



Moving from Waste to Resource Management Executive Environmental Sustainability Forum

*Co-hosted by Waste Management and the Allwin Initiative for Corporate Citizenship
Tuck School of Business at Dartmouth
October 28–29, 2008*

Nearly 50 years ago, an expression surfaced in computing that remains in our lexicon: garbage in, garbage out. It was first used to encapsulate a fundamental truth in feeding data to a computer. Today, however, the phrase is also used in other fields to state simply that bad input produces a bad result. It can even be applied quite appropriately to actual garbage—the oft maligned by-product of human existence. Garbage, or waste, can be handled in such a way to create economic value, or it can be mishandled to create, well, a bigger mess.

The importance of how society—from the individual to the corporation—processes waste was clearly demonstrated at the Executive Environmental Sustainability Forum, October 28–29, 2008, hosted by Waste Management and the Allwin Initiative for Corporate Citizenship at the Tuck School of Business at Dartmouth. At the outset, forum moderator Nicholas Eisenberger, managing principal of sustainability strategy firm GreenOrder, stated that this conference was “about waste as a resource.” At first, this phrase appears to be an oxymoron, but it most certainly is not. While Eisenberger admitted that waste is not a sexy subject, waste management has become a key element in resource management (RM), with a very real opportunity for economic benefits. He emphasized that companies need to figure out how resource management can help them grow their business—how it can be a source of value over the long term.

The Allwin Initiative at Tuck, Eisenberger noted, wants to come away from the forum with actionable items and take the conversation mainstream. To move the dialogue forward, the forum brought together over 40 resource management experts representing a cross section of industries that included energy, industrial equipment, waste services, foods, electronics, and media, among others. To achieve a balanced perspective, there were also members of nonprofits and the U.S. Environmental Protection Agency (EPA) in attendance, as well as experts on European Union (EU) resource management.

After a keynote speech by Pat DeRueda, president of Waste Management Recycle America, which provided an incisive overview of the waste and recycling industry, the forum followed a panel discussion format. Three successive panels addressed the various aspects of moving from waste to resource management, covering such pivotal topics as pushing RM upstream, using technology, considering regulation, taking a holistic life-cycle approach, and, most importantly, sharing real-world successes.

Defining RM and Its Strategic Role

Succinctly put, RM “plays an important role in promoting sustainable materials use,” said Priscilla Halloran, who is with the EPA’s Office of Solid Waste and Emergency Response. It serves well the larger goal of using systematic efforts to attain effective and efficient use of

materials “to minimize inputs and undesirable outputs” throughout a material’s or product’s life cycle. “It seeks to bring materials back into the industrial cycle for reuse or materials back into the natural cycle to nourish the earth.”

RM is a critical component of sustainability when you consider that sustainability—meeting current needs without sacrificing the future—is built upon the conservation of resources. While sustainability’s three pillars are social, environmental, and economic prosperity, the consensus at the forum was that companies alone are not responsible for trying to save the planet. While sustainability is a core strategy, converting waste into resources must serve a respective company’s growth strategy; it has to be profitable.

The Evolution of RM

To understand how RM and sustainability have become interconnected with a company’s core growth strategy, it is necessary to understand what has driven these concepts to the forefront in recent years. Robert Hansen, senior associate dean at the Tuck School, believes that focus on sustainability comes in cycles as big events, such as the Love Canal state of emergency (1978), the discovery of a hole in the ozone layer (1985), and the infamous New York garbage barge (1987), capture people’s imaginations and push the dialogue forward. Climate change has now recharged the conversation, added Eisenberger.

The link between RM and climate change was put in stark terms by Halloran: “Material use is a major contributor to global warming and habitat destruction, which, in turn, has led to the disappearance of species at rates about a thousand times faster than normal.” There is also a very definite resource issue, she added. “Over the next 50 years, world population is expected to grow 50 percent, global economic activity is expected to grow 500 percent, and global energy and materials use is expected to grow 300 percent.”

There is simply not that much resource available, concurs Mark Small, vice president of safety and health, Sony America. He emphasized that there is a finite amount of material and energy in the universe, saying, “This is the true reason a company like Sony needs to embrace sustainability.”

Accidental RM

Not all companies consciously initiated an RM program. Some found themselves at a convenient confluence of sustainability and growth strategies. For Georgia-Pacific (GP), a forest products company that manufactures tissue, packaging, paper, pulp, building products, and related chemicals, using renewable resources and recycling waste have been just good business strategies for years. For example, the company has a subsidiary, Harmon Associates, that purchases and supplies recovered paper to its mills. That business also supplies other customers and brokers with almost eight million tons of recovered paper annually.

GP’s business model initially had more to do with good business practice than with a fully developed view of sustainability, explained Bill Frerking, GP’s vice president and chief sustainability officer. “That is not surprising as businesses historically were pretty good at making decisions involving the impacts they understood and could measure. Sustainability requires making decisions at the optimal balance of social, environmental, and economic dimensions.” GP now has a formal “sustainability framework” built on these three traditional pillars. Yet value creation, measured by long-term profitability, remains priority number one. Frerking explained that the truest measure of sustainable performance is the long-term performance and profitability of a company.

