Talking Trash

WHY RECYCLING MEANS 'GREEN' IN MANY MORE WAYS THAN ONE.

PLUS: BUILDING A BETTER LANDFILL

BY MICHAEL ANFT AND SUE DE PASQUALE

IN AN ERA WHEN iffy mortgages and tangled financial packages have proven harmful to both investors and society, there's one type of junk vehicle that actually makes money: household trash. As cities across the country and around the world seek to lower the costs associated with garbage trucks and landfill space—and "go green"—companies that deal in garbage have found ways to convert all that putrid output into cash.

During the last half-century, recycling has grown to become a routine part of waste management, and daily life, as recycling of all kinds of materials (everything from newspapers and cans to electronics and complex plastics) has become commonplace. According to the U.S. Environmental Protection Agency, Americans recycled a mere 5.6 million tons in 1960, just 6.4 percent of "the waste stream." By 2008, that percentage was up to 33.2. The United States now recycles roughly 83 million tons each year.

The U.S. is not alone in this trend. In Canada, the recovery of paper has increased from around 26 percent in 1990 to about 40 percent today, according to Natural Resources Canada. Many European nations —including Sweden, Germany and Austria—do even better, with annual recycling rates of 40 to 60 percent.

With improvements in technology and growing markets for recycled products, municipalities are recognizing that going green can be profitable. The United Kingdom, which currently recycles about 45 percent of its plastic bottles, had been exporting most of its recycled plastics to plants outside the country. But in the last two years, the U.K. has invested in increasing its plastic bottle processing capacity. The U.K.'s first "mixed-plastics" reprocessing facility is set to open in 2011. "Given the strong U.K. demand for high-quality recycled plastics, this represents a great opportunity for U.K. manufacturers to exploit this 'green' niche," says Marcus Gover, director of market development for the U.K.'s Waste & Resources Action Programme (WRAP).

On the 'pre-sort' line at a plant operated by Waste Management Recycle America, workers pick through conveyor belts of garbage to pluck out materials that can't be recycled.

Recycling is hardly a new concept. History shows leaders as far back as Plato advocating the strategy in 400 B.C. In their digs of ancient dumpsites, modern archaeologists note a drop in household waste (broken tools, ash, etc.) during periods when resources were scarce. The implication: People were making do with what they had, reusing and recycling whatever possible. In pre-industrial times, it wasn't unusual to see "dustmen" walking the streets of England; their dirty task involved collecting dust and ash from wood and coal fires to be used for making bricks. By the early 1800s, rag pickers in Yorkshire had joined the recycling ranks, collecting old bits of cloth that were combined with virgin wool to create "shoddy" wool, for a thriving industry that lasted well into the early 1900s.

With the tough economic times of the Great Depression and then the advent of World War II, recycling became a famous cause for patriotism. Governments in countries around the world—embroiled in a war that gobbled up metal and rubber for weapons—launched massive recycling campaigns, encouraging citizens to collect and donate nylon, old tires and used metal equipment. Enthusiasm for recycling largely faded in the economic boom of the postwar years, but it moved again into the mainstream in the 1970s, a result of rising energy costs and the birth of the environmental movement. Today, it is this growing concern about the environment that has prompted many citizens and government leaders to embrace the "reduce, reuse, recycle" philosophy when it comes to disposing of the mountains of trash we generate each year.

Such efforts appear to have merit: In an international study published last year by WRAP, researchers compared more than 180 municipal waste management systems. Their conclusion? Recycling proved better for the environment than burying or burning waste in 83 percent of the cases.

'Single-Stream' Flows

Thanks to recent advances in technology, the leading edge in U.S. recycling these days is "single-stream" recovery. In many American communities, homeowners no longer need to carefully sort and store their trash by color or type—newspapers in one bin, aluminum cans in another, plastic milk jugs in yet another. Instead, they can throw it all together and put it out at the curb for pickup.

Because of the convenience factor, single-stream strategies lead to the recovery of up to 30 percent more recyclable materials than household pickup plans that require pre-sorting, says Jim Marcinko, area recycling

operations director for Waste Management Recycle America, which operates 100 recycling plants and offers marketing services for more than 140 locations in the U.S. and Canada. Waste Management currently handles 8 million tons of recyclables a year, and projects it will process and sell 20 million tons by 2020—mostly due to single-stream recycling. "More and more jurisdictions are jumping on the bandwagon these days," says Marcinko.

He oversees the company's Elkridge, Md., plant, which runs through more trash than any single-stream plant in the country, handling as many as 1,500 tons of reusable refuse per day (delivered by 250 garbage trucks). In a hulking shed outfitted with crisscrossing conveyors, pulleys and walkways, three shifts of workers help separate glass, plastic, paper and aluminum for 20 hours a day, six days per week.

