and expects to add 35 more when the new facility is fully operational.

Goodemote, a cheerful, enthusiastic man working in a field where few have dared to try to make money, has had to deal with everything from the DEP to citizen outrage. But there is one problem that has yet to arise. "When I told people I was going to New Jersey to work with garbage, they all said 'Oh! the mafia,' but this is not the same as the Sopranos. We have not had any problems."

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Coverted Organics

Jack Walsdorf, CEO of Converted Organics, ticks off the advantages of turning food waste into organic fertilizer. "It's a green technology," he says. "It preserves the life of landfills." The end product, used mainly by agribusiness and by golf courses, ensures that the inevitable run-off that follows rain storms will not pollute streams or harm wildlife, as chemicals might. And, he adds, "it's an opportunity to make money."

There is increasing concern among sophisticated consumers about the dangers posed both by chemical-laced fertilizers and by "closed" signs on full-to-capacity landfills, but still, few greet the plants that produce a green alternative with open arms. "We had a very difficult time finding a location in New Jersey," says Walsdorf. "It's a NIMBY thing."

Scouting for his company, which has yet to decide on a headquarters, but is leaning toward Boston, despite the fact that he lives in Fanwood, he found suitable space in a recycling zone in Woodbridge. "We're in the process of finishing the lease and should get going in 90 days," he says.

The company, which has a successful test facility in Canada and is networked in with the Rutgers Solid Waste Policy Group, is planning to operate a 60,000-square-foot in-vessel recycling plant. The term "in vessel," Walsdorf explains, simply means that all recycling will take place indoors under controlled conditions. This means that there should be no odor, and that the atmosphere can be kept at exactly the right temperature to allow microbes to break down food waste quickly - in about six days, which is about 25 times faster than they could work in an open site.

He compares the process to making sour dough bread. "The agent used, yeast, goes back to the 1800s," he says. "It's the same with microbes. You reserve a portion to put in the next batch." Microbes are naturally occurring in rotting food, but Converted Organics adds more garbage-loving microbes, thereby speeding up the process of breaking down the food.

Converted Organics plans to use everything from plate scrapings to Coke that has passed its freshness date to deli waste as its raw material. "We've had conversations with at least two leading supermarket chains already," says Walsdorf. "We'll take pure food waste - no knives and forks, and a minimum of plastic bags." The company plans to charge haulers about 20 percent less than they would have to pay to dump at a landfill.

After the food is broken down, the oxygen being fed in to speed decay will be shut off, excess water will be squeezed out, and what remains will be liquid fertilizer, some of which will be sold as a liquid and some as pellets. Walsdorf thinks there will be a substantial market for the chemical-free fertilizer in the agricultural community. "There is a general trend," he says. "People want organic. It's better for you. I know that when my wife and I go shopping, we look for organic."

The popularity of supermarket chains like Whole Foods, which has earned the nickname "whole paycheck" for its above-average prices, but which continues to grow, suggests that Walsdorf's start-up may be on to something.

The company plans to market its fertilizer to a broad range of agribusinesses, including those involved in growing cotton, blueberries, and cranberries. After agribusiness, the next biggest market will be golf courses, which have had serious image problems because of the enormous amounts of chemicals they use. Other turf environments, including soccer fields, baseball diamonds, and parks, are target markets.

Walsdorf is not concerned about competition on the input end of his business, assuming that there is enough garbage to go around, but does worry about competition for sales of its products - "all of the time." Still, he says that "intuitively, I know that golf courses, and agribusiness, and people are moving toward this."

His background is not in recycling, manufacturing, or even in product sales. Walsdorf, a Chicago native with a B.S. in finance from Southern Illinois University (Class of 1970) and MBA from Loyola, has spent most of his working life in commercial real estate, first for Trammell Crow, where he worked solely on the Mobil account, and then for Amerada Hess.

He got involved in Converted Organics through a friend in Boston. Most of the partners in the business are in Boston, and they are now completing financing arrangements for the new facility in Woodbridge. Four

more facilities, probably in or near New England, are to follow. Walsdorf, who points out that money starts to roll in along with the first load of bruised bananas or stale bagels, says that the company expects to be profitable within one year.