PPL Renewable Energy LLC also did not start off calling what made business sense as “sustainability,” said Kurt Zwerko, the company’s vice president; it was about doing what is right.

The company is focused on energy, so RM fits tightly into the firm's strategic plans. As part of its core strategy, PPL seeks alternative energy solutions as well as opportunities to create more energy from existing resources. This need for greater efficiency is paramount as there is little interest in adding either new coal plants or nuclear plants, and dams for hydroelectric power can take upwards of 10 years to build. New business is key to the firm's growth, Zwerko said.

PPL's sustainability program has evolved to include waste alliance teams that involve a partnership with Waste Management (WM); waste oil recycling and reuse; programs for recycling batteries and light bulbs; environmental support projects, such as land conservation; and educational programs on sustainability. The company has also built one of its facilities to the highest standard of certified energy and environmental design—a Gold LEED (Leadership in Energy and Environmental Design)—to show it walks the talk, even though the decision was not solely economic. Zwerko said you get “recognized by the public” for being a good citizen. This recognition was also mentioned by Mark Small of Sony, who said one of the major reasons for his company's RM initiative is to be known for social consciousness. “If we're known as green and socially conscious,” he explained, “it gives us a little more push in the market.” The consensus at the forum was that companies need balance among the three dimensions.

Life-Cycle Analysis and Identifying Wasteful Practices

RM and sustainability programs must become more sophisticated to address the daunting resource challenges cited by Halloran and faced by corporations. The forum attendees espoused a holistic approach to solutions that use life-cycle analysis, with the current trend across industries to push RM upstream and involve suppliers and vendors. “Life-cycle analysis is necessary to determine the total environmental impact of management decisions for residuals, by-products, and waste materials,” said Harry Lamberton, vice president, Waste Management Upstream.

Companies need to create a value stream map and then determine where there are inefficiencies that can be eliminated, DeRueda said. For DeRueda, this can be as simple as using a process of putting colored “stickies” that represent elements of materials flow on a board and looking at what can be eliminated. To drive out wasteful practices at WM, DeRueda explained the company has adopted a manufacturing approach that zeroes in on using resources only for the creation of value. In concert with this philosophy, the RM trend in corporate America is to look for inefficiencies at each stage of a product's life cycle—in particular, to look upstream. This more holistic approach is in contrast to the traditional linear view that focuses on waste generated at the end of a product's life cycle—that is, the waste generated by consumers. Such municipal waste is a mere 1 percent of the 13 billion tons of waste generated in the U.S., while industrial waste accounts for 57 percent, according to Joel Makower, co-founder and chairman, Greener World Media.

Along with looking upstream, another significant trend is to map a product's life cycle in a circular fashion, with interconnecting loops illustrating inputs and outputs at each stage, rather than taking the linear approach. “A one-way linear path is not sustainable,” Halloran warned. “We're trying to break out of the compartmentalized regulatory approach,” she said about the EPA's work. She identified the major stages (Figure 1) as resource extraction, materials processing, product design and manufacturing, product use, collection/processing, and disposal, as well as transportation across the stages. At each stage, a company must study how the inputs and outputs can be minimized, whether it is water, energy, or materials. “What can be renewed, recycled, or remanufactured? How can products be designed for this? How can material choice affect this? How are the air, water, and land impacted?” Halloran asked.

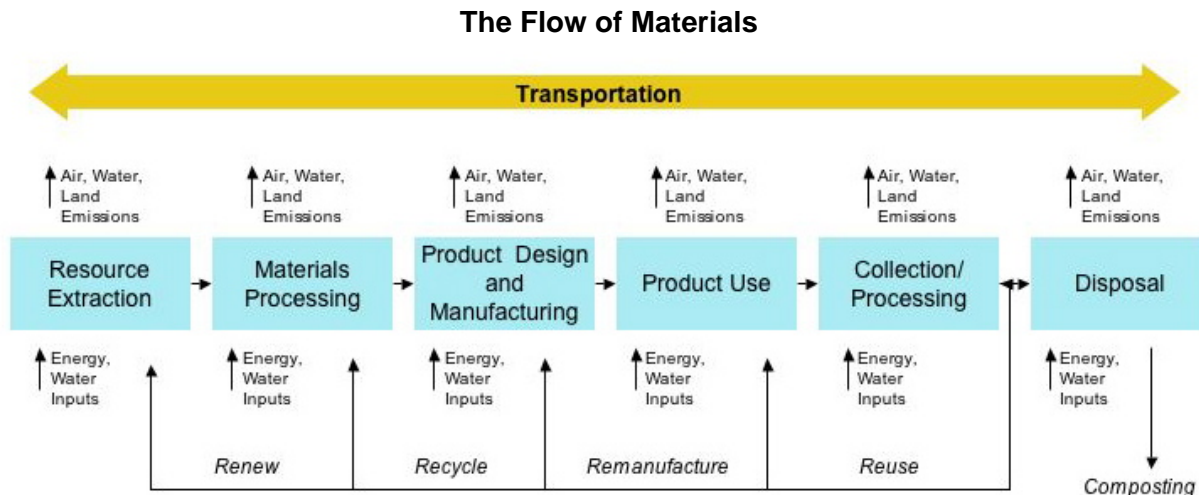


Figure 1. Source: United States Environmental Protection Agency, 2020 Vision Workgroup, 2007

