A World without Waste?

UPSTUDIO / BIGSTOCK

By Rick Docksai

If current trends continue, we'll be dealing with three times as much waste by the end of this century as we are now, warns the World Bank. One solution is to treat waste as a resource—a solution that could also cut global pollution, stave off looming resource crises, and lower manufacturing costs, among other benefits.

Waste is, well, wasteful. Communities and industrial facilities all across the globe let ton after ton of scrap metal, chemical sludge, glass, plastic, and other raw materials slip from their grasp every day. The disposal costs money and time, and inevitably results in some spillover into nearby ecosystems, thereby jeopardizing the health of wildlife and people. Moreover, it discards volumes of still-good materials that we could find new use for if we just looked.

Fortunately, numerous communities and industries are finding ways to cut down on trash outflows and to repurpose their rubbish as new recycled products. These "zero waste" efforts, as their initiatives are called, offer the hope of a *waste-free* future, where not only landfills, but also the unsustainable consumption habits that they embody, have become things of the past.

The Military Gets Out of the Landfill Business

A military force's survival depends on making the best use of the resources at its disposal. That includes garbage. So goes the thinking behind the U.S. Army's Net Zero Waste 2020 initiative, by which eight Army installations are pursuing full-fledged programs to downsize their garbage output to zero—or at least close to it. The eight are upping their recycling, utilizing recycled building materials, and gathering up and redistributing as many used household items as possible.

Fort Hood, Texas, is one of the eight. As of 2013, the Net Zero Waste 2020 project's second year, the inflow of garbage into the Fort Hood landfill has dropped by 20%.

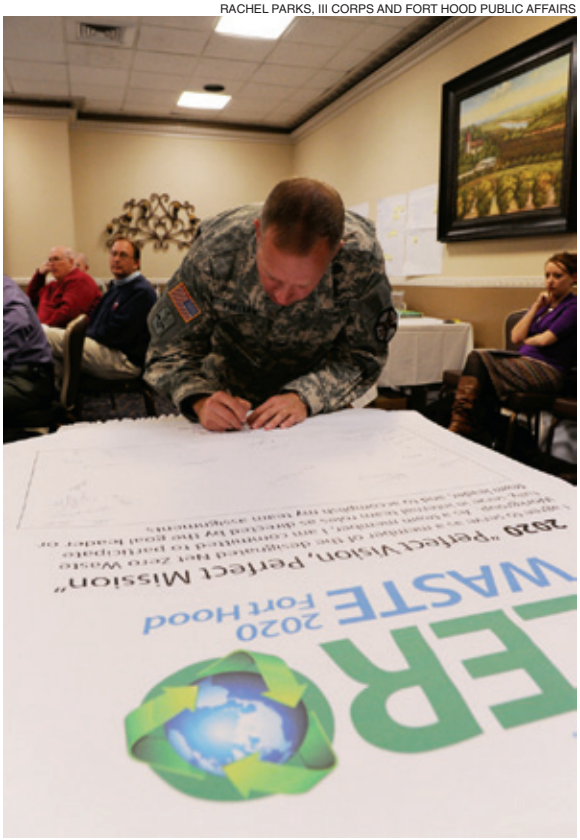
"Our goal is to get out of the landfill business," says Steve Burrow, Fort Hood's chief of environmental programs. "We're a guinea pig, along with a few other installations, to see what we can do to get there."

The installation aims to increase recycling by 5% a year for every fiscal year. In 2012, the goal was 50% of waste diverted from landfills; while the installation didn't meet that target, it came awfully close: 48%.

"We keep trying to set the bar higher, and if we don't get there we just try harder," says program manager Jennifer Rawlings.

Some of the recycling-enhancement measures were surprisingly simple. One change consisted of replacing Fort Hood residents' original

RACHEL PARKS, III CORPS AND FORT HOOD PUBLIC AFFAIRS



Fort Hood Garrison Commander Col. Mark Freitag signs the Net Zero Waste workgroup mission statement at the conclusion of the Net Zero Waste workgroup kick-off on December 8, 2011. Fort Hood is one of eight U.S. Army installations participating in the program.

18-gallon recycling bins with 96-gallon ones. Having larger bins around prompted residents to put more recyclables into them. Not long after the new bins' debut, recycling uptake had doubled.