The 50,000-square-foot plant is particularly well situated to take advantage of a growing market for recyclables. Only a mile from the I-95 corridor (the main north/south highway of the U.S. East Coast) and even closer to the rail lines that run parallel to the plant. It sits within easy reach of several East Coast paper mills. What's more, the company positioned the plant so that it could tap into international markets. "We sell a lot of export here because we're close to the Port of Baltimore," Marcinko says, referring to the major Maryland seaport that handled 33 million tons in foreign commerce in 2008, valued at $45.3 billion.

The sorting process starts after a truck pulls in at the plant, has its load weighed and then tilts and spills. A smelly tossed salad of recyclable trash is moved by front-end loaders to the main feeding belt. What follows is a highly coordinated marriage of human and machine labor.

Most of the plant's 80 employees sift through the trash as it moves briskly along conveyors. At the front end, they are on the lookout for items that can jam up the works, especially plastic grocery bags that can get into gears,

THE SAD SAGA OF FRESH KILLS

In 1947, when New York City opened a "temporary landfill" on a marsh on the northwestern end of Staten Island, city fathers didn't envision that it would operate as the city's primary dumping grounds for 54 years. They also had no way of foreseeing how macabre the name they dubbed it—Fresh Kills—would become.

Formerly a squishy 2,200 acres of farmland and swamp, Fresh Kills is named for the estuary it snuggles up against. The landfill site was originally scheduled to remain open for two decades, and then be converted into factory space, parks and residences. But as the city's output of trash grew, so did the mounds at Fresh Kills—for several more decades. Despite operating under federal consent decrees because it fell well short of several environmental regulations, the landfill remained open far beyond its planned capping date. At its peak, it took in the contents of 20 barges carrying 650 tons of garbage daily. As a result, some sources say, its volume grew larger than that of the Great Wall of China. By the time it closed, Fresh Kills was dubbed the world's largest landfill and stood 80 feet taller than the Statue of Liberty.

Decades of protest from residents, who were forced to live with smells and rats, and environmentalists, who argued that the unlined landfill was leaching thousands of pounds of toxins into New York waterways, led authorities to close the dump in March 2001. But part of it would reopen six months later. After the terrorist attacks of 9/11, Fresh Kills was the sorting ground for a large portion of the debris from Ground Zero. More than 1,000 personal effects were found during the sorting process.

Today, the Fresh Kills landfill is being re-created as a park.

SO, YOU WANT TO OPEN A LANDFILL...

Though recycling is on the rise, an appreciative amount of our garbage still finds its final resting place in a landfill (about 54 percent of municipal solid waste generated in the U.S. in 2008). The 3,000 landfills across the United States that inter 251 million tons of waste chucked annually dot all facets of the landscape: mountainsides, valleys, abandoned quarries and mines, old swamps. Even with those topographical differences, people who design dumps consider the same factors when preparing an open-air site for garbage, including:

WHAT TO DO WITH THE LAND

Local governments, which oversee the operations of most landfills, must perform an environmental impact study before opening one. They'll look into how much buffer should be left around a site to minimize the unpleasantness that emanates from dumps to nearby residents and businesses. They'll investigate how much land is needed and what the underlying soil and bedrock are made of. They'll check to see if water flows over the proposed site, how wildlife and humans will be affected by a landfill, and whether the area has any archaeological or historical value.

The goal: to locate landfills where underground rock systems are as watertight as possible. This will prevent seepage of toxins found in many types of waste into groundwater. Keeping local fisheries and nesting areas safe is strongly encouraged by the federal Environmental Protection Agency as well.

HOW TO KEEP RAINWATER AND RUNOFF FROM FILTERING INTO THE DIRT AND WATER BELOW

Once federal, state and local governments grant the required permits, engineers devise ways to keep runoff from leaching into underlying soils and groundwater. The purpose of a landfill isn't to compost the trash so it decomposes quickly, but to bury it in such a way that it will be isolated from groundwater. One method for achieving that involves using a clay liner to keep trash-tainted water from leaching downward. But clay liners can crack, so many engineers prefer to use "bottom liners" made from puncture-resistant synthetic plastic. To keep rain water from entering "cells"—specific areas where trash has been dumped and compacted—some landfill builders install a storm drainage system that channels the water into ditches, and away from trash.

