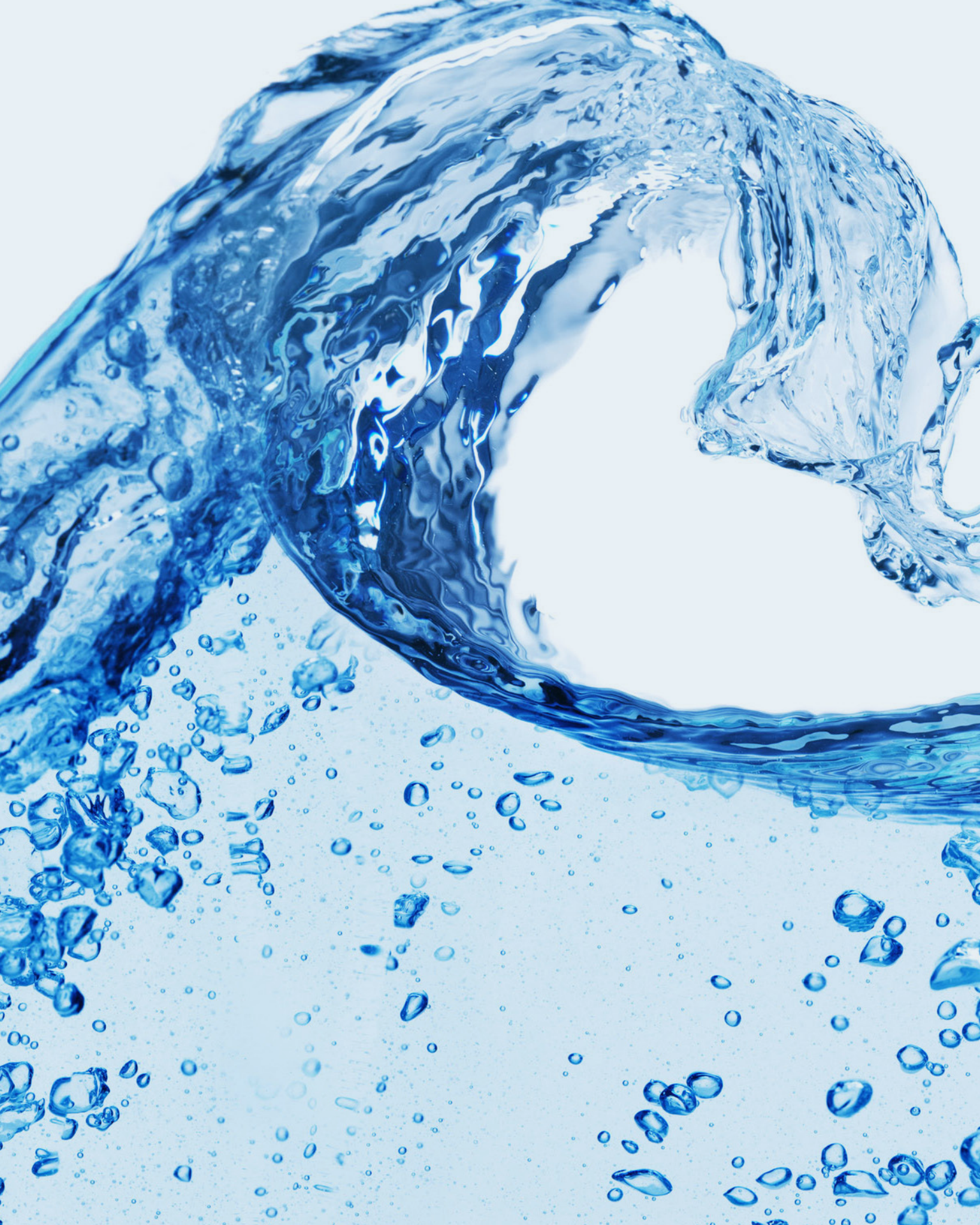
BUILDING A GREEN FUTURE

INDUSTRIAL ECOLOGY

EXECUTIVE SUMMARY

This report provides an analysis and evaluation of the current wastewater treatment plants systems and how it can be improved. Especially it focuses on industrial ecology, a subject emerging these past years and very important for a green future. The New York City department of Environmental Protection makes efforts every day to improve its service quality and preserve the environment. Due to the increasing population, we investigate new ways to build and maintain wastewater treatment plants that are not only cleaner but also more energy-efficient.

