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WasteWise Update

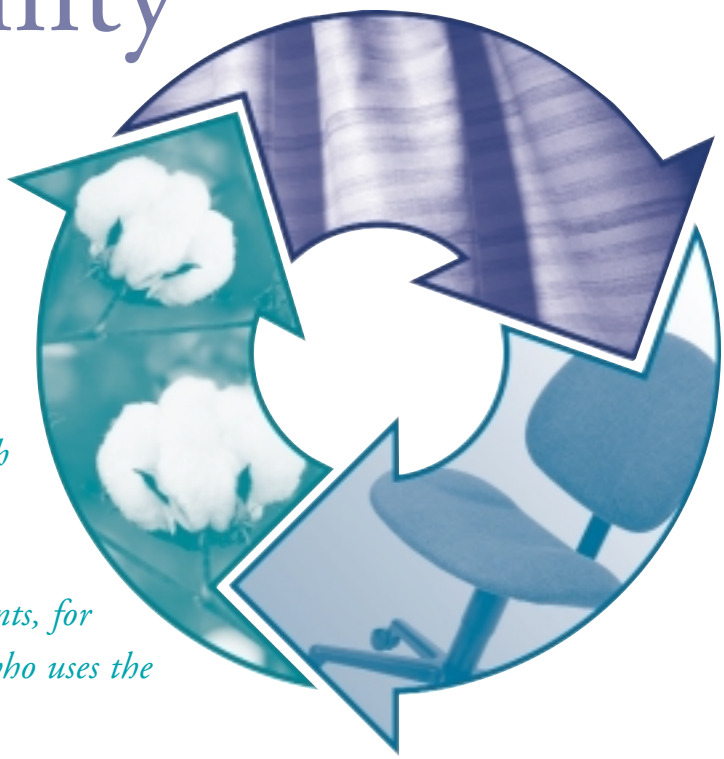
MOVING TOWARD SUSTAINABILITY

EPA WASTE WISE

Preserving Resources,
Preventing Waste

Printed on paper that contains at least 30 percent postconsumer fiber.

The Sustainability Continuum



A textile maker in rural Georgia ships cotton fabric trimmings to a furniture manufacturer in Atlanta, who processes the trimmings for use in office chairs. The manufacturer takes the chairs back when customers are finished with them, reuses all the serviceable parts, recycles all the parts that cannot be reused, and shreds the damaged upholstery, uncontaminated with hazardous constituents, for composting. The compost is sold to a nearby farmer, who uses the material as fertilizer for his organic cotton crop.

This 'closed loop' industrial system can become a reality when businesses, institutions, governments, and consumers join hands to reject the currently predominant *take-use-dispose* system of materials consumption. Under this system, too many resources flow in one direction: from the earth, into products, and finally into landfills and incinerators, from which the original materials are, in most cases, unrecoverable. Many products are not designed with reuse or recycling in mind, often making these activities difficult and expensive. This linear or *cradle-to-grave* model is inherently wasteful.

In the emerging circular or *cradle-to-cradle* model, the concept of waste eventually becomes obsolete. Waste from producers and consumers becomes input for other producers and consumers, or for the earth itself, and resources are cycled through the system to sustain future generations.

The transition from a linear to a sustainable, cradle-to-cradle system of materials use will not happen overnight. Rather, it involves an evolution of approaches, each more ambitious than the last one. This *Update* looks at the continuum of sustainability approaches, beginning with those that examine material flows *within* an organization. Next, we discuss approaches that explore the flow of material resources *among* a network of organizations. Finally, we discuss the ultimate goal of sustainability, a socioeconomic system that protects and enhances, rather than degrades, the human and natural resources needed by future generations to enjoy a quality of life equal to or greater than our own.

The sustainability continuum represents a gradual widening of organizational perspective and responsibility from an immediate group of facilities, suppliers, and customers to society as a whole. This *Update* is designed to inspire your organization to use WasteWise to help set your organization on the road to sustainability. Doing so will help keep your organization competitive in the new paradigm of interaction among society, the economy, and the environment. Ray Anderson, chairman and chief executive officer of Interface, Inc., has captured the necessity of this transformation: "In the 21st

"If there is to be prosperity in the future, society must make its use of resources vastly more productive—deriving 4, 10, or even 100 times as much benefit from each unit of energy, water, materials, or anything else borrowed from the planet and consumed."

—Paul Hawken and Amory and L. Hunter Lovins in *Natural Capitalism: Creating the Next Industrial Revolution*, 1999.

century, as the [next industrial revolution] gathers speed, I believe the winners will be the resource efficient. At whose expense will they win? At the expense of the resource inefficient. Technology at its best, emulating nature, will eliminate the inefficient adapters." Make sure your organization adapts.

Early Environmental Responses

The first responses to environmental challenges involved 'end-of-pipe' thinking. Citizens, scientists, industry, and policymakers looked at the effects of pollution after it exited a drain pipe or a smokestack and demanded that producers better manage the pollution they created. This meant cleaning waste water, installing air filters on smokestacks, and building cleaner and safer landfills and incinerators.

Over the last two decades, forward-thinking leaders from government and industry have begun to realize that it makes more sense (both environmentally and economically) to *prevent* pollution rather than manage it after it is generated. Rather than, for example, having to clean waste water before discharging it into nearby rivers, responsible companies have begun to find ways to alter their industrial processes to reduce or eliminate the use of hazardous chemicals. For solid waste, this means designing more efficient processes and products so that less solid waste is generated or identifying ways to recycle or reuse waste materials. *Pollution prevention* remains a leading environmental strategy for organizations today. Waste prevention, a subset of pollution prevention, has been the cornerstone of the WasteWise program.