Sustainability and Life-Cycle Analysis in Practice

For Caterpillar, a leading manufacturer of construction and mining equipment, sustainability is a key element of its strategic vision and part of its branding as the company strives to improve fuel efficiency and reduce the emissions of its equipment. “A successful sustainability program involves turning the definition of sustainable development away from a kind of standard language and turning it into something that is very specific and meaningful to your own company,” said Jody Howard, the firm’s director of social responsibility. Toward that end, Caterpillar has involved its customers. When the company sponsored 10 customer focus groups to understand what their needs are, sustainability came to the forefront. It was (and is) becoming a mainstream part of Caterpillar customers’ business. These customers want energy-efficient quality equipment, in part so society doesn’t thumb its nose at construction and mining projects. They also want good, sustainable products so they, in turn, can use them to differentiate themselves when seeking their own customers.

To stay abreast of the changing marketplace and to satisfy its customers’ needs, Caterpillar now rigorously analyzes the life cycle of a product, which, Howard explained, is particularly important when some machines have a 40-year life. In analyzing an earth-moving piece of equipment, a medium wheel loader, the company discovered that only 2 percent of the emissions in its life cycle were generated by its initial making, while 97 percent of the greenhouse gas (GHG) emissions came from engine use. This hammered home the need for better fuel efficiency. One of the exemplary results from this analysis is Caterpillar’s new D7E electric-drive track-type tractor, which has 50 percent less operator noise, 60 percent fewer moving parts in its drive train, and uses up to 20 percent less fuel per hour. To truly measure its progress or changing sustainability footprint, the company charts the environmental, social, and economic impacts and costs of the new versus the old products in a spreadsheet and a spider diagram.

The old model provides the baseline, which is absolutely necessary when measuring progress. Good data on RM and sustainability programs was a recurring theme at the forum. This information also feeds right into Caterpillar’s marketing pieces used by the firm’s sales department, explained Howard.

Companies “must set specific goals,” she said, not only for a product’s efficiency but for operations as well. Caterpillar has done so. By 2020, the company plans to increase material efficiency by 20 percent, increase energy efficiency by 20 percent, and reduce GHG by 20 percent. The company also aims to send zero waste to landfills, hold consumption of water flat while the company doubles in size, and have all new construction LEED certified, among other

initiatives. Once such goals are set, Howard emphasized, they must be drilled into the organization. She noted that the company keeps a scorecard on how well its top executives meet the goals. "We hold each top executive accountable."

Transparency is also critical, and such commitments must be made public, Howard said. Toward that end, Caterpillar participates in the Carbon Disclosure Project and the United States Climate Action Partnership (USCAP), among other such groups, and the company issues an annual sustainability report. Good data on RM and sustainability programs was a recurring theme at the forum.

In evaluating what makes life-cycle analysis successful, DeRueda noted you need dialogue between all parties involved in a product's life cycle. A critical issue is manufacturer and supplier collaboration. Another issue is time-frame considerations. George Caraghiaur, vice president of energy services at Simon Property Group, the largest public U.S. retail real estate company, emphasized that companies need to look beyond three years when looking at life-cycle costs. He said he finds it amazing that so many companies seem to disregard the benefits generated over the entire life cycle of a product.

The Recycling Quandary

While life-cycle analysis provides an excellent macro view to help guide strategy and set goals, companies must then take the analysis to a micro level when examining each stage. Naturally, one of the most significant stages is the recycling of waste. For companies like WM, a big challenge is how to put less material in the landfill, said DeRueda. "Can we go from diverting 25 percent from the landfill to 50 percent?" he asked. The latter figure has been reached by a number of European countries.

WM has a division that helps companies control waste and improve recycling, which means less garbage for WM to haul. It may seem counterintuitive to the company's business model to tell customers how to cut waste, but DeRueda explained that WM must "be part of the solution or become extinct." Recycling offers growth, which is why RM is embedded in the company's strategic plans.

The key is to recover more recyclable materials before they are buried. To achieve this goal, DeRueda said WM has paid particular attention to the opportunity single-stream technology offers versus the traditional dual stream. In the former, all recyclables are lumped together by the customer, while in the latter, fibers and other materials are separated before collection. Because single stream is easier for customers, they tend to recycle on average 35 percent more material. This increase is critical when performing a cost-benefit analysis between the two methods. Consider that at curbside, the single-stream cost is lower because one truck is making one pass versus two, lowering the company's carbon footprint. The processing of single stream is more expensive since it requires a more sophisticated technology, so the increase in volume is critical to achieve scale.

When evaluating recycling, WM must also consider that at a certain point, each incremental increase costs more; it becomes more labor and capital intensive. It is a quandary because publicly traded companies like WM must determine how to integrate returns that meet shareholder expectations with the desire to do the right thing environmentally. Tuck professor Hansen said society we shouldn't think of diminishing marginal returns. Instead, we should count on new designs and new technology to improve margins.