"We found out that, the larger the containers for recycling, the better the participation," says Burrow.

Recycling is certainly nothing new. Communities throughout the developed world have had recycling facilities in their midst for more than 40 years. But most of these sites are chronically underutilized, and some have been shutting down, as local governments look for ways to trim expenses.

Fort Hood makes use of some new technologies, which helps. Its on-site recycling center, which processes recyclables from administrative offices and work stations, now accepts many products that your typical neighborhood facility won't, such as plastic shopping bags and Styrofoam.

Recyclables from Fort Hood's residences go to another recycling facility in Austin. This one is another rare find among today's recycling facilities: It is "single-stream," meaning that human operators don't have to feed it plastics, glass, paper, and such categories of waste separately from each other; it can receive them all at once. Fort Hood's residents thus don't have to spend any time sorting their recyclables into separate bins anymore. The work of recycling consequently becomes immensely easier, which means that people will do more of it.

The households are Fort Hood's number-one generator of waste, according to Burrow, so any increase in recycling on the household front adds up in an especially big way. The facility has also begun letting residents opt out of receiving paper junk mail, cutting down on bulk paper waste.

Among the enlisted personnel, Fort Hood has assigned a few soldiers in every unit to serve as "recycling coordinators," who make sure that their fellow troops keep up with the recycling protocols.

Finding new uses for old household items is another component of the program. The Fort Hood community has been organizing numerous furniture donations, for instance, to transfer old hardwood items from those who no longer want them to those who do. Also, the garrison's director of Family and Morale, Welfare and Recreation held an auction that sold off a warehouse-worth of gym equipment, office hardware, and other merchandise that hitherto might have simply gone to the dumpster.

Even more used items are available at the Hood Classification Unit, an on-site facility where residents and personnel can drop off batteries, cleaners, pesticides, and other chemical products. If something still has any good use left to it, the facility will keep it on hand. And families who need it can come, fill out some paperwork, and help themselves to it.

"A lot of it is just reducing the costs we're spending on new items," says Rawlings. "We're able to find furniture that's been sitting in warehouses and get them to soldiers that need furniture."

Burrow and Rawlings don't promise that they and their team will completely eliminate garbage at Fort Hood by 2020—that would be a huge stretch with today's technology, they caution. But an 80%–90% reduction in garbage outflow by that date is possible. The installation will strive to get as close to 100% as it can over the remaining six years and will take note of every practice or policy change that helps bring it closer.

Come 2020, Fort Hood and the other seven installations involved in Net Zero Waste 2020 will reconvene and compare notes. Then it will be time for the next phase: disseminating what they learned throughout the whole army. By 2050, it is hoped, every army installation will be as waste-minimal as Fort Hood, if not more.

"The goal is, by 2020, to have a sum total of best practices we can share with all army installations and that they can put into practice so that they all get there by 2050," says Rawlings.

Civilian communities are learning from the army experience, too. As Fort Hood and the other Net Zero Waste 2020 installations make progress on their waste-reduction goals, they share their best practices with nearby communities in workshops and forums. Thus, the Fort Hood–adjacent towns of Copper's Cove and Temple recently instituted single-stream recycling in some of their neighborhoods. While the dynamics of policy making are clearly different in civilian settings, the right prac-

tices and tools can enable some positive outcomes.

Repurposing Waste in Europe

Europe imports more materials than almost any continent on Earth. It throws more away than most other continents, too: On average, 60% of Europe's municipal waste ends up in landfills or incinerators. But a few countries on the continent definitely beat the average. There's Norway, for example, which recycles 68% of its garbage. What if every European nation recycled like Norway?

The organizers of ZeroWIN are doing their part to help make that happen. This initiative, whose name is an acronym for "Towards Zero Waste in Industrial Networks," has spent the past five years channeling funds from the European Commission to host research-and-development ventures among 31 business and academic institutions from across Europe and Asia. Together, these partner groups have been looking for new ways to minimize or eliminate consumer and industrial waste.

Community recycling, as most of us know it, is just one of ZeroWIN's tools. They're also looking into business-to-business recycling streams, whereby one company invites another to share a work site with it, and waste byproducts from one company's industrial operations get collected and reused as a raw material by the other company.