HOW TO ISOLATE WATER THAT DOES LEACH OUT FROM THE TRASH HEAP

Some water inevitably makes it through the trash, picking up contaminants (including toxic metals) along the way. To catch this seepage, landfill builders plant perforated pipes in the ground to collect it. Those pipes drain into a "leachate pipe," which delivers the swill to a pond, where it is tested for various chemicals. After testing, the leachate will be handled as sewage or wastewater and is often shipped off to treatment plants.

HOW TO COVER UP THE TRASH

Typically, each cell is covered daily with 6 inches of compacted soil, after trucks and bulldozers have smashed down the refuse. The soil prevents birds, flies, mice, and rats from getting at the trash. Some landfill operators are experimenting with tarps or spray coverings because they take up less space than soil. When a cell is completely filled, it is often permanently covered by a cap of polyethylene, and, finally, a 2-foot-deep layer of soil.

WHAT TO DO WITH THE GAS BELCHED UP BY TRAPPED MOUNDS OF TRASH

An airtight landfill will prevent oxygen from entering the equation. But bacteria will still break down the trash. When they do, they create "landfill gas," a heady brew made up of about 50 percent carbon dioxide and 50 percent methane. Landfill builders sink pipes into the covered mounds to collect gas, which then is either vented or burned off. Some sell the rights to the gas to utility companies or manufacturers that use it to power their boilers.

The amount of trash that Americans create—about 1,600 pounds per year for each person—has almost tripled since 1960, while the amount sent to landfills has doubled during that time. So, landfill practices that safeguard the environment are at a premium, as are recycling schemes that further lower the amount of waste sent to them.

Source: http://science.howstuffworks.com/landfill.htm

rollers and pulleys, and disable them. Other machine-wrecking gems at this plant have included car doors and bumpers, concrete blocks—even bowling balls.

On the "pre-sort line," eight mask-wearing employees pick out long sheets of plastic, tablecloths, buckets and other heavy plastic items and toss them down chutes that have trash barrels waiting for them at the bottom. Much of the barrel will eventually be bundled up as trash. About 5 percent of what the plant receives can't be reused.

A steady stream of what is left—cardboard, cans, paper and bottles—travels on to the next step at the end of the line, where technology takes over the sorting. First the conveyors sort out items by size and density. Then the high-tech modes kick in, with a system that makes use of discs that are 1-foot-square and contain six points. They look like star-shaped gears, and spin madly in tandem at the end of each conveyor line, allowing heavier items—glass and plastic—to roll back and down onto a separate moving line, while generating enough of an upward gust of air to take the lighter paper and cardboard up to another belt. The system was devised by Lubo USA, a company based in the Netherlands that first developed screening techniques to separate dirt from conveyor-borne potatoes in the 1960s.

"It's a violent process," explains Marcinko. "But it works well. We have less worries about contamination of paper because glass shards will be pulled down while the paper goes above the discs." Waste Management Recycle America guarantees that this plant will produce recyclables with 2 percent or less contamination—meaning that what purchasers of recycled paper eventually buy will be 98 percent pure.

The Elkridge plant uses 200 discs on each of its eight end-of-conveyor screens, including some that separate "chipboard" (the stuff of cereal boxes) and cardboard from newspaper, the most prevalent item in the recycling business. "This is the Cadillac of recycling equipment," Marcinko says. "Some places use magnets and such to separate things. This is better." (Because aging paper can be dusty, Waste Management Recycle America installed air handlers to change the air in the plant six times per hour.)

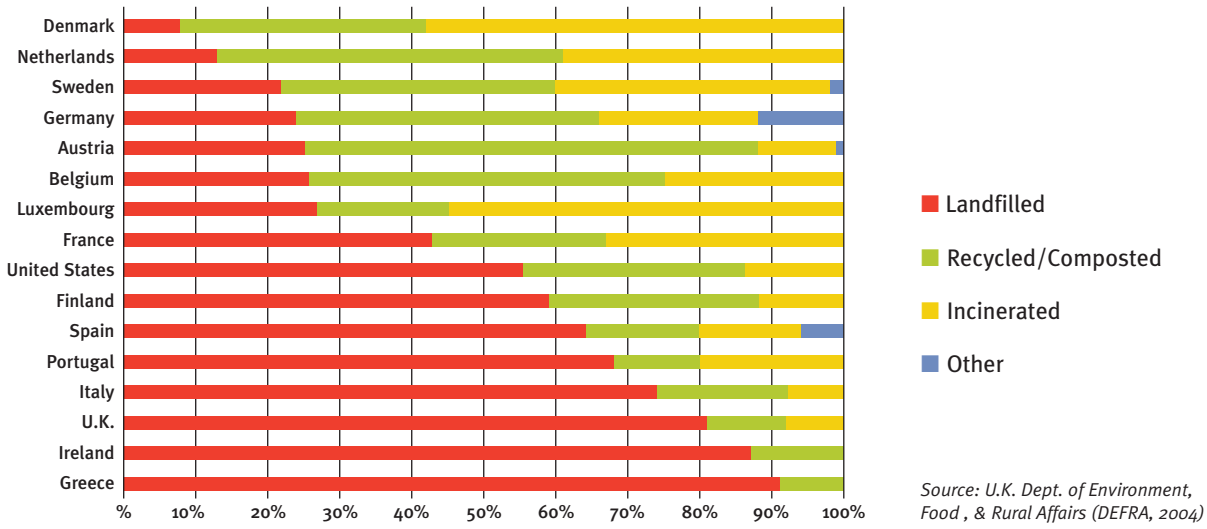
Aluminum cans are separated out by an 'eddy current' created by the spinning of a rotor, which creates a field of energy around non-ferrous (metals without an appreciable amount of iron) items that repels them from the rest of the scrap. The eddy current pushes cans over a break in the line, while other non-paper items fall off of it. The cans then travel off on their own conveyor. It's important that aluminum be completely separated. Manufacturers who melt it down into sheets won't accept materials with even 1 percent contamination.