Companies must also understand the balance between the benefit of increased recycling versus the carbon footprint created in the process. WM Upstream executive Harry Lamberton posed the question, "Is it better to use the local landfill or haul it 500 miles to an incinerator?" While burning might appeal to some, hauling the waste 500 miles could end up having a greater carbon impact than just going to the landfill, where it is sequestered or potentially turned into energy. In his analysis of one such case, going to the landfill was the better choice. Certain items probably should just be landfilled.

A Zero-Waste Recycling Program in Practice

In spite of potential diminishing returns with incremental increases in recycling, Lamberton believes there is opportunity for zero-waste programs and enthusiastically shared his experience in implementing a program for an aluminum manufacturer. As he defined it, such programs must achieve “zero waste at zero additional cost, with zero additional environmental impact.” Zero waste equates to finding the highest value use for process residuals and by-products. It is necessary to move away from a “waste mind frame into a resource focus.”

That was the mind-set when the company hired WM to analyze and reduce its waste. WM discovered a great deal of aluminum in the plant’s floor sweepings that had been simply tossed out because the quality was tainted once the aluminum hit the floor. In response, the company implemented a zero-waste program that recycled and cleaned the floor sweepings at two plants. By year three, the recycling rates and savings had increased dramatically.

Recycling Rates			Cost Savings	
	<u>Yr 1</u>	<u>Yr 3</u>		
East Plant	2.0%	76%	Year 1 Savings = \$566,180.17	
			Year 2 Savings = \$540,374.41	
			<u>Year 3 Savings = \$324,428.26</u>	
West Plant	0.3%	86%	Total Savings = \$1,430,982.84	

Figure 2: Recycling Rates and Cost Savings, Source: Waste Management

Sony: 100 Percent Recovery Rate Needed for Growth

Sony also believes that zero waste is possible and, for the electronics firm, such an initiative is critical to creating value within its growth strategy, according to Mark Small of Sony America. With irrefutable logic, Small explained that Sony wants consumers in China to have electronics equipment on the same level as those in the West, but there simply isn’t enough material to accomplish that goal. Only resource management—recycling and reuse—will allow a company like Sony to realize the massive potential of the Chinese market.

“The existing model of make it, use it, and throw it out is not going to work,” warned Small. “We need to mine urban electronic waste just like any other mine.” Small said that after all, the copper in electronics is high quality, so waste has real value. “We just need to figure out how to do it efficiently and then push toward a 100 percent recovery rate.” For example, design changes need to occur that are as simple as no need for a screwdriver to dismantle a product when recycling.

E-Waste Critical Issues

Issues critical to e-waste (electronic waste) were discussed at roundtable lunch sessions.

- New electronic products being issued all the time
- Thirty-four percent of households have a television that doesn’t work. Where will it end up?
- Fees in some municipalities do not provide incentive for recycling.
- Is it profitable to take in electronics for free?
- Commodity prices lead to more recycling.
- Will the volume be there to justify investment in a recycling plant?

Another factor that would help RM is to eliminate hazardous materials that can’t be recycled. “Old materials that are not reusable, such as non-fire-retardant plastics, are a very

serious hurdle for Sony," said Small, who pointed out that there are components only three years old that can't be reused due to regulatory and design changes. Small estimates that the company currently is reusing only 5 to 10 percent of plastics. "Sony needs to get engineers involved upstream," he concluded. "They need to be thinking of recycling, but it's a big step as there is a long way to go due to logistical and technical issues. Sony has to be much more efficient on resource management and resource use."

Customers Prompt Mission Zero

Another company striving for zero waste is carpet manufacturer Interface, Inc., which takes Sony's desire for 100 percent recovery a step farther. In its sustainability program, called Mission Zero, Interface aims to use technology as well as product and process redesign to eliminate any negative impact on the environment by the year 2020. This lofty goal originated in the early 1990s when customers started asking, "What is Interface doing in the area of sustainability?" explained Eric Nelson, vice president of Interface Americas. The company's founder, Ray Anderson, responded with enthusiasm. "Ray said we are going to reinvent ourselves as a truly sustainable company," Nelson said, "a company that gave back more to the earth than we took from the earth."

The first step is to understand internal waste, said Nelson. How do you minimize waste and reuse what waste is created? Early in the company's program, the focus was on traditional postindustrial waste management. The second step was to "move from postindustrial waste to post-consumer waste," which involves the recovery and recycling of the firm's products. "We have to take responsibility for 30 years of putting petroleum-based products out there in the world and take responsibility for bringing those back and turning [them] into useful raw materials."

Nelson admits that it is a daunting task because carpet is a mix of petroleum-based products. Looking forward, changes to design and use of different materials will aid recycling tremendously. Separating the materials during the recycling process is the key, and developing the technology to do it efficiently is crucial. To test this RM business model, the company opened a recycling plant over a year ago. Once the plant proves itself, the plan is to regionalize recycling operations to minimize freight costs. The company also plans to have a manufacturing facility adjacent to one that uses the recycled material.