Improving Resource Efficiency Within the Organization

While pollution prevention often involves a process-by-process analysis, it has inspired some organizations to look at the manner in which natural resources flow through their entire systems. *Material flow analyses* look at where an organization's resources come from, how they are used, and where they end up. Such analyses, for example, could help a company or institution discover that a majority of its environmental problems—and some of its costs—come from its use of one particular substance. Switching to a more environmentally friendly alternative, therefore, could make a big difference for this organization, both environmentally and financially. Material flow analyses can also be used to improve resource productivity—getting more value out of every unit of a resource—while simultaneously reducing the ecological impact of one's activities. Put simply, the goal is to produce more with less.

Eco-efficiency is a comprehensive new approach to this goal. It involves a range of interrelated business and environmental goals such as cutting costs, delivering higher quality products, reducing materials consumption and waste, and eliminating toxic releases into the environment. According to the World Business Council for Sustainable Development (WBCSD), eco-efficiency is a "management philosophy that encourages businesses to simultaneously become more competitive, more innovative, and more environmentally responsible." [1]

WasteWise and World Business Council for Sustainable Development

In addition to participating in WasteWise, the following partners are also WBCSD members:

- 3M
- AT&T
- BASF Corp.
- Dow Chemical Company
- Eastman Kodak Company
- Ford Motor Company
- General Motors Corp.
- International Paper Company
- Johnson & Johnson
- Monsanto Company
- The Procter & Gamble Company
- S.C. Johnson & Son, Inc.
- Weyerhauser Company
- Xerox Corp.

Identifying Opportunities for Resource Efficiency

WasteWise has always focused on resource efficiency. The ultimate goal of preventing or recycling waste is the efficient (nonwasteful) use of natural resources—such as trees, minerals, and petroleum—and financial resources. Organizations leading the movement toward greater sustainability evaluate how their overall systems can become more resource efficient throughout every stage of operation and use. Tools to do so include *lifecycle assessment (LCA)* and *Design for the Environment (DfE)*.

LCA is an analytical tool to holistically evaluate the environmental consequences of a product or process. Using LCA, an organization can examine a product's environmental impact as it moves from raw materials extraction through manufacturing and use to final disposal—from cradle to grave. Although sometimes complicated and data-intensive, LCA evaluates whether materials and products are environmentally preferable for the uses to which they are put.

In 1996, **Dell Computer Corporation** launched a "cradle-to-cradle" design scheme for its OptiPlex line of computers. The new modular design allows easy upgrading, disassembly, recycling, and reuse. The product's chassis is fully recyclable. This environmentally sound design has since been introduced in all non-portable Dell-branded computers.

For more examples like this, see the *WasteWise Update: Extended Product Responsibility* (October 1998).

<www.epa.gov/wastewise/pub_c.htm#ten>

[1] World Business Council for Sustainable Development. *Eco-Efficient Leadership for Improved Economic and Environmental Performance*. 1996. p. 4.

DfE is a strategy organizations can use to design products with reduced environmental burden over the course of a product's life cycle. DfE focuses on adding environmental attributes to products to reduce material and energy intensiveness during production. Some DfE strategies implemented by WasteWise partners include lightweighting products or product packaging, designing them to be more durable, making them out of recyclable materials, or designing them for easy disassembly to facilitate repair and remanufacture.

DfE looks beyond the product itself and addresses minimizing the environmental consequences associated with each component of the *product system*. A product system expands the boundaries of the "product" to include the business transactions surrounding the production process, such as distribution and management. Organizations can take this approach a step further by involving their suppliers and customers. Some companies, for example, have established programs to take back the packaging used to transport products to their customers or even the products themselves after their useful lives. These materials are then reused or recycled. *Product takeback* programs are becoming more and more common among producers of electronic products.

Organizations with the foresight to improve environmental performance and resource efficiency before being mandated to do so by regulations will avoid delays and higher costs later. Furthermore, those that give priority to resource productivity, process change, and product innovation will achieve significant performance gains at a lower cost and gain a competitive advantage in the marketplace. These actions minimize pollution and resource depletion while helping to build a sustainable environment, economy, and society.

> **"Eco-efficiency is an essential step, a bridge, on the road to sustainability... Intellectually and physically, you cannot go from [the idea of] pollution control to sustainability. You must go through a sequence of learning."**
>
> —Professor Andrea Larson,
> Darden School of Business, University of Virginia
> at a presentation during the 1998
> WasteWise National Forum.

By the end of 1998, 3M formally integrated Life Cycle Management, a technique to improve management of environmental, health, and safety impacts through all phases of a product's life cycle, into half of its business units. The company expects 100 percent integration by the end of 2000. Since 1990, 3M has reduced volatile organic air emissions 80 percent, releases to water 75 percent, and solid waste 20 percent. Since 1993, the company also has reduced its worldwide reportable injury and illness rate 50 percent.

Looking at a Wider Network

According to author Robert Ayres, "10 tons of active mass raw materials (not including construction materials) per person [are] extracted from U.S. territory by the economy... 6 percent of the total is embodied in durable products. The other 94 percent is converted into waste residuals as fast as it is extracted..."[2] These statistics demonstrate that today's organizations need to go beyond the simplest steps of waste reduction in order to make facilities and industries sustainable. Organizations that have recognized this need are moving further along on the sustainability continuum, looking beyond their own walls to transform their relationships with a wider network of organizations.

The study of material and energy flows and their transformations into products, byproducts, and wastes throughout industrial and ecological systems is a primary concept of the movement often referred to as *industrial ecology*.