"Sometimes, you have byproducts that come out of the process that are usually dumped but could be used to make other products. They have the possibility, on their sites, of bringing in other firms that use their byproducts to produce their own products," says Luk Van Wassenhove, professor of operations management at INSEAD, a Paris-based business school that is one of ZeroWIN's participating institutions. "So it's no longer waste. It's being used."

This industrial waste swap is actually more common than many might think. For example, in Denmark, smoke from DONG Energy's smokestacks can be retrieved and converted into gypsum, a mineral sulfate that can be used as fertilizer or as an ingredient in plaster. Danish biotech company Novozymes hands over some of its organic waste to Kalundborg Kommune, which turns it into an agricultural fertilizer.

ZeroWIN's partners have been researching more potential waste-reuse collaborations and discussing how to put them into action. If the program succeeds to the degree that its organizers hope for, all of Europe will see the difference: a possible 30% reduction in greenhouse-gas emissions, a 75% reduction in the use of freshwater, and 70% increase in recycling and reuse of waste.

The iameco D4R laptop is one early achievement of the ZeroWIN collaboration. Manufactured in Dublin, Ireland, by MicroPro, it is a personal laptop computer on par in speed and performance with just about any standard model you'll find in an electronics outlet near you. The only difference: It's wood, made with 89% recycled materials, and thus contributes 61% less greenhouse-gas pollution during its manufacture.

The largest source of waste in Europe nowadays is the construction sector. Building roads, bridges, homes, and any other structure typically leaves hefty piles of waste cement, scrap wood or metal, and other such materials. Much of this residual material could be repurposed if the companies invested in it, Van Wassenhove notes. Even more gains would come about if they up their deployment of recycled fibers in insulation, recycle glass to use as an ingredient for cement or concrete, and restore waste wood or steel into new wood or steel fixtures.

Of course, not everything from the scrap pile is salvageable, but if demolition crews are careful not to smash a condemned structure's components too thoroughly, a surprising amount of them can find new life in new buildings.

Automobile manufacturing is another growth area for waste-repurposing methods. Van Wassenhove points out that many car parts could be made from recycled plastics. Doing so would more than benefit the environment, he adds; it could benefit the companies' bottom lines, as well. Recycled plastics are lighter than many conventional materials, so the finished cars would be less costly and better on fuel—improvements that are sure to go over well with the customer base.

"There is an element of low-hanging fruit," he says. "If you look at your processes and you take an angle like quality improvement or

MICROPRO

Note the wooden paneling that encases MicroPro's iameco laptop computer. Recycled materials, including wood, compose 85% or more of each laptop.

GLOBAL WASTE RESEARCH INSTITUTE

Piles of rubble from building construction and demolition sites await processing at a California recycling facility. It is feasible to regenerate that waste asphalt, concrete, and other debris into usable building materials, but far too few construction industries are doing enough of it, according to European researchers who attribute the largest share of their continent's landfill waste to the construction industry. Initiatives such as ZeroWIN hope to cut construction's waste output down to size.

environmental footprint, you usually come up with ideas that will improve the indicator but at the same time will be opportunities to reduce cost. So there is no conflict for a while."

INSEAD and the other ZeroWIN partners have completed five years of R&D, and are now in a dissemination phase. Most are holding conferences and seminars to share what they have found with the larger business communities. They, like the Net Zero Waste 2020 group, look forward to setting in motion a much bigger change in waste management far and wide.

Waste Not, Spend Not

Businesses are often all for more sustainability but fear that it will cost more. That's not necessarily the case in waste management. Sometimes, it's just the opposite: By eliminating or repurposing waste byproducts, they also eliminate the need to spend money on cleaning them up and disposing of them. Less waste thus translates to more savings. That's why the UK's metal-manufacturing sector could save an estimated £4 billion a year if it applied resource efficiency measures more fully, according to the European Commission.

Cost savings are just as achievable for industries on the other side of the Atlantic, as well. Many U.S. oil companies began undertaking waste-minimization measures in the 1990s, recalls Yarrow Nelson, a professor of civil and environmental engineering at California Polytechnic State University (Cal Poly). As the new measures went into effect, it wasn't just the waste accumulations that started to decline—the companies' overhead costs shrank along with them.