Converting Waste into Renewable Energy

If certain waste does have to go into the landfill, the question WM has been asking is, can something productive be done with that waste? In answering its own question, WM is working on capturing methane gas produced at landfills. In one such project, the company is successfully powering 80 to 85 percent of the University of New Hampshire's energy needs. WM also powers one million homes by converting trash to energy, which is more power than that generated by the solar industry with its landfill-gas-to-energy facilities.

Converting by-products to energy is a significant emerging RM trend that extends to companies that generate bio-waste, which can be converted into renewable energy. Tyson Foods is a prime example. It generates approximately 2.2 billion pounds of animal fat in processing beef, chicken, and pork. "Recycling and finding higher value uses for by-products is critical to the company's core strategy," explained Tyson senior vice president and chief environmental, health, and safety officer Kevin Igli. A new area for the company is using by-products in renewable energy.

In a partnership with ConocoPhillips, the companies are using a proprietary thermal depolymerization technology to process tallow (animal fat) with diesel to create the next generation of renewable diesel fuel, which will help supplement the traditional petroleum-based diesel fuel supply. The renewable diesel meets all federal standards for ultra-low-sulfur diesel. In addition to lower life-cycle carbon emissions, this fuel will increase energy security by using a

domestic and renewable energy source and reduce greenhouse gas emissions. Iglu makes it a point to distinguish this fuel, which can be used in existing pipelines and engines, from bio-diesel, which can require changes to the engine or mixing with another fuel. In fall 2008, the company broke ground on a synthetic fuel plant in Louisiana that will use non-food-grade animal fats, such as beef tallow, pork lard, chicken fat, and greases. A partner in the project is the state of Louisiana, which has assisted in the funding. The Louisiana State Bond Commission approved \$100 million in Gulf Opportunity Zone Bonds. Tyson has also conducted a chicken-litter-to-energy gasification pilot project at one of its feed mills in Georgia. The gasified litter was used to power part of the feed mill, providing up to 30 percent of the needed steam, an energy source that can also turn a turbine. And the company has covered a number of its anaerobic lagoons, which produce biogas that is 50 to 75 percent methane. Once condensed and cleaned, the gas can be used in place of natural gas in the company's boilers.

In an effort to improve renewable fuels and make the waste-to-fuel process more efficient, Siemens and the United States Department of Agriculture's Agricultural Research Service recently partnered to study the conversion of biofuel, such as animal waste, into bio-oil. Seeking renewable energy sources is a natural fit for Siemens, which provides products and services to the energy, healthcare, and transportation industries, among others. RM comes down to "energy, energy, energy," said Karen Kalina, Siemens One director of strategic business development and sustainability. The company, which has increasingly concentrated on wind and other sustainable energy sources, has an energy and environmental solutions business unit that is working to capture methane gas from wastewater treatment plants. For this type of program to be successful, Kalina emphasized, community involvement is significant. The company currently is working with San Leandro, California, to build a 330-kilowatt, methane-fueled co-generation facility at the city's wastewater treatment plant that is expected to save 60 percent in plant energy use and cut carbon dioxide emissions by 1,500 tons annually. While Kalina cited this success, she acknowledged the challenge of establishing municipality and business collaboration, obtaining financing, and securing legislative support. "It's complex but doable," she said.

The General Electric (GE) Company is also pursuing opportunities to capture what was traditionally considered waste and turning it into energy. GE has installed 20 of the company's Jenbacher gas-powered engines at a Ukrainian coal mine. Designed to use alternative fuels and meet tough emissions standards, the engines use coal mine methane gas and then generate energy to supplement the mine's operation power and heat needs. As Dave Searles, director of GE's Ecomagination program, pointed out, it is a much better alternative to venting or flaring the gas. Searles also identified similar opportunities in the steel, gas, and oil industries to capture waste gases rather than just using flaring. He presented an estimate that gas captured from a blast furnace application could produce approximately 160 tons of steam annually.

From the murky anaerobic lagoons, surface pivotal questions: What is the return on investment for renewable energy projects? Are they scalable? Are they economically viable? Kurt Zwerko, who had been managing modest renewable projects, such as solar, landfill gas, and biomass plants, at PPL, said the company's CEO made it very clear that he wants a return and set a goal of 20 cents a share for the business. Scalability became crucial, so Zwerko hired managers for each renewable segment to build the business. The work is still in progress, but clearly the growth of renewable energy has become critical to PPL's growth strategy.

Industrial Symbiosis

While some of the RM examples cited focused on a firm recycling its own waste, there is significant opportunity for businesses to share resources across company boundaries. Marian Chertow, associate professor of industrial environmental management at Yale University, calls this "industrial symbiosis." As a researcher and consultant, she seeks opportunities for interchanges between companies in sharing resources and transferring best practices. She

studied two rum distilleries in Puerto Rico, mapping the material flows in detail to find opportunities for reuse, recycling, and symbiosis.

In looking at inputs and outputs, she learned that the rum manufacturers reuse oak barrels from the whiskey industry. As for an opportunity to improve on RM, one plant uses methane gas for energy, which can be purchased from a renewable source. In looking at outputs, the distilleries' by-product of carbon dioxide was being sent to a drink manufacturer and the oak barrels were being reused yet again. However, the wastewater was not being reused, presenting an opportunity. Methane was being generated that could be captured. Chertow sought to transfer the best practices she found at one distillery to the other.