Cradle-to-Cradle

Material flow analyses can help organizations redirect their own materials to flow in more circular patterns, that is, providing their wastes as inputs for other industries and vice-versa. Under this model, organizations no longer view the life cycles of the materials and energy they consume as finite, ultimately ending in a landfill or in the environment. Rather, they seek opportunities for the continual reuse and recycling of materials through a cooperative industrial system in which processes are designed to consume available waste streams and to produce only usable waste. In an October 1998 article in *The Atlantic Monthly*, William McDonough and Michael Braungart elaborate on this vision: "If people are to prosper within the natural world, all the products and materials manufactured by industry must after each useful life provide nourishment for something

[2] Ayres, Robert U. "Externalities: Economics and Thermodynamics." Archibugi and Nijkamp, ed. *Economy and Ecology*. 1989. Cited in Lowe, Ernest, John Warren, and Stephen Moran. *The Source of Value: An Executive Briefing and Sourcebook on Industrial Ecology*. 1996. p. 1.1.

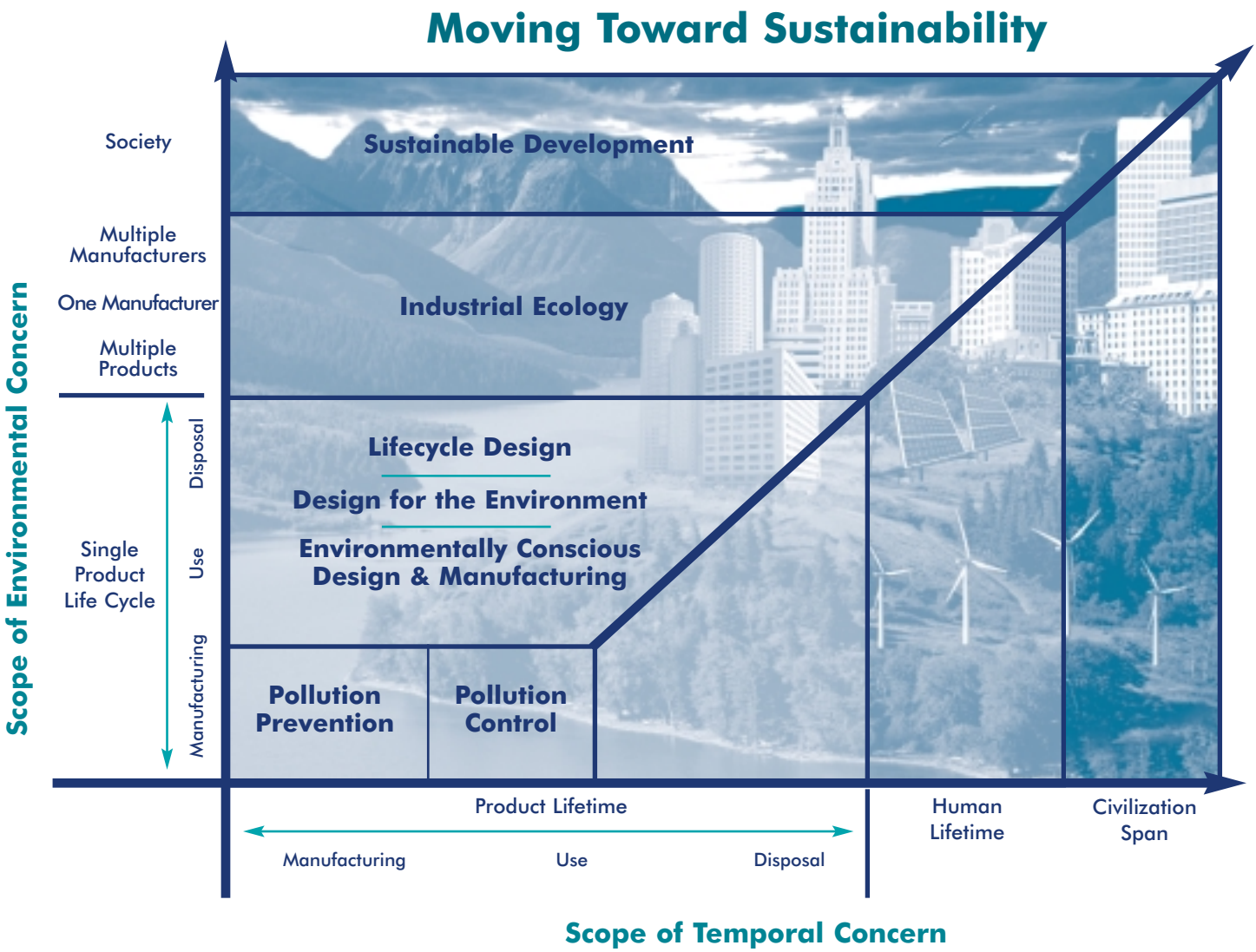
new. Since many of the things people make are not natural, they are not safe 'food' for biological systems. Products composed of materials that do not biodegrade should be designed [to] continually circulate within closed-loop industrial cycles." Ideally, this closed cycle would approximate the dynamic equilibrium that exists in nature, "…where energy and wastes are constantly recycled and reused by other organisms and processes within the system… In a totally closed industrial system, only solar energy would come from outside, while all byproducts would be constantly reused and recycled within."[3]

Creating Industrial Ecosystems

As organizations pursue opportunities to create cradle-to-cradle materials systems, they begin to forge cooperative, resource-sharing relationships with otherwise unrelated businesses and institutions and the surrounding community. Individual processes and products become part of an interconnected industrial system in which new products or processes evolve out of or consume available waste streams, water, and energy; in turn, processes are developed to produce usable resources. This systemic model of integrated processes and materials, called an *industrial ecosystem*, is typically characterized by resource-efficient relationships among organizations, including the use of recycled materials in production, minimum waste generation, and, most importantly, the reassessment and exchange of byproduct materials, water, and/or energy as raw material for other companies' processes.

In their efforts to become sustainable, entire business communities have forged cooperative environmental partnerships to establish *eco-industrial parks*. In *The Source of Value: An Executive Briefing and Sourcebook on Industrial Ecology*, Ernest Lowe, John Warren, and Stephen Moran define an eco-industrial park as "a community of manufacturing and service businesses seeking enhanced environmental and economic performance through collaboration in managing environmental and resource issues including energy, water, and materials. By working together, the community of businesses

[3] Garner, Andy and Gregory Keoleian. *Industrial Ecology: An Introduction*. November 1995. p. 12.