"There was an industry push for 'pollution prevention,' a new paradigm for dealing with industrial pollution by changing the way we do business to not produce the pollution in the first place. This was a huge jump from the '70s and '80s when we practiced 'end-of-the-pipe' treatment," says Nelson.

Zero waste marks the next step in the chain of progress. Now that oil industries have achieved less residual waste, they will need a new round of innovations to advance toward no waste at all.

"They found most of the low-hanging fruit. Most of the gross inefficiencies were found. And now we're fine-tuning it," says Nelson. "And looking to the future, that's where the concept of zero waste comes in. That's where you're taking it and tightening it up to a whole new level."

Cal Poly's Global Waste Research Institute (GWRI) is now working with Chevron on a new waste-reduction method to gather the oily sludge residue that accumulates in oil refineries and reenter it into the fuel cycle to burn off and produce additional electricity. There is much to like about this experimental process: It stands to deliver slightly more electricity out of the same amount of oil while cutting down on the pollution hazard that this sludge otherwise poses to a refinery's workforce and surrounding communities.

"It's to Chevron's benefit to not have this difficult type of waste that they don't know what to do with it or where to send it," says Nelson, "and to avoid future liability. If people deposit their materials in a hazardous waste landfill, it could come back to bite them 20 years later if people discover that it's leaking or polluting groundwater or something like that."

Improper disposal of waste sludge by some refineries has resulted in serious land and water pollution in quite a few parts of the world, Nelson points out. On top of that, transporting the sludge to the disposal sites can expose some waste to the air and contribute to smog.

"The primary benefit of recycling and reusing sludge is less contamination of land and water near refineries around the world, and less expense of handling all of this hazardous waste," says Nelson. "You're not trucking the stuff all over."

Oil isn't the only industry with which GWRI is partnering. The institute's Integrated Dairy Waste Management project, for example, is testing a new method for cattle farms to collect their wastewater into pools in which they might grow algae for biofuel. Dairy farms hose down their barns regularly to flush out the manure and grime. This tide of wastewater needs to go somewhere—ideally not nearby streams, since the manure's nitrogen and phosphorus will trigger unhealthy algae blooms if it seeps into the waterways. Instead, the Integrated Dairy Waste method channels the wastewater into a collecting pool, where an "intentional" algae bloom emerges.

The algae are photosynthetic and survive by extracting carbon dioxide from the air. Their metabolic processes also use the nitrogen and phosphorus that are in this wastewater. They digest these compounds and produce lipids that the farmers can draw out and use as biodiesel for their farm machinery.

So, waste product for waste product, the farms and the algae facilitate each other, a natural equivalent of the companies exchanging waste under the aegis of ZeroWIN. As an added perk, that water can be reused again and again, either for more algae cultivation or—following further filtering—for watering crops.

If this wastewater-recycling method does scale up, it could be a very effective control on farm runoff pollution—the farm's algae digest the waste before it has a chance to dirty up a nearby stream. It would also be an optimal fuel source for farmers who live in remote areas off the main grid, Nelson notes. They could produce much of their needed energy on-site, a much more affordable proposition than importing biofuel in bulk from afar.

These are just a few of the zero-waste applications that Nelson sees under development at GWRI and other institutions. Many more are in the works. Some could even be making their way into suburban homes. He cites a company called efuels, which is now marketing a refrigerator-sized biofuel generator. Put anything with sugar into it, and it will produce ethanol that you can use to power a car. The product is selling outside most buyers' price ranges, at around $15,000. Nonetheless, remember that the personal computer, mobile phone, and many commonplace consumer technologies all started off at prices most consumers

could not afford. Perhaps this one, too, will only need time.

Solving the "Peak Resource" Issue

Waste-reduction initiatives clearly make for a healthier future, but they can cost more money in the present. That poses an unfortunate dilemma for the advanced nations' business sectors, many of which are still mired in shaky economies and have to worry about boosting revenue in the near term. Van Wassenhove, for one, doubts the private sector's commitment to waste reduction over the longer term. Few companies have an interest in spending more money than necessary, even for a cause like waste reduction.