Chertow also "uncovered" existing industrial symbiosis at a coal-fired power plant in Honolulu, Hawaii, that supplied steam to a nearby refinery. As coal was very expensive to purchase and ship, and water would eventually become a limited resource in Hawaii, businesses began on their own to explore alternative inputs. Burning shredded tires provided by a recycling company became one significant alternative energy source, and several other industrial plants began to supply either waste oil or used activated carbon as a coal substitute. Two types of reclaimed water are used from the city's water reclamation plant. Chertow also looked at outputs and discovered opportunities. The fly ash could be sold to a concrete company as a cement substitute and also used as backfill at a limestone quarry. Chertow calls this local symbiosis "clusters" and encourages companies to seek cooperative solutions with their neighbors as a means of achieving efficient resource management.

Transferable Solutions Regardless of Industry

Certain industries offer obvious and significant RM opportunities, as seen with both Tyson Foods and Interface. Regardless of what a company produces, it was made apparent at the forum that there are transferable practices that could be embedded in any company serious about sustainability. These practices include aligning incentives and goals, engaging employees, and simply conserving energy.

It is difficult for companies to allocate money to recycling, "especially in hard times," explained Tom Votta, deputy director at Chemical Strategies Partnerships. Companies sometimes can't afford to hire a waste management team, so it's often just one person handling recycling as well as other environmental issues. "How can a company get suppliers and vendors involved?" he asked. Votta recommends using incentives. As he explained, in a traditional disposal contract, the service provider wants to increase its service by hauling and disposing of more waste, while the customer wants a decrease. From the start, the two parties are in conflict (Figure 3).



Figure 3. Source: Ligon and Votta. Tellus Institute, *From Waste to Resource Management*, 2003.

In an RM model, it's about resource efficiency and cost savings, with both parties desiring an increase in service. It is up to the customer to provide the proper incentives for the vendor to drive down costs, Votta said, which leads to the company desiring greater RM services to realize further cost savings. The two parties are more likely to agree on payment and incentives, he explained, if the vendor has access to information, if both sides understand the cost structure, and if the vendor is rewarded for the company's bottom-line improvements—in other words, if the vendor gets a piece of the savings.

Lamberton, of WM, concurred that incentives must be aligned between customer and vendor. In a typical case that is applicable regardless of industry, an automotive company hired WM to analyze how it handled trash, cardboard, and wooden pallets. After studying 20 locations, from parts distribution centers to assembly plants, WM identified 35 workers over three shifts handling the waste work. WM restructured its client's waste management operation, reducing the number of workers to 14 workers over two shifts. The changes secured annual cost savings of over \$2 million by year three of the program.

The alignment of incentives must be internal too, Lamberton said. For example, a company division might not be motivated to cut waste if workers from another division are responsible for handling it. Also, critical employees upstream, such as purchasing agents, must be properly motivated to buy efficiently, keeping downstream waste issues in mind. Ultimately, for RM programs to be successful, Lamberton said, senior leaders—from the CEO to the plant manager—must be on board.

Engage Employees

For a successful RM and sustainability program, companies need to listen to employees, said Howard of Caterpillar. Toward that end, Caterpillar hosted a worldwide blog on sustainability for its employees. "During a two-day, online 'SD Jam' in July 2008, we got a glimpse of our employees' passion for sustainable development issues," she noted. Over 2,200 employees logged on to ask questions, make comments, and offer suggestions.

For a company like WM, engaging employees carries great weight as they offer RM solutions to their customers. To improve its practices, WM formed four sustainability teams, made up of employees with different backgrounds from different geographies. Team one looked at landfill material that should, in fact, be put back in the marketplace; team two studied how WM moves materials; team three addressed sustainability within the company by looking at its internal practices and carbon footprint; and team four considered how the company offers solutions to customers. As DeRueda said, "It's about walking the talk."

Common Sense Energy Efficiency

While a great deal of focus has been placed on renewable energy, being energy efficient in a traditional sense goes a long way—and it's not even about technology. "Making sure lights are off when you leave a room is not rocket science," said Caraghiaur of Simon Property Group (with over 380 properties). Drilling such simple practices into employees helped Simon realize 11 percent savings in energy use since 2004, critical to the company's bottom line because 95 percent of its energy consumption is electricity at the company's malls. For Simon, the "Keys to Sustainability through EE" (energy efficiency) include involving employees, sharing best operating practices, investing in energy efficiency projects, and monitoring and reporting on a continuous basis. All of these factors are themes echoed by other participants at the forum.

Caraghiaur calls the amount of energy you don't use "negawatts," a term coined by Amory Lovins, who had first seen the word as a typo for "megawatts" in a report he was reading. It struck a chord with him, and he used it in a 1989 speech. Now, the concept promotes investing to reduce electricity demand rather than investing to increase capacity. "Worrying about negawatts makes good business sense," said Caraghiaur. Unfortunately, he observed, "market enhancement activities will always take predominance over waste minimization efforts

in a capital-constrained world. That's why it's generally challenging to engage executive management on the issue of waste minimization.”