Source: Yale School of Forestry and Environmental Studies

Nike's Reuse-A-Shoe program collects and grinds up old sneakers, yielding three materials: rubber, fabric, and foam. Nike uses the rubber and foam to make soccer fields, running tracks, tennis courts, basketball courts, and climbing wall decking. The granulated fabric from the shoe uppers is recycled into carpet padding. Nike's ultimate goal is to close the recycling loop—to make new Nike products out of old ones. Currently, Nike is working on designing athletic footwear to be disassembled and reused.

seeks a collective benefit that is greater than the sum of the individual benefits each company would [otherwise] realize." The establishment of these networks of businesses and organizations committed to sharing resources and using one another's byproducts represents a big step toward the ultimate goal of reaching a sustainable ecological and economic state. Two such networks, the Kalundborg, Denmark, eco-industrial park and the Red Hills Ecoplex in Mississippi, are discussed on page 10.

Striving Toward Sustainability

The end goal of the sustainability continuum is to adopt strategies and activities that meet the needs of society while protecting, sustaining, and enhancing the human and natural resources that will be needed by future generations to enjoy a quality of life equal to or greater than our own. In practice, this means questioning and reworking our entire institutional and industrial system so that organizations examine their relationships not just to other organizations, but to present and future society.

Much of what this really implies remains uncertain because of the numerous, interrelated factors that influence society, the environment, and the economy in complex ways. What is certain, however, is that attainment of sustainability will require more than facile changes in organizations' operations—it will require restructuring our socio-economic system according to an entirely new paradigm. Author Paul Wilson in the article "Changing Direction Toward Sustainable Culture" in the Northwest Area Foundation's periodical *The Northwest Report*, explains how a sustainable system would differ from society's current mode of operating: "A sustainable society would not undermine its resource base, the assimilative capacity of its surroundings, or the biotic stocks on which its future prosperity depends. Sustainability means living on interest, not drawing down capital."

The remainder of this *Update* presents a sample of selected accomplishments and examples of organizations that are putting sustainability theories into action.

The mention of any company, product, or process in this publication does not constitute or imply endorsement by the U.S. Environmental Protection Agency.

Interview With AT&T

*Brad Allenby is the environment, health and safety vice president for AT&T and an adjunct professor at Columbia University's School of International and Public Affairs. He is a coauthor of the first three engineering textbooks on industrial ecology (*Industrial Ecology, Industrial Ecology and the Automobile, *and* Design for Environment*), and the author of the first policy textbook on industrial ecology (*Industrial Ecology: Policy Framework and Implementation*). WasteWise staff spoke to Dr. Allenby about the sustainability concept and its application at AT&T.*

WasteWise: How did you first get involved with industrial ecology and sustainability issues?

Allenby: How I came into the role is probably indicative of how I think our understanding of the environment has shifted in the last 10 years. Ten years ago, I was a senior environmental attorney for AT&T working the usual issues—Superfund, TSCA, RCRA—and it was to some degree increasingly dissatisfying. The regulations addressed a small subset of the issues that were becoming apparent as potential concerns.

The thinking was that the environment is only affected by end-of-pipe manufacturing impacts, so we had our problems beat. But environmental issues involve more than that. They arise from the fundamental interaction of 6 billion people, their economic system, and their technologies with the natural system. Within this framework, I realized we didn't have a clue. Because it was becoming more apparent that it was the latter and not the former framework in which we would need to work, I began to get into design for the environment, industrial ecology, and related areas.

WasteWise: How are companies like AT&T adapting to address the latter framework—that environmental issues involve more complex interactions than end-of-pipe fixes?

Allenby: Some companies, society as a whole, and individuals started shifting away from viewing the environment as an overhead function—that is, you take care of the environmental impacts only as an afterthought, only after what you've intended to do has already affected it. Now they are viewing the environment as a strategic function and are realizing that concern about impacts on natural systems has to be built into the processes that underlie the very existence of the institution, whether it's the government or AT&T. In addition, there is now the concept of the triple bottom line, where companies are evaluated by stakeholders not just on economic performance, but also on environmental and social performance.

WasteWise: Many companies use the word "sustainability" to describe the direction their business practices are heading. Where does AT&T stand on the road to sustainability?

Allenby: I will tell you honestly that I don't think there's a company in the world that is anywhere near sustainability; moreover, I don't think there's a company in the world that truly understands sustainability.

WasteWise: Are there some common steps or stages that companies need to go through to start heading in the general direction of sustainability?

Allenby: To attain sustainability, there are at least three dimensions along which evolution has to occur:

- **Institutional.** We simply don't have the institutions to manage the environment strategically. For example, institutional inadequacy is a big part of the dispute over the Kyoto Protocol.
- **Ethical.** What kind of world do we really want and who's to decide?
- **Scientific.** Industrial ecology is the science and technology base that underlies sustainability. We have a lot of gaps right now in our understanding of sustainability from a scientific perspective.

WasteWise: Do you think that more research and scientific exploration is the key to moving forward on the road to sustainability?

Allenby: Yes and no. One of the unfortunate things about the way that people throw around the phrase 'sustainable development' is that it hides the fact that none of us really know anything about it along any dimension.

If you try to establish policy without any science behind it, that's not a good thing, so I think we need to do a lot of scientific research. But similarly, if you have a lot of data but the institutions and the ethical structure haven't been developed, you don't get anywhere either. It all needs to happen in unison.

It's complicated by the fact that previously all a firm had to do was talk to the national and state governments to find out what it had to do. But now the dialogue is not only between a firm and the federal government, but also includes nongovernmental organizations (NGOs), other stakeholders, communities, and other firms; it's a far more complex operating environment than we had in the past.