"Companies aren't interested in investments that will pay off later," he says. "Companies are interested in now, and investments that give them short payback periods. That's the problem with improving environmental impact."

The value of waste reduction could rise in years to come, however, as raw materials grow scarcer. Regions such as Europe that import large volumes of aluminum, lithium, and other industry-grade metals and chemical compounds will find it more fiscally prudent to look into new ways to reuse the quantities that they already have—i.e., those that are sitting in their piles of junk.

"Some materials are becoming very scarce," says Van Wassenhove. "You have to get return streams instead of virgin materials. So you have to get better at recycling and extracting the materials and reuse them instead of trying to find virgin materials. For some of these materials, the mining is more expensive than recycling and reusing."

Granted, the prospects of "peak metal" or "peak limestone" don't get as much air time as "peak oil," but they are real possibilities all the same. The human race now consumes ores and minerals 27 times faster, and construction materials 34 times faster, than it did in 1900, observed ZeroWIN researcher Ian Williams of the University of Southampton at an April 2013 lecture. All resources in general are being used up at an average of eight times as quickly as they did at the dawn of the twentieth century.

That growth trajectory shows no signs of slowing. By 2015, Williams told his audience, we will be using twice the resource capacity of the planet. If trends keep up to 2100, then our resource use will exceed the planet's capacity by fourfold as the twenty-second century begins.

We don't have to wait until 2100 to see the repercussions in mass markets, however. As Williams noted, the prices of dozens of raw metals and materials have gone up sharply in the last decade, and have done so after more than a century of steady decline.

The whole European Union is on alert. In September 2012, an EU workshop titled "Defining Critical Raw Materials in the EU: Information Gaps and Available Solutions" identified 14 raw materials that are critically important but at high risk of sudden shortages or supply shocks. These include tungsten, graphite, gallium, magnesium, cobalt, and other strategic industrial materials.

While the supply shocks haven't materialized just yet, alarming price increases have. For instance, global antimony prices surged from $6,050 a ton in December 2009 to as high as $12,830 a ton in April 2012. It's not too hard to see why, as these critical raw materials go into some products that are in very high demand: cars, mobile phones, solar panels, and computers, among others.

As these products roll out of warehouse inventories and into homes and offices in growing volumes, they will also head eventually to landfills in growing numbers. That presents us with a crucial opportunity to pull those usable materials up out of the landfills and return them to the factories for reuse. No need to mine more earth, to draw out new quantities of magnesium, tungsten, etc., when the metal of choice that we need is waiting for us, ripe for the taking, at our nearest municipal dump.

Williams calls this salvaging process "urban mining" and likens it to the never-ending life cycles of nature itself. The natural world's food chains sustain themselves through the generation and regeneration of their resource bases—i.e., soil, air, water, and plant matter. We can do the same.

"We need to mimic nature's cycles. Nutrients develop plants, which we eat, and then we die, we decompose, we form nutrients, which form plants, and so on," according to Williams. "We need to have the same cycle for our waste materials. We need to make sure that instead of digging materials out of the earth constantly, with all of the subsequent health and environmental impacts, and of course the moral and ethical issues, we need to mimic that cycle."

The range of products that urban mining can repurpose is vast, he went on to say. Construction materials, computer hardware, and automobiles are just a few of them. The cost implications are considerable, by the way. Each one of these products holds a volume of metal or rock that chains of laborers and distributors had to extract from the earth and ship to a manufacturing site. To forgo that mining and simply repurpose landfill waste is to save a bundle in business expenses. More importantly, it averts huge upheaval to the ecosystems that lie in the miners' way.

The Way Forward

The world has a long way to go on recycling and reuse. Globally, our species discards about 1.3 billion tons of new landfill waste every year. This sum is projected to nearly double to 2.2 billion tons a year by 2025.

It clearly doesn't have to be this way. Innovative communities, government agencies, and businesses in Europe, North America, and elsewhere are showing that it's possible to draw from our garbage piles, not add to them. It takes some effort and some investment, but the rewards in cost efficiency and, more importantly, our health and the planet's health, will repay us many times over. ❑

About the Author
Rick Docksai is the associate editor of THE FUTURIST and *World Future Review.*
E-mail rdocksai@wfs.org.