A lot of work has gone into preparation for turning out garbage by-products, and Walsdorf, a man who freely and happily chose to be immersed in a successor to the venerable New Jersey pig farm as a second career, wants to make sure that credit is given to ELM environmental consultants, a company based at 218 Wall Street in Princeton. "They are absolutely aces," says Walsdorf.

ELM has helped to clear the way for garbage to start rolling into Converted Organics' facility. That will just be stage one. The company is in an infant industry, and only time will tell whether the era of serious food recycling has begun - and whether a profitable business can be built around left-overs.

- Kathleen McGinn Spring

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From Sludge to Oil in Trenton

For nearly 15 years John Magennis has meticulously maintained an \$85 million building on Duck Island, just across from Trenton's riverfront marina. Its lights are burning, its circuit boxes are immaculate, its machinery looks freshly painted - brand new. But there are vines growing in the chain link fence that protects it from intruders, and its parking lot is empty.

Magennis, manager of information systems for the Mercer County Improvement Authority (MCIA), is keeping watch over the Regional Sludge Drying Facility, a never-used plant that was to have turned treated sewage from Trenton, Lawrence, Hamilton, and Ewing into fertilizer. The building, first proposed in the early-1980s, and completed in 1992 in what turned out to be a stroke of almost unbelievably bad timing, is now on death row. Its land and equipment, with a salvage value of just \$2.2 million, will soon be sold to the highest bidder - unless a savior steps in.

Stephen Paul, a Ph.D. physicist with Princeton Plasma Physics Lab (PPPL), badly wants to be that savior. Having painstakingly raised \$5.5 million in seed money, he is tantalizingly close to taking the first steps toward realizing his dream of using the plant to turn food waste and other elements into P-Series automobile fuel.

P-Series fuel, named by Paul after Princeton University, is a renewable biomass-based fuel, which was classified as an alternative fuel by the U.S. Department of Energy in 1999, and is the only fuel to be added to the list of alternative fuels since it was created under the Energy Policy Act of 1992. The Department of Energy is counting on alternative fuels such as P-Series products to power government fleet vehicles. P-Series fuel can also be used with the millions of privately-owned flexible fuel passenger cars now on the road - and the impetus to do so rises in direct proportion to the price of gasoline.

Magennis, a Hamilton native and Chesterfield resident, has worked on a wide range of projects for the MCIA. A graduate of Bordentown High School he is married to Lynn Magennis, a real estate agent with ReMax in Hamilton. They have a son who will be a freshman at New York University in the fall.

He became involved in the sludge drying facility in 1990. By then it was already mired in problems, but it had started out to be what sounded like a smart, cost-efficient solution to an expensive waste disposal problem. "It used to cost \$300 to \$600 a ton to dispose of sludge," he says. Trenton decided that a better alternative would be to build a plant where the waste could be turned into granular fertilizer. "They were going to send it to orchards in Florida," he says, "because of the long growing season there."

Only four such plants were ever built in the United States. In addition to the Trenton plant, there was one in Ocean County and there were two in California. Only one of the plants, the one located in Los Angeles, ever operated. Now all are closed. A mid-sized plant, the Trenton facility "could have handled 400 percent of the area's waste flow," Magennis says wistfully. "We could have taken from other towns."

The plant was nearly complete in 1988. "It was to be the first on line," says Magennis. But then there a contractor dispute arose. In the meantime, the Los Angeles plant got started, and it was immediately apparent that it had a design flaw. "We had to go back and redesign the plant," he says.

It was complete in 1992, the very year in which the DEP declassified sludge as hazardous waste. "The shit hit the fan in 1992," is how Paul puts it. "Everyone was looking to point fingers. The timing was terrible. It was still a good idea, but it wasn't economically feasible."

It was going to cost \$400 a ton to turn sludge into fertilizer at the plant, but, suddenly, Trenton and surrounding towns, freed from treating the sludge as hazardous waste, could dump it for \$60 a ton. The sludge now is trucked to farms. "I'm not sure what kind of farms, probably sludge," says Magennis, "and golf courses, too, but it's not approved for vegetable farms."

Rendered a dinosaur just as it was about to open, the sludge drying facility had economic issues. The federal government had provided \$30 million in grants. These grants are usually forgiven if promising new technology does not pan out, but the feds did not want to forgive these grants. Magennis' position was "why spend \$6 to \$8 million to start it up to prove that it wouldn't work economically?" He helped to argue this case for eight years, and, in 2000, the grants were forgiven.