The European Union: A Culture Fosters RM

“We can learn from Europe,” said DeRueda. A leader in sustainability, Europe simply is much better at RM because it is not a throwaway culture, he explained, and it will be very difficult for the U.S. to catch up, to push its recycling rate of 32 percent to 50 percent, the latter rate exceeded by a number of European Union (EU) countries. We have to tackle all types of recycling but, ultimately, the “culture has to drive it,” he said.

The EU has always been much more conscious of sustainability because there is a land issue, with many more people per acre compared to the U.S., explained Benoit Cushman-Roisin, an engineering professor at Dartmouth’s Thayer School of Engineering. For example, Germany has 231 people per square kilometer versus the U.S.’s 31 people.

To promote RM, the EU has issued environmental directives based on hierarchical principles (Figure 4). In terms of reducing waste, one of the tactics is to attempt to influence consumers to demand greener products and less packaging. In the area of recycling, Cushman-Roisin noted that the EU has identified specific waste streams for priority attention, including packaging waste, end-of-life vehicles, and batteries, as well as electrical and electronic waste. As for final disposal, the philosophy is the same as that expressed by a number of attendees at the forum: use the landfill only as a last resort.

In Europe, the economic factor is of secondary importance when it comes to waste disposal. This situation was made apparent when Cushman-Roisin highlighted the “Framework Directive on Waste Disposal” approved by the European Parliament on April 5, 2006. “The essential objective must be the protection of human health and the environment against harmful effects caused by the collection, transport, treatment, storage, and tipping of waste,” he paraphrased in his presentation.

But even within the EU, the recycling rates among countries vary greatly. Germany excels, having recycled more than 50 percent of household waste in 2006, while Greece lagged far behind at 9 percent¹. These stark differences are due in part to cultural differences within the EU. The waste-management models also vary greatly among countries, explained Cushman-Roisin. For example, Austria and Ireland use an incentive-driven model, while Denmark uses a command and control system. For Austria and Ireland, as well as the majority of EU countries, the incentive model relies on a producer-responsibility recycling scheme, which, Cushman-Roisin said, “gives the producers the organizational and economic responsibility.” It is characterized by the establishment of a specific company for collection and treatment, to be financed by the producer. Because it is financed by the waste producer, there is opportunity for incentives. A drawback is that there can be an overlapping, or parallel of, effort by businesses and municipalities, which could be eliminated in a command and control scheme. In contrast to Austria and Ireland, Denmark’s command and control scheme relies on taxes and fees to fund waste management. The high fees encourage recycling, but the drawback is that high fees could lead to illegal dumping.

EU Hierarchy of RM Principles



Figure 4. Source: Benoit Cushman-Roisin.

¹ www.foe.co.uk/resource/press_releases/recycling_rates_increasing_23012006.html

In comparing Denmark and Ireland's recycling rates, in recovering package waste as of 2001, Denmark had easily exceeded 50 percent, whereas Ireland lagged at less than 30 percent. With the same scheme as Ireland, Austria posted a rate over 60 percent, beating Denmark, which indicates there is more to recycling than just the chosen model. Cultural differences within the EU are indeed significant factors.

As for vehicle recycling, an EU imperative, the current waste is 20 to 25 percent in Europe, about the same as the U.S., the latter having done well in this area. The "European twist" that Cushman-Roisin noted is that the recycling of vehicles is the producer's responsibility. In other words, BMW is responsible for BMW vehicles. The EU legislation has set a cap of 5 percent vehicle waste, to be effective 2015. The U.S. will struggle to match this because there is less steel in cars today, which had made them so attractive for recycling in the past.

Another EU imperative is battery recycling, said Cushman-Roisin. A directive was issued that sets collection rates of at least 25 percent and 45 percent by 2012 and 2016 respectively. To facilitate recycling, Europe has many collection points; for example, the schools in Belgium are used. There is also an EU directive on Waste Electrical and Electronic Equipment (WEEE) that pushes the responsibility for recycling on the manufacturer. The manufacturer must establish the infrastructure for collection, and the disposal or refurbishment must be environmentally sound. In addition, collection is at no cost to individuals, which is in contrast to how many U.S. municipalities handle it. In promoting recycling and reducing waste, the EU clearly is ahead of the U.S., Cushman-Roisin concluded, but this is not so much due to a high demand for green products by consumers as it is to committed leadership on the part of governing bodies.

EPA and Cultural Change

In response to the cultural quandary, the EPA is taking a more macro approach to sustainability and trying to create a road map to move the U.S. from current managing waste practices toward managing materials in a more holistic and less environmentally burdensome way. "People are turning resources into waste faster than nature can turn waste back into resources," warned Priscilla Halloran of the EPA. "Our society relies heavily on non-renewables." She emphasized that we need "to think about how we meet our society's needs differently."

A prime example involves U.S. consumers' attitudes toward packaging. Their mind-set is much different compared to EU or Asian consumers. U.S. consumers want to see the product before they buy it, so companies use clear plastic packaging, which is not RM friendly. In contrast,

consumers in Japan buy products packaged in recycled cardboard. The mentality in Germany is also much different from that of Americans; consumers actually leave their packaging in the store to be reused.