This plant will produce recyclables with 2 percent or less contamination—meaning that what purchasers of recycled paper eventually buy will be 98 percent pure.

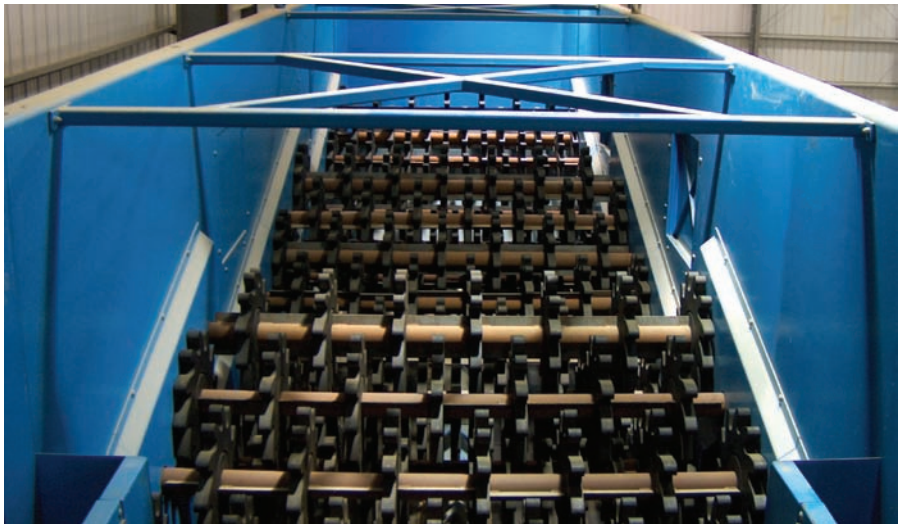
By the time the process is over, each product is on its own line. Paper is cubed into 1-ton bales, as are plastics. Glass and aluminum are stored in big bins.

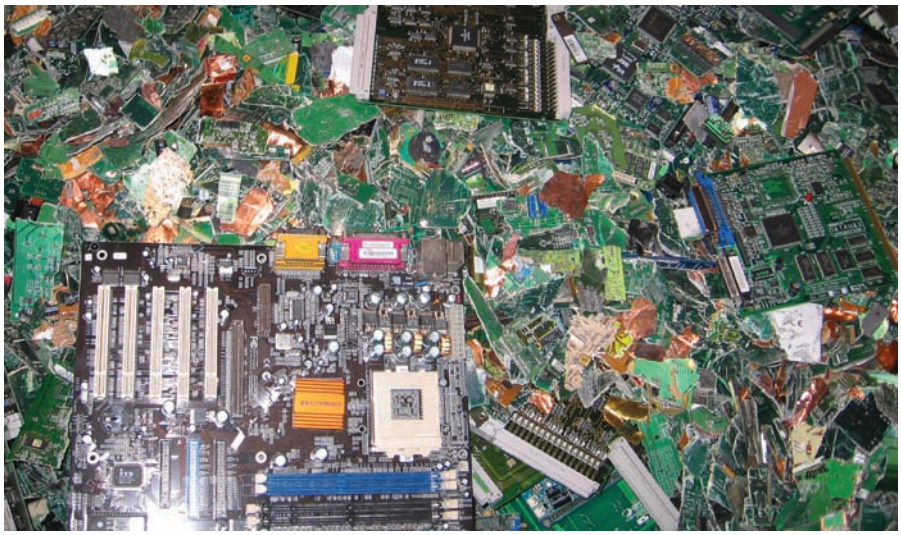
Then it's off to market. The Elkridge

WASTE MANAGEMENT IN THE U.S. & EUROPE



Source: U.K. Dept. of Environment, Food , & Rural Affairs (DEFRA, 2004)