WasteWise: What are some of AT&T's contributions?

Allenby: The most important thing to understand is that the traditional environmental approach, which tends to focus on manufacturing and manufacturing waste, breaks down for a service company like AT&T. The traditional environmental assessment, which only asks, "What are the bad things that you do?", ignores the fact that AT&T's greatest environmental impact is to enable improvements in environmental efficiency across the economy as a whole.

Of course, for AT&T as for every firm, the bottom line has got to be compliance and meeting all the safety and environmental requirements. Waste minimization activities also should be standard business practice. For example, over the past year or so, we have kept more than 5,000 of AT&T's used personal computers out of landfills. We refurbished them and gave them to schools, or we recycled and refurbished them inside for AT&T's use. Moving to e-commerce technology with just one major supplier saved about 1.5 million sheets of paper per year.

The next level is: what are you doing as a company to support the development of industrial ecology and broader options for society? There, the AT&T Foundation supports Industrial Ecology faculty fellowships. We award about six per year. We work with the National Environmental Education and Training Foundation to develop an industrial ecology curriculum for community colleges.

Then you go to the top level, where AT&T as a broadband service provider can enable improvements in environmental and social efficiency across the economy. This is the most important environmental performance level for many service firms. Take something as simple as "telework."

WasteWise: "Telework" meaning telecommuting?

Allenby: Telecommuting, or virtual offices, or working from a satellite office. Telework offers not just the primary benefits for the environment (the emissions prevented from the cars that are not on the road), but also the secondary one: every car you take off the road reduces congestion by a small amount and therefore reduces the emissions of all the other cars on the road by a small amount. Additionally, we have saved over half-a-billion dollars from 1992 to 1998 because of office space reductions we've been able to make as a result of telework. That's less construction material.

WasteWise: What are some of the obstacles to measuring real environmental progress?

Allenby: If I'm doing environment as overhead, I can identify it. I know what it is, I know it's environmental. But if I'm doing something that truly matters, if it's strategic, then environment becomes only one dimension of the activity. Both the analysis, and the technological issues, become far more complex. Consider the environmental costs and benefits of e-commerce. If I buy a book from an e-commerce vendor, is it better or worse for the environment that I haven't driven down to the bookstore in the mall? Well, I don't know! And those are the kinds of questions that are critical, because although they're very complex, they're what's happening in the real world and the economy right now.

WasteWise: What advice would you offer to other organizations in the WasteWise program or other Fortune 1000 companies that are striving to increase their sustainability?

Allenby: The first comment I'd make is that there is a very strong psychology built into the environmental movement with NGOs, with regulators, and within companies that, to be done right, environment has to cost you. That is not true, but people still let that psychology prevent them from doing things that are very smart. Again teleworking is a good example. From a social point of view, broad-band technologies will support new ways of commuting and working that can significantly reduce waste, and that's where you get the bang for the buck. . . the opportunities are enormous. But telework as an environmental technology has yet to be understood by environmentalists or regulators. Many such opportunities exist in every sector. It's a question of imagination.

WasteWise: What do you expect will be AT&T's future impact on industry, society, and the environment?

Allenby: That is hard to answer because telecommunications is such a fundamental part of the infrastructure of any robust economy. I think the industrial revolution started by focusing on energy and materials-intensive sectors. That's where the quality of life came from in the early days of the industrial revolution: better fiber, better clothing, the cotton gins, steam engines, then automobiles. I think that the information sector, including companies like AT&T, has the potential to generate significant increases in the quality of life while reducing the environmental impact so that perhaps we can sustain that quality of life over time. Nobody knows if it's going to happen but it has that promise. The question, in part, is how much imagination, creativity, and innovation can we bring to the process?

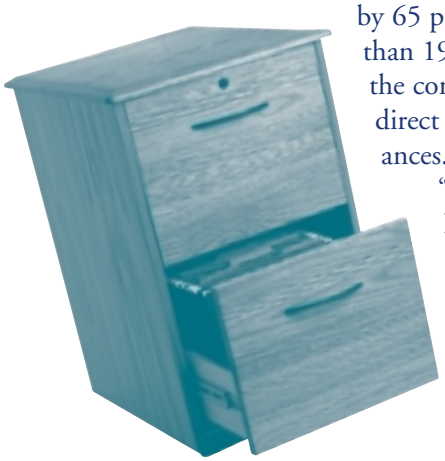
The more that AT&T pushes that envelope, the more it will push other companies to do so as well. And the more we do so, the better off we all will be.

Dr. Allenby can be reached via e-mail at ballenby@att.com.

Herman Miller Manufactures for the Future

When it comes to sustainability, Herman Miller, Inc., isn't just sitting around: as a leading international furniture manufacturer, Herman Miller's goal is to become a sustainable business. Dedicated to preserving natural resources for future generations, this company understands the significance of using environmentally friendly materials and processes. Herman Miller is consistently being recognized for its environmental achievements—the company was not only a 1999 WasteWise Partner of the Year, but also a recipient of a 1998 Green Award from the U.S. General Service Administration for product design and business practices and one of Fortune magazine's "Most Admired" companies. "Our achievements toward reaching sustainability take a lot of determination and hard work. We set substantial environmental goals for Herman Miller and do our best to reach those goals in a timely manner," says James Gillespie, environmental specialist.

Recognizing that complex relationships exist among the land, water, and air, Herman Miller has developed comprehensive environmental goals that include energy conservation, air emissions reductions, transportation impact reductions, and green buildings. The company has made some of its most notable accomplishments with its solid waste management program, mostly by reducing transport packaging. In fact, in 1999 the company eliminated more than 370 tons of wood pallet waste, nearly 270 tons of corrugated cartons, and nearly 8 tons of polystyrene packaging filler through packaging changes. While not quite reaching its "zero landfill" goal by the end of 1995, Herman Miller was able to reduce its use of landfills by 65 percent, or 5,500 tons less than 1994. This endeavor helped the company realize $500,000 in direct cost savings and avoidances. Still striving to reach the "zero landfill" goal, Herman Miller is working on reducing its solid waste by another 10 percent over the next 3 years.