This report finds that the current system needs improvement. Updating existing treatment plants to use renewable energy and update the technology in recycling water is needed. Otherwise, building new treatment plants would be needed to assure a long-term solution.



INDUSTRIAL ECOLOGY

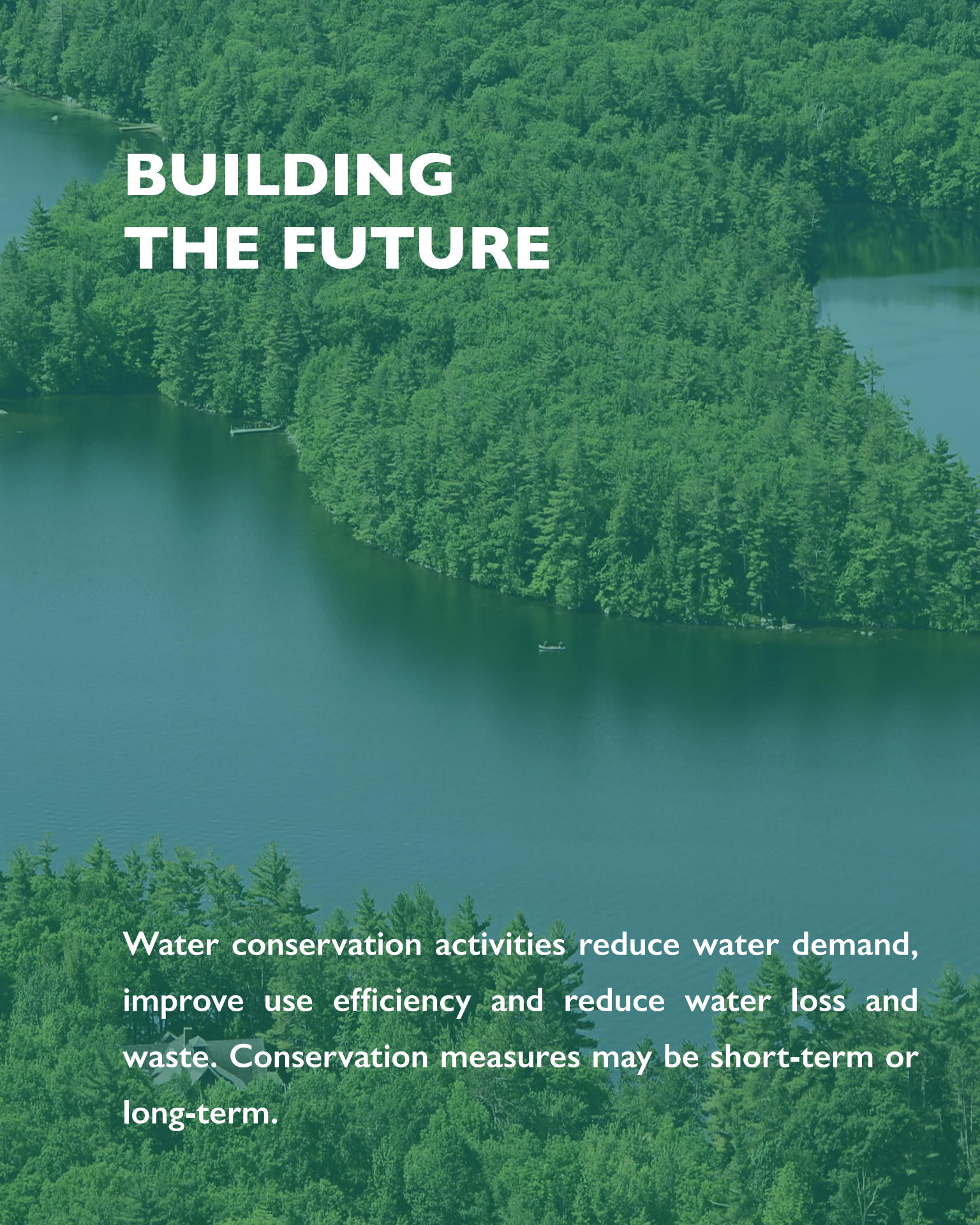
Ecological engineering brings more highly evolved flora and fauna into the equation, providing an attractive and educational alternative for wastewater treatment.