The \$55 million the county had kicked in, however, is largely lost. It will recoup \$2.2 million if it sells to Paul's company, Trenton Fuel Works. It will also save the \$160,000 to \$200,000 it has been paying to keep essential light and heat on. All of the municipal players involved have agreed to sell to Paul. In turn, his investors are just waiting for the county's approval of the feasibility study he has commissioned from Biomedics, a company based in Waltham, Massachusetts.

"Both parties, the buyer and the seller, are highly motivated," says Paul. "The sale is imminent." He doesn't actually cross his fingers as he says this, but he knows that getting to the point where he is actually turning supermarket leftovers into fuel - even getting to the point where he can claim the building as his own - will be, if not a miracle, than at least a feat akin to finding a parking spot on Nassau Street at noon.

The road to this point has been anything but smooth. Paul, interestingly enough, reveals this as he swats away a question on financing, politely labeling it dumb, and at the same time demonstrating his own keen grasp of the subject - way too keen for your average research scientist.

Refitting the plant for his process will cost about \$50 million, he says. So, has he started to raise the difference between the \$5.5 million committed to his company and that amount? "Of course not," he says,

explaining that everyone knows that a start-up wants to reduce the risk for investors as much as possible before asking for money, thereby securing better terms.

The feasibility study has provided some comfort. "I'm very, very pleased with it," he says. "I did do a complete lay-out and cost analysis. Investors will want a detailed engineering study next." The study will take about six to nine months.

Paul, who holds a patent on the P-Series fuel mixture he will manufacture at the plant, didn't always know so much about business. Originally, he licensed his patent to a group of businessmen. The arrangement did not work out well. He now has nothing but contempt, not only for businessmen, but also for American business. "We don't make anything," he says, throwing his hands up in despair. "It's all buying and selling, selling and buying."

After substantial wrangling, Paul got the license back, and is still smarting, but is also much smarter about how business works. From now on, it will be hands on. "You need that passion," interjects Magennis.

Paul, who earned his undergraduate physics degree from Cornell (Class of 1975) and his graduate degree from Columbia, has passion to spare.

Asked when he decided to devote himself to formulating an alternative fuel, he shoots back: "The last Gulf War. The last time that people died over oil."

In addition to decrying dependence on Middle Eastern oil, Paul is appalled over the garbage that we oh-so-casually toss away.

"Priscilla Hayes says we send 1 1/2 million tons of food waste to landfills," he says, referring to a statement made by the coordinator of the New Jersey Solid Waste Policy Group. "They're just bioreactors," he says of the garbage mountains. "They're full of gasses, including methane - a very potent gas that reflects 21 percent greater heat than carbon dioxide. It creates totally needless greenhouse gas. We have to keep organics out of landfills. The climate of the planet is hanging in the balance. Every piece of orange that you throw away will decompose and get in the atmosphere. It will end up as gas."

While few think twice about chucking a half-eaten orange into the trash, Paul paints a picture of the fate of that fruit that could well make its way into a horror film. "You should see a landfill in the morning," he says. "Huge plumes of gas suddenly erupt and shoot up high into the air."

Perhaps that's a reason that "Garbageland: On the Secret Trail of Trash," the popular 2005 book detailing the attempts of its author, Elizabeth Royte, to follow the trail of her garbage, features so many scenes wherein she is chased away from landfills by aggressive security guards.

In any case, Paul is on a mission fueled by the dual 21st century dilemmas of an increasingly unstable Middle East, with all the implications that holds for conflict, misery, and soaring gasoline prices, and an increasingly unmanageable landfill situation, with implications ranging from out-of-control dumping fees to global warming.

Paul's fuel will use one problem to solve another. If widely adopted, it could go a long way toward erasing both.

This is how it will work. Garbage trucks will bring organic waste to the Trenton plant. There will be food waste, probably from supermarkets, schools, and institutions of all kinds. There will also be grass cuttings, food-contaminated paper (think burger wrappers), sawdust, and leaves. It will all be dumped into the hoppers that were to be used for sludge, and, through the addition of mineral acids and heat (450 degrees Fahrenheit), turned into a clear liquid in something like 20 seconds.