While emulating Japan or Germany may seem like a simple solution, there is a dilemma. The cost of products is much lower in the U.S. than in Europe, reported Sony's Mark Small, so you have to be careful what you wish for. Are consumers ready to pay a higher cost for products

The Packaging Dilemma

Issues and potential solutions concerning packaging were discussed at a lunchtime roundtable.

- Packaging is a huge part of the U.S. waste stream (31 percent) and is excessive at times.
- Loss of branding with less packaging is an issue.
- What are opportunities for intra-industry collaboration?
- Consider packaging that is biodegradable.
- Put the packaging into the product itself.
- Evaluate take-back programs.
- Use packaging scorecards to keep companies sustainable.

to reduce waste? There is a sense that a cultural shift is happening in the U.S., but consumers are going to have to drive it.

Regulation Not Necessarily a Bad Thing

Certainly in the U.S., there is a wariness of the federal government handing down directives and meddling with business, but there can be significant benefits. The Tuck School's Hansen said he is "a big free-market guy," but he profoundly believes that regulation "has to be a big driver" of RM. "Regulation has to solve some of these problems" faced by society and business. To illustrate his point, he noted the benefits of the Clean Water Act, which, for example, transformed the Connecticut River from a polluted waterway, barely able to sustain life, to a fantastic resource.

Hansen is not alone in his opinion. Kalina of Siemens also believes RM and sustainability will be legislatively driven. Policies of the federal and state governments, such as tax credits or carbon caps, will drive in part how companies invest capital. Companies will analyze what they are permitted to do and where the better profits exist.

Companies must anticipate potential regulation changes, said Lamberton, before investing in a waste program. That's not easy. As Zwerko pointed out, states can be fickle in their policy making. As an example, New Jersey keeps changing its policies on solar energy. If a state keeps changing its policies, how can a company make an investment? In addition, he said, "each state is a different world," so it would help to have a broad national policy set by the federal government that would guide the states. For a company like PPL, with many of its strategic decisions dictated by regulation, consistent policies are tantamount. In contrast to PPL's changing regulatory environment, Germany has established long-term policies for renewables, according to Kalina, so companies know where to invest their capital. Siemens's goal is 20 percent reduction in energy consumption relative to revenues such that with a reduction in energy consumption there is a corresponding reduction in its carbon dioxide emissions. This goal is not driven by U.S. legislation but by an internal mandate from the company.

Not all forum participants favored regulation as the best solution. Concerning RM and regulation, Frerking of Georgia-Pacific concluded, "If you look around the world, it's such a politically driven process in terms of what strategies will ultimately prevail, how carbon will be taxed or controlled or limited. It's hard in this atmosphere to make a lot of big forward bets." He believes the market and competition for materials and customers will best address RM. "The market is the best arbiter of solutions. Regulation provides momentary certainty but is always a vote away from changing and limits experimentation."

A Summary of RM Challenges and Moving Forward

Legislative and regulatory policies are just some of the many challenges cited at the Executive Environmental Sustainability Forum. In summary, other hurdles that cut across the spectrum of industries include

- cultural factors that require teaching people to think differently,
- coordinating RM efforts between municipalities and the private sector,
- improving the efficiency of existing technology and developing separation technology for recycling,
- achieving economies of scale for recycling and renewable energy to provide an acceptable return on investment,
- aligning incentives and RM goals internally and externally along the waste stream.

In seeking solutions, a number of RM trends that are applicable across industries emerged at the forum, including

- taking a holistic approach and pushing RM upstream by involving suppliers, vendors, and employees,
- using a circular approach to life-cycle analysis that looks at the inputs and outputs at each stage,
- redefining relationships between companies and their refuse and recycling vendors so that both sides are motivated to improve RM.

In addition to highlighting these broad trends, the forum brought together businesses that are making concrete strides in RM and offering real solutions—from how Caterpillar improves the efficiency of its heavy equipment to how Tyson makes use of chicken droppings to generate energy. Sometimes, technology offers solutions, said DeRueda; sometimes, creative thinking offers solutions.

In terms of turning waste into resource, WM is certainly well positioned to understand what the immediate future holds. And while the company's growth strategy may not impact all industries, it certainly reflects opportunities in RM. The company's goal is in harmony with Sony's: recycle pound for pound, or zero waste. To achieve it, WM is setting up drop-off stations with the hope of having stations within 20 miles of 95 percent of the population. Toward that end, in less than two years, WM has grown the number of centers from 75 to 170. Another pillar of the company's growth strategy is to take proven, viable RM solutions to municipalities so communities can become more sustainable.

In reviewing the current state of RM affairs, forum moderator Eisenberger asked, is it a green revolution yet? He doesn't think so because there is still more talk than action. For many companies, sustainability is not yet integral to their growth and strategic plans. Even though some people still think of sustainability proponents as "tree huggers," Kevin Igli of Tyson believes that one day sustainability will be the norm. The dialogue must continue, and, at the close of the forum, Eisenberger invited all participants to do just that.