ECOLOGICAL WASTEWATER treatment plants operate odor-free and can be esthetically pleasing. Industrial ecology is the study of industrial systems (materials and energy flows) from the perspective of natural ecosystems. Natural ecosystems have evolved so that any available source of useful material or energy is used by some organism in the system. Animals and plants live on each other and on each other's waste matter. These systems do, of course, leave some waste materials, or fossil fuels would not exist. But on the whole, the system regulates itself and consumes what it produces. As the green game is played out in corporate boardrooms, the shop floor, in the home, and in the community, it is clear that technology and engineering will continue to play a critical role in reducing many environmental impacts of production and consumption. Incorporated in consumption are the following points.

Wastewater treatment plant

Neither technology nor technological know-how are in short supply. The primary opportunities come from the continued, sustained application of existing technology to identified problems. The primary need is to create the incentives and techniques for companies to use technology and knowledge to improve environmental quality

HUMAN ECONOMIC ACTIVITY has been characterized by an open and linear system of materials flows, where materials are taken in, transformed, used, and thrown out. Tools, clothing, and other products have been forged and fashioned from natural plant, animal, and mineral materials. Worn-out goods and materials left over from the production process have been dumped in backyards and landfills.



BUILDING THE FUTURE

Water conservation activities reduce water demand, improve use efficiency and reduce water loss and waste. Conservation measures may be short-term or long-term.

LONG-TERM MEASURES are substitutes for new water supplies while short-term, or emergency measures are applied to quickly fix temporary emergency water problems. When designing a conservation program it is necessary to have an accurate picture of water demands in order to estimate potential savings. Regulatory pressures and shifting public opinion have spurred the industrial and engineering community to initiate efforts aimed at closing the materials loops more effectively and improving energy-use efficiencies. Today, there are more of us and fewer new places to which to move. We face serious pollution in many locations and have poisoned some areas into uninhabitability. As human populations grow, discarding waste material is becoming increasingly problematic.

O'ne way for industry to be more self-sufficient and less wasteful is to improve the efficiency of materials use. It seems worthwhile to examine both production processes and product designs to see if the use of materials (and energy) can be improved. Currently, when products wear out or are replaced by newer models, they are usually thrown away. Currently, when products wear out or are replaced by newer models. They may be used as landfill or incinerated or they may litter the landscape.

REGULATORY PRESSURES AND SHIFTING PUBLIC OPINION have spurred the industrial and engineering community to initiate efforts aimed at closing the materials loops more effectively and improving energy-use efficiencies. Automobile manufacturers such as BMW and Volkswagen have designed cars for easy disassembly and recycling. Companies such as Hewlett-Packard, Canon, and Xerox have begun to take back

"Man must learn that his current path is not suitable for Earth, and soon, Earth won't be suitable for Man"

- DONALD L. HICKS

their own used components, such as toner cartridges, and to manufacture new ones using refurbished components and recycled materials from the old ones. These companies are designing new products with reuse, remanufacture, and recycling in mind. The industrial ecology perspective is beginning to influence designers of manufacturing processes. Designers of products are beginning to view their creations as transient embodiments of matter and energy with added value that can be recaptured and recreated within a continuing flow of materials extending beyond the point of sale. Products and the materials they contain are being designed so that they reused at the end of their lives.

BUILDING NEW TREATMENT PLANTS. GREENER AND CLEANER

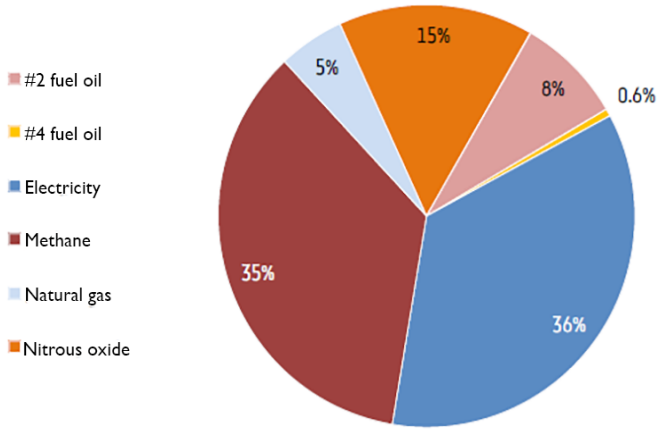
SUITABILITY OF A MATERIAL for an intended reuse is a key technical concern. Metals, metal compounds, and organic materials make up a large fraction of industrial products. The metals are relatively easy to reprocess and reuse. In many cases, however, organic materials are best thought of as energy stored in chemical bonds rather than as reusable materials. The choice between recycling the material and burning it as fuel or otherwise extracting its chemical energy might be made on the basis of comparative market values.