Turning food waste into other products, including compost and fertilizer, requires de-watering. Food can easily contain 50 percent water, a percentage that rises to 95 percent for watery vegetables like lettuce. For the creation of compost, this is a bad thing, or at least something that must be wrung out of the product. But Paul's P-Series fuel process requires water, so no de-watering needs to be done before the waste can be dumped.

Once the food waste has been liquefied, though, the water does have to be removed. "You can't have water in your gas tank," says Paul. That's the next step, and the equipment to accomplish it is in place. The water will go off as steam, and that, says Paul, is the only emission that will emanate from his plant.

After being dewatered, the food waste destined to become P-Series fuel will be sent off-site, to tank farms, where ethanol and the liquid by-product of natural gas production will be added to it. The mixture will be 20 to 25 percent food waste, 30 percent natural gas, and 40 percent ethanol. Paul says that the 89 octane fuel will sell for about 10 to 15 percent less than mid-range gasoline.

An early customer could be the government. Under government mandates, these fleets must use alternative fuel where it is available. He believes that any car that can use ethanol can use his P-Series fuel, and says there are 6 million such vehicles now on the road, with 1 million a year more expected.

Seasoned businessman that he now is, Paul acknowledges that each car manufacturer will have to agree that the P-Series fuel, a clear liquid that can be used alone or mixed with gasoline, will not damage cars or void warranties. He thinks that this will happen.

The next step would be P-Series fuel pumps at gas stations. But will gas stations install the pumps? "If they don't, I will," declares Paul. "I'll go as close to retail as I have to. Exxon did, and I will too."

The plant will also use some of the food waste it takes in to produce a granular substance that, when mixed with small pieces of coal, can be used to power industrial equipment. "We'll use it here, for our operations," says Paul. Some may also be sold to other manufacturers.

Because of the high water content of food, it will take a lot of garbage to keep the plant running at capacity. Paul and Magennis do the math, taking into account the high water content of food waste and the amount that can be packed into a garbage truck or tractor trailer. They figure that it would take about 45 loads to get to capacity. It won't be easy getting that much raw material, but Paul is confident that Hayes, who shares his passions, is working hard to get it flowing.

He also hopes that there will soon be a day when householders will add their apple cores, dinner plate scrapings, and gunked up pizza boxes to the mix. He points out that Burlington County ran a pilot program in which it asked residents to separate food waste. The response was enthusiastic, says Paul, "and they went into it knowing that there was no place for the food to go." Imagine the response, he says, if people knew that their leftovers could reduce their tax bills through lower disposal costs, could lower their gasoline bills, and could help the environment.

He will charge haulers about half the \$105 a ton tipping fee they would ordinarily pay to dump their loads, and hopes that that will be incentive enough for waste producers to sign on with haulers who use his facility.

With his dream so close that he can almost smell the leftovers, Paul says that his employer, PPPL, has been "enormously supportive." The lab encourages scientific advances by allowing its scientists to spend 20 percent of their time on their own projects. For the rest, he can use vacation. And any waking hour he can steal. "I was up until 3 a.m. last night," he says.

Paul is the father of three, one of whom is a year ahead of Magennis' son at NYU. His wife, Gilda, is a psychologist who works for Princeton University, doing administrative work and research.

Completing a tour of the proposed Trenton Fuel Works plant, Paul points out a hopper that had been installed to shoot the fertilizer that was to have been made there onto railroad cars. He points through the bushes to railroad tracks, and says that it would be easy to restore the rail link. He walks past a power box, full of new-looking coiled wires, which Magennis opens to flip on a blower. Moving toward the blower, Paul gets a bit tangled in briars.

"By summer there will be bees and wasps here," says Magennis.

Paul just smiles. If he is indeed here this summer to battle the bees, so long used to having the place to themselves, it will mean that P-Series alternative fuel from his plant is really on its way to powering cars and trucks. "In two years," he says, "I'll have it gushing fuel enough for 15,000 cars."

Bees, watch out. The whole sludge thing didn't pan out, but maybe, just maybe, the constellations are lined up just right, and the time for Trenton Fuel Works is here. Perhaps the timing for turning last night's leftovers into fuel is just as good as the timing for turning sludge into fertilizer was bad.

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