The star-spinner system devised by Lubo, USA, top, allows heavier items (glass and plastic) to roll back and down, while generating air that pushes paper and cupboard upward to another conveyor belt. Electronic waste—including computer circuit boards—often ends up in landfills, where it can leak carcinogenic toxins.

facility annually sells thousands of tons of aluminum cans to Anheuser-Busch, at $1,000 per ton. Plastic bottles are sent to a plant in North Carolina that provides bottles to Coca-Cola. Plastic fetches $300 to $500 a ton, depending on the type. Plastic that isn't converted into more bottles will be made into spun-plastic carpets, jackets and T-shirts, among other things. Most paper from this plant is exported, where it will be reduced to pulp, liquefied, laid out on felt and then cut into sheets. As of spring 2010, paper was bringing in $90 per ton—nowhere near the all-time highs of $120 or so that occurred when China was buying paper like mad in advance of the 2008 Summer Olympics, but well above the average price of $70.

Glass presents a problem, however. Because it is so cheaply made, the market for glass, which is broken up while being subjected to the aggressiveness of the sorting process, is almost non-existent. Marcinko says he'll send the glass along to out-of-state middlemen for next to nothing.

Evils of E-Waste

Not all trash can safely be put out at the curb for recycling pickup. Electronic waste, or "e-waste," represents a rapidly growing source of trash, as our increasingly tech savvy society casts off televisions, computers, monitors, cell phones and other equipment, in time for the next state-of-the-art technological upgrade.

According to the U.S. Environmental Protection Agency, some 30 to 40 million personal computers will be ready for "end-of-life-management" over the next several years, notes journalist Chris Carroll, the author of "High-Tech Trash," an article that appeared in the January 2008 issue of *National Geographic*. With the switch to high-definition televisions, about 25 million TVs are taken out of service annually.

Much of this waste (some 70 to 80 percent in the United States) ends up in landfills, Carroll reports, where it has the potential to leak toxins including lead, mercury, arsenic and cadmium into the ground. Currently, just about one-fifth of e-waste is channeled through recycling companies—but that doesn't guarantee such waste will be safely disposed of. That's because some companies sell it to brokers, who end up shipping it to the developing world where environmental enforcement is weak and "the key to making money is speed, not safety," Carroll writes.

In Accra, Ghana, he witnessed villagers breaking the copper yokes of TV picture tubes, littering the ground with lead (a neurotoxin) and cadmium (a carcinogen). After stripping out drives and computer chips for re-sale, these salvage workers, many of them children, burned the remaining plastic, sending clouds of toxic fumes into the air.

Much of the waste ends up in landfills, where it has the potential to leak toxins including lead, mercury, arsenic and cadmium into the ground.

There are responsible recyclers of e-waste, Carroll notes, and he points to Creative Recycling Systems as one good example. The Tampa, Fla.-based company (one of several in the United States equipped to recycle e-waste) can handle about 150 million pounds (68 million kilograms) of electronic waste a year. Thanks to vacuum pressure and filters installed throughout the company's plant, "the air that

FACTS AND FIGURES

comes out is cleaner than the ambient air in the building," according to company vice president Joe Yob. Creative Recycling uses a $3 million conveyor belt system, with vibrating screens and magnets, to process and separate nonferrous metals (copper and aluminum) and precious ones (gold, silver and palladium).

The most valuable output from this process? Shredded circuit boards. The company ships this material to a Belgium smelter that specializes in precious metals recycling. Carroll reports that a 4-foot-square box of the stuff can fetch $10,000.

In the world of recycling, it would seem, one man's junk is another man's treasure.

Total amount of waste recycled in the United States, 1960 to 2008:

1960	5.6 million tons
1970	8 million tons
1980	14.5 million tons
1990	33.23 million tons
2000	69.3 million tons
2003	74.7 million tons
2005	79 million tons
2007	84 million tons
2008	82.9 million tons

Percentage of total waste recycled in the United States, 1960 to 2008:

1960	6.4%
1970:	6.6%
1980:	9.6%
1990:	16.2%
2000:	29%
2003:	30.9%
2005:	31.7%
2007:	33.1%
2008:	33.2%

Source: U.S. Environmental Protection Agency (Nov. 2009)