In pursuit of the elusive goal of sustainability, the company also requires an environmental lifecycle assessment (LCA) for all new products. Herman Miller has a Design for Environment Team that will use the LCA to look at product life cycles, including all the processes and materials involved in the manufacture and distribution of its products. The LCA will help the company determine how it can conserve resources by altering product designs and processes.

Despite these successes, Herman Miller cannot become a sustainable business on its own. Some of its processes generate byproducts that Herman Miller itself cannot transform into usable material. To meet its "zero landfill" goal, Herman Miller is working with area businesses and agencies to make sure its byproducts become usable inputs for local industries. The company is a charter member of the West Michigan Sustainable Business Forum (WMSBF), a group of more than 50 companies encouraging the adoption and implementation of sustainable business practices. Herman Miller and its peer group of West Michigan organizations are laying the groundwork for an interconnected industrial system by developing cooperative solutions to mutual waste management concerns.

They are working, for example, to form a marketing cooperative for recyclables in response to recent consolidations in the Michigan waste management industry. Smaller waste haulers that used to service niche market recyclables such as polyurethane foam and low-density polyethylene shrink wrap have been acquired by larger companies with more restricted service offerings.

WMSBF reacted to this dilemma by polling its members on their interest in pooling recyclables in the hope of finding better prices and collection service. Eighty percent of the members expressed interest. WMSBF is surveying area companies to determine the material types and quantities available for group marketing, collection container needs,

(Continued on Page 12)

WasteWise Partners in the West Michigan Sustainable Business Forum

- American Electric Power Service Corp.
- Georgia-Pacific Corp.
- Herman Miller, Inc.
- Pharmacia & Upjohn Company
- Steelcase Inc.

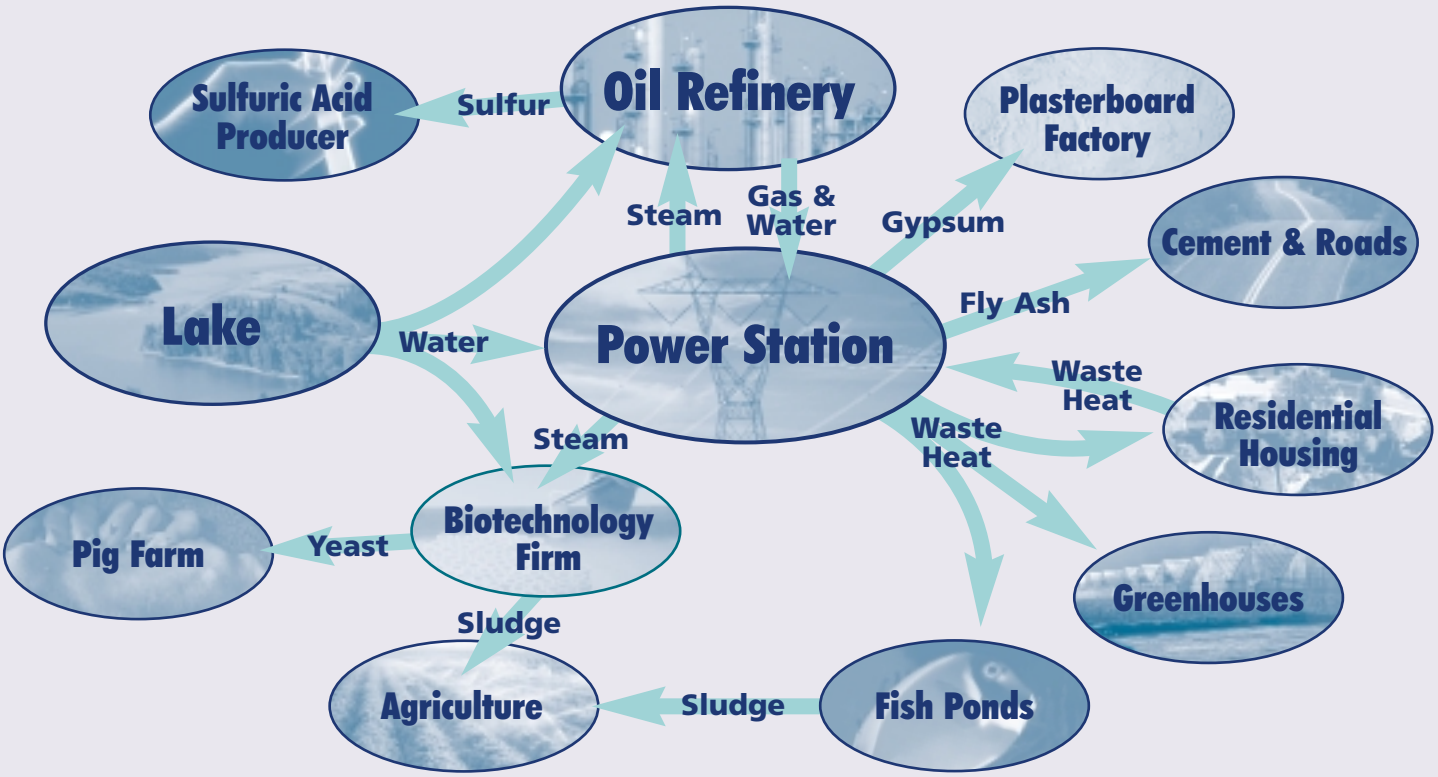
Eco-Industrial Parks

The Kalundborg Industrial Ecosystem

When it comes to industrial ecology and sustainability, Kalundborg, Denmark, represents perhaps the best known example in the world. In Kalundborg, industries are working together to promote sustainable development by exchanging wastes and conserving resources. These industries sought to make economic use of their byproducts and to minimize the cost of compliance with new, stricter environmental regulations.[4] While the symbiotic relationships among the industries evolved gradually over the past 25 years without any planning, the Kalundborg industrial ecosystem represents a closed system within which one facility's waste becomes another facility's feedstock, ensuring that raw materials are recycled or disposed of efficiently and safely. Participating industries each benefit economically from reduced costs of waste disposal, improved efficiencies of resource use, and improved environmental performance.

