Pollution Prevention in Corporate Strategy

NATIONAL POLLUTION PREVENTION CENTER FOR HIGHER EDUCATION

McDonald's/EDF Case Studies and Notes

Teaching Note
Case A: McDonald's Environmental Strategy
Case B1: The Clamshell Controversy
Case B2: McDonald's Decision
Case C: Sustaining McDonald's Environmental Success
Note on Life Cycle Analysis
Note on the Trash Crisis

National Pollution Prevention Center for Higher Education • University of Michigan
Dana Building, 430 East University, Ann Arbor MI 48109-1115
Phone: 313.764.1412 • Fax: 313.936.2195 • E-mail: nppc@umich.edu

McDonald's/EDF Cases
March 1995

Pollution Prevention in Corporate Strategy
NATIONAL POLLUTION PREVENTION CENTER FOR HIGHER EDUCATION

For the Instructor: Teaching Note

Prepared by Susan Svoboda, manager, University of Michigan Corporate Environmental Management Program (CEMP), under the guidance of Stuart Hart, director, CEMP.

Part 1: Series Overview

Purpose and Positioning

The McDonald's case series is comprised of three cases, two supporting notes and a video that lay the foundation for an active discussion of a broad range of environmental management issues regarding how to develop partnerships between businesses and environmental groups, how to use life cycle analysis (LCA) for decision making, and how environmental issues impact corporate strategy.

The series was designed to be taught as an MBA elective corporate strategy course on environmental management. However, it has been tested with both MBA and Natural Resources students. It would also be appropriate for an executive education program.

This series of cases focuses on the work of a Joint Task Force of McDonald's Corp. and the Environmental Defense Fund (EDF); first, as it addresses McDonald's solid waste management strategy and second, as it poses the question of whether or not to replace polystyrene packaging with paper wrap. This series allows students to consider how environmental issues affect corporate strategy, how selecting appropriate partners can build credibility, and how to frame decision-making in situations of limited information and conflicting perspectives.

The specific challenge of determining which packaging material, paper or polystyrene, will satisfy McDonald's performance criteria as well as its environmentally concerned customers is the central issue of the case. As corporations seek to improve their environmental management performance, they will require new methods and tools. Life Cycle Analysis (LCA) is one such tool that helps companies to understand the environmental impacts associated with their products, processes, and activities. LCA is controversial and still evolving as a methodology. However, the principles behind LCA thinking are being rapidly adopted by manufacturers and service organizations alike as a way of opening new perspectives and expanding the debate over environmentally sound products and processes. The goal of LCA is not to arrive at the answer but, rather, to provide important inputs to a broader strategic planning process. Sufficient life cycle data is included to enable students to use LCA principles in order to reach a recommendation.

Case Content and Lessons

CASE A

The "A" case gives background information on McDonald's that is essential to the analysis throughout the series. McDonald's fundamental principles, organizational structure, and management style are discussed, as well as its overall strategy and objectives. Its recent marketing efforts and operational practices are also presented.

A summary of McDonald's environmental strategy is provided, including an excerpt from the corporation's policy statement declaring the importance of being an environmental leader. Background information on the formation of the joint task force with EDF and on EDF itself is covered.

The case then goes into more depth on environmental efforts proposed by the task force relating to source reduction, reuse of materials, recycling, and composting (presented in order of the U.S. EPA waste management hierarchy).

The case concludes with a discussion of the growing importance of environmental groups in terms of public confidence. The joint task force was one of the first high-profile, collaborative efforts between business and an environmental group. As such it posed opportunities and challenges for both parties. EDF hoped it would become a model to be used by other companies, but risked being accused by environmentalists of "selling out." McDonald's hoped it would give them needed credibility with their customers; however, potential task force disputes could further hurt their position.

The case concludes by raising the issue that businesses today face an increasing credibility gap with the public. However, environmental groups are trusted by the public. As a result, environmental organizations are rapidly adding members as individuals seek to understand and monitor corporate environmental practices. Yet despite educational efforts and various environmental initiatives, McDonald's reputation was eroding.