Automobiles, their components, and other metal products, especially those made of iron and steel, have a long history of being recycled without regulatory prodding. For other metal products and materials, progress has come later and been much

slower. Why is there so much waste, especially of iron, steel, and precious metals, in the metal industry, which has such a long tradition of recycling?

FY 2016 Government CO_2e Wastewater Emissions by Source

Total = 0.60 million metric tons



Emission from propane and steam are less than 0.1% of total

THE BARRIERS TO INDUSTRIAL RECYCLING of metals can be classified into six interrelated areas: technical hurdles, economic barriers, information barriers, organizational obstacles, regulatory issues, and legal concerns. When recycling is technically feasible, it may be economically unsound. When it is technically and economically satisfactory, a lack of information may block its adoption. Even when the requisite information is at hand, organizational problems can still stymie implementation. Finally, when all else is satisfactory, a recycling scheme can founder on the rocks.

Waste and product materials sometimes contain unwanted "tramp" elements. These contaminants can ruin the reuse potential of the materials or make handling difficult or dangerous, and purification is often problematic. As products are redesigned for newer more cyclical material use, some of the material problems may be eliminated through smarter design.

MAKING GREEN HAPPEN

Choosing renewable energy is an easy and important thing that can be done to help protect the environment. A way to live a greener lifestyle.

BLUE IS THE NEW GREEN, t will not always be possible to "design out" problematic materials. For example, zinc is often used to coat steel to prevent corrosion. It can interfere with the desirable properties of new steel forged from melted recycled scrap steel. Steel mills therefore limit the permissible content of zinc in the scrap they buy or they pay less for scrap with more than a threshold concentration of zinc.

The manufacturing process tends to mix materials that are further mixed in the process of waste disposal. In remanufacturing, one generally wants to separate things into their original components and materials. There are costs involved in collecting, sorting, and transporting used-up products, scrap, and waste. Such separation requires information, effort, and energy, which must all be paid for. These costs must be compared with the costs of new materials.

Even when the operating costs of recycling are attractive, there may be capital costs that pose barriers. Heavy capital investment in existing systems may prevent a company from securing an easy source of new investment to start over. This obstacle may introduce a time lag, postponing the decision to recycle until it is suitable to make a capital investment, such as when the machinery requires change for some other reason.

Some companies that face competitive forces of ever-shorter product lifespans, and in particularly those in the electronics industry, have introduced "design for the environment" techniques as a major impetus for reengineering their products and processes.

"Human use, population, and technology have reached that certain stage where mother Earth no longer accepts our presence with silence"

- DALAI LAMA XIV

THE COST OF ELIMINATING OR REUSING CERTAIN MATERIALS FOR NEW TREATMENT PLANTS MUST BE BALANCED AGAINST THE COST OF DISPOSAL

POLLUTION FREE WASTEWATER PLANTS disposal costs bring up the question of how companies should take account of indirect costs such as the effect of wastes on the environment. These issues have generally been handled by regulatory control of emissions but could equally be dealt with by including the costs of environmental damage in a firm's bookkeeping. The bookkeeping approach would provide an incentive to minimize such costs and it might force a truer comparison of the costs of alternative schemes. However, it has proved very difficult to find suitable, agreed-upon measures for such costs. The requisite information about costs is not usually available to everyone in the firm who might be able to use it to good advantage.

Standard management and other accounting systems often do not track costs in a way that is useful to designers. Design engineers may not know of the real costs to the company of the materials they choose.

Credits

This report was created by Marc Estruch Tena for Carnegie Mellon's 2016 Interaction Design Sutido 1.

This project would not have been possible without the help and guidance of Karen Kornblum Berntsen and Skip Shelly.

All images were open source images, except for the following:
Faucet: istockphoto.com, AdamG1975
Wastewater treatment plant: photodune.net, dmitrimaruta
Wastewater treatment plant in construction: regina.ca
Water drop on leaves: naturewallpaper.eu
Water wave: weknowyourdreams.com
Water droplet: thinkstockphotos.com, rob_lan

NYC Environmental Protection