Here's how the Kalundborg industrial ecosystem works. Steam and various raw materials are exchanged within the industrial ecosystem, which includes an oil refinery, a plasterboard factory, a biotechnology production plant, a fish farm, a coal-fired electrical power station, cement producers, and the municipality of Kalundborg. Gas captured from the oil refinery, for example, is sent to the electrical power station, saving the equivalent of 30,000 tons of coal annually. The town of Kalundborg eliminated the use of 3,500 oil-fired residential furnaces by working with the power plant to distribute heat through a network of

Industrial Symbiosis: The Eco-Industrial Park at Kalundborg



Source: Yale School of Forestry and Environmental Studies

[4] Denmark is already establishing regulations that will require virtually all industry discharges to be in the form of products that can serve other useful purposes by the year 2000.

Mississippi 'Ecoplex' Puts Industrial Ecology Into Practice

Eco-industrial parks are an emerging reality in several U.S. states as well as in Europe. A small slice of Choctaw County, Mississippi, is hosting an industrial complex that will take industrial ecology from the textbooks and put it into practice. Mississippi's Red Hills Ecoplex is one of the few eco-industrial parks in the United States that has started construction, and one of about 20 projects currently in the works. The companies involved in the Red Hills Ecoplex include a power plant (whose lignite deposits are the energy center for the complex), a brick manufacturer, cement and wallboard producers, a greenhouse, and a fish farm.

According to Ron Forsythe of the Mississippi Department of Economic and Community Planning's Energy Division, "the original intent of the project was simply to stimulate the local economy by developing a lignite-based power plant and helping potential businesses reduce costs." The developers of the power plant had access to deposits of lignite, a low grade of coal, located in the northeast corner of the state. The plant will burn the lignite with minimal emissions using Clean Coal technology. As plans progressed, the developers and government officials started to evaluate the environmental impact of the project. At the same time, they considered what other types of facilities might have synergies with all the waste streams from the power plant operation. This coincided with plans to reduce costs by selling the byproducts of the power plant, among them clay, fly ash, and waste heat.

The clay from the lignite mining operation will be used by a brick manufacturer and the fly ash from the lignite-burning will be used for manufacturing cement or wallboard. The waste heat will be used in a greenhouse nursery which, in turn, exchanges wastes with a nearby fish farm. Any waste water will be filtered through an artificial marsh and returned to the environment.

Project coordinators are ensuring that the Ecoplex businesses do not compete directly with existing businesses in Mississippi. Forsythe added that they will plan and implement the project using EPA's Designing Industrial Ecosystems Tool (DIET), a software application designed to aid decision-makers and planners in identifying combinations of industrial facilities that exhibit economic and environmental potential for an eco-industrial park at a given site. For more information about the Red Hills Ecoplex, contact Ron Forsythe at 601 359-6600. For more information on EPA's DIET software, visit <www.smartgrowth.org/library/DIET.html>.

underground pipes. Homeowners pay for the piping, but receive inexpensive, reliable heat in return. Local fish ponds also receive heat from the power plant, thereby increasing the growth rate of fish due to warmer water. In turn, these fish ponds provide sludge as a fertilizer for local agriculture. The power plant also delivers process steam to the biotechnology company and oil refinery, provides a gypsum-containing feedstock to the plasterboard plant, and sells fly ash for road building and cement production. The oil refinery supplies the plasterboard plant with all of its gas, eliminating the need to flare waste gases. The biotechnology company provides a nutrient rich sludge from harvesting crops for insulin, enzymes, and penicillin to local farmers for use as fertilizer.

The Kalundborg industrial ecosystem is a good example of how industrial ecology and the development of technologies that eliminate waste and maximize resource efficiency will be critical to achieving material and energy reductions that help attain a sustainable future. Kalundborg's gradual development of a systematic environmental way of thinking is applicable to many other industries and might prove particularly beneficial when planning future industrial complexes in the United States or abroad. WasteWise partners should take a close look at Kalundborg because this may be the face of the future.

For more information on eco-industrial parks, including projects currently under way in the United States visit <http://www.smartgrowth.org/library/eco_ind_case_intro.html>.

Herman Miller (continued from page 9)

loading dock access, and other cooperative logistics. The end result of this effort will either be a set of contracts with existing materials recovery facilities (MRFs) in the area or the development of a new MRF to accommodate all the materials. In keeping with WMSBF's broad sustainability objectives, any new MRF would be developed by retrofitting an underutilized industrial facility.

This effort is important because it sets the stage for more ambitious byproduct and resource sharing initiatives. Presently, intermittent waste trading is occurring between WMSBF members for such materials as plastics and oily waste water. In the future, however, the forum hopes to establish a fully functional industrial ecology infrastructure. Working with the Grand Rapids Chamber of Commerce, WMSBF has developed a proposal to create a macro-level "mass balance" analysis of industrial waste generation and composition in West Michigan. The organizations would then examine the demand for various materials in order to establish waste exchange matches and recommend ways to develop the infrastructure for recycling high-volume waste materials. The research benefits and resulting new enterprise development would be concentrated in low-income industrial areas called "Michigan renaissance zones," supporting sustainable economic development goals.

According to Gillespie, "Herman Miller's membership in the WMBSF and actively participating in its efforts has been critical to helping the company move forward on the road to sustainability."

For more information on Herman Miller's sustainable business initiatives, please contact James Gillespie at 616 654-5020 or send e-mail to <Jim_Gillespie@hermanmiller.com>. For more information about WMSBF, visit <www.sustainable-busforum.org> or contact William Stough at 616 459-3737 or <bstough@bldi.com>.

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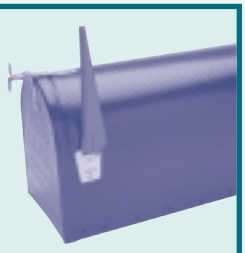

EPA

United States
Environmental Protection Agency
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Washington, DC 20460

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Resources
for Sustainability

The Ecology of Commerce: A Declaration of Sustainability

Paul Hawken

HarperBusiness, 1994.

Provides a blueprint for a marketplace where businesses and environmentalists work together, showing companies how to redesign and manufacture products in innovative ways, reeducate customers, and work closely with government toward a profitable, productive, and ecologically sound future.

Industrial Ecology: An Introduction

University of Michigan's National Pollution Prevention Center for Higher Education

This publication describes the background of industrial ecology, defines its main attributes, and provides an overview of the topic as an academic discipline. It covers goals, key concepts, sustainable development, system tools (such as life cycle assessment), and future needs.

<www.umich.edu/~nppcpub/resources/compendia/ind.ecol.html>

"Industrial Ecology and 'Getting the Prices Right'"

Resources for the Future

This article from Resources for the Future's quarterly newsletter argues that markets need to be fundamentally restructured so that prices reflect the full costs of social production. This, combined with proper incentives such as emissions and effluent fees, will persuade more firms to act in environmentally beneficial ways.

<www.rff.org/resources_archive/1998.htm>

Journal of Industrial Ecology

The MIT Press

This international, multi-disciplinary quarterly journal is designed to foster both understanding and practice in the emerging field of industrial ecology.

<mitpress.mit.edu/JIE>

Mid-Course Correction: Toward a Sustainable Enterprise: The Interface Model

Ray Anderson

Chelsea Green Publishing Company

Ray Anderson, Founder, Chairman, and CEO of a large interior furnishings company, recounts his awakening to the importance of environmental issues and outlines the steps his company, Atlanta-based Interface, Inc., is taking in its quest to become a sustainable enterprise.

Natural Capitalism: Creating the Next Industrial Revolution

Paul Hawken, Amory Lovins, and L. Hunter Lovins

Rocky Mountain Institute, 1999

The authors describe the four principles of a new business model in which businesses can properly account for "natural capital" (natural resources and the ecological systems that support life) while increasing profits, production, and employment.

<www.naturalcapitalism.org>

The Next Bottom Line: Making Sustainable Development Tangible

World Resources Institute

This publication defines the concept of sustainable development in a business context and describes the ways businesses can put sustainability into practice.

<www.igc.org/wri/meb/sei/nbl.html>

"The NEXT Industrial Revolution"

The Atlantic Monthly

October 1998

In this article, William McDonough and Michael Braungart argue that eco-efficiency slows—but does not stop—an already environmentally destructive industrial system. They instead explain that it is possible for businesses to be "eco-effective"—changing processes and designs so that they have no adverse impact on the environment.

<www.theatlantic.com/issues/98oct/industry.htm>

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Center of Excellence for Sustainable Development

<www.sustainable.doe.gov>

This U.S. Department of Energy Web site is a gateway to the latest news, information, research, and resources on sustainable development for businesses and communities.

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Cornell University's Work and Environment Initiative: Eco-Industrial Parks

<www.cfe.cornell.edu/wei/EIDP/eid.html>

Hosted by Cornell University's Center for the Environment, this Web site provides the latest information on industrial ecology in practice. It includes updates and case studies on eco-industrial park projects in the United States.

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Guide to Sustainable Design, Development, and Policy on the Web

<www.lib.virginia.edu/fine-arts/sustain.html>

Supports the University of Virginia's Institute for Sustainable Design by organizing resources on sustainability, including organizations, publications, and Web links, into various categories.

▼

International Institute for Sustainable Development

<iisd1.iisd.ca/business/>

The Business and Sustainable Development section of this Canadian-based organization encourages business leaders to develop a vision of a sustainable company, translate that vision into a management action plan, and turn sustainability into a competitive advantage. The site is a comprehensive source on sustainable development for the private sector.

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President's Council for Sustainable Development

<www.whitehouse.gov/PCSD>

President Clinton formed this council in 1993 to advise him on sustainable development and to develop bold, new approaches to achieve the country's economic, environmental, and equity goals.

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SustainableBusiness.com

<www.sustainablebusiness.com>

This business-oriented Web site provides the latest news and research on sustainable business practices. The online magazine Sustainable Business Insider features in-depth articles, "experts" columns, and case studies.

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Sustainable Business Network

<sbn.envirolink.org>

Promotes the growth and development of environmentally and socially responsible businesses, providing the tools and information necessary to make sustainable business a prominent global economic force.

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World Business Council for Sustainable Development (WBCSD)

<www.wbcsd.ch>

WBCSD is a coalition of international companies committed to economic growth and sustainable development. The Web site provides news on the council's activities and links to all of their business-oriented publications, many of which are viewable online.

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SUNetwork

<www.sustainableusa.com/default.cfm>

This Web site was developed for the May 1999 National Town Meeting for a Sustainable America and continues to provide valuable information on sustainability. It contains the meeting proceedings and listings of sustainability news and events. Visitors also can view sustainability commitments made by other organizations across the country.

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United Nations Commission on Sustainable Development

<www.un.org/esa/sustdev/index.html>

This Web site includes a full version of Agenda 21, the environmental action plan adopted at the 1992 United Nations Conference on Environment and Development in Rio de Janeiro, as well as topical summaries and a linked index to the document. The site also includes other United Nations Commission on Sustainable Development publications and information.