The supplementary note on the Trash Crisis gives the reader additional information on U.S. disposal practices and issues relating to landfilling, incinerating, recycling, and composting trash that will aid students' analysis of the case.

CASE B1

Case B1 narrows the scope of the case to the debate surrounding polystyrene "clamshell" sandwich containers in order to frame a teachable situation for LCA. Environmentally concerned customers oppose these containers despite scientific arguments that they are preferred over paper wraps. The case opens with a description of McDonald's deteriorating public image — especially with children, their most loyal customer base — and the urgency for making the "right" choice.

The case then provides background information on packaging's utility to the food industry and to McDonald's. A brief description of how packaging has become an issue of public concern in the U.S. due to the growing volume of packaging entering landfills, especially due to convenience products, is intended to provide context to students.

The consulting group Franklin Associates provided the task force with the LCA decision-making methodology. This tool is intended to facilitate a comparison of products in terms of their environmental impacts. LCA has three components: an inventory, an impact assessment, and an improvement analysis. The inventory component simply lists emissions, effluents, energy consumption, etc. Impact assessment addresses ecological and human-health impacts of these releases. Improvement analysis combines quantitative and qualitative data to determine opportunities for improvements in environmental impacts. Franklin Associates performs only the inventory component since it has the strongest scientific basis. Another supplementary note, discussed below, regarding LCA is provided to give students specific information on how to perform this analysis.

The case then provides students with a detailed description of the manufacturing process used to produce both paper and polystyrene sandwich containers. The actual life-cycle data from Franklin Associates that the task force used to reach a decision are included in Appendices A and B. The data in Appendix A is from a 1990 study that compared paper wrap to polystyrene. The data in the Appendix B compares these two alternatives with a new paper-based wrap called quilt-wrap. Quilt wrap is comprised of an inner layer of tissue to absorb grease, a layer of polyethylene for insulation, and another layer of paper for strength.

The case concludes by suggesting that the task force will need to make some assumptions about future disposal methods, unmeasured environmental impacts, and consumer response when using this tool. Also to be considered is McDonald's commitment to recycling especially relating to clamshells.

CASE B2

Case B2 presents the decision made by the joint task force and highlights reactions to the decision from various newspaper editors, suppliers, and the national polystyrene recycling center. Reactions differ greatly and students are faced with the question of whether they made the "right" decision.

SUPPORTING NOTES

The supporting note on LCA reviews the origins of the methodology and describes how it may be used for benchmarking efforts, setting resource-reduction targets, new product development, or comparing materials, products, or processes. The results of LCA are greatly affected by how managers establish the scope of the analysis, the level of data used, and the assumptions they make at each stage. Therefore, a detailed description of the types of information to be included at each stage of raw material extraction, processing, and disposal is included.

The supporting note on the Trash Crisis gives students background information on typical issues relating to landfill, incineration, recycling, and composting practices. This information is intended to improve their understanding of these issues in order to help them make more realistic assumptions in their analysis.

Assignment Questions and Case Sequencing

The cases are designed to be taught in a two-class sequence with video segments in both sessions. The following are suggested assignment questions:

CASE A

- Why did EDF approach McDonald's?
- Why did McDonald's enter into the Joint Task Force with EDF? Was EDF the right choice for a partner?
- How well does the structure of the Joint Task Force serve as a model for future partnerships?
- Has the Joint Task Force worked?

CASE B1

- Should McDonald's continue its recycling efforts or drop the "clamshell" sandwich container? Why?
- What are the difficulties in using LCA in decision-making?
- What are the appropriate boundaries for the analysis?
- Is there one best environmental solution? Will it change over time?

CASE B2

- Should McDonald's be accused of "flip-flopping" or commended for being adaptive?
- Is the customer always right? Does it matter if customer perceptions of environmental impacts are incorrect?

Case A Suggested Readings

Stenger, Wallace. "It All Began with Conservation." *Smithsonian* 21, no. 1 (April 1990): 35-43.

Prince, Jackie. "Launching A New Business Ethic: The Environment As A Standard Operating Procedure." *Industrial Management*, p. 15.

Case B Suggested Readings

"Management Brief: Food for Thought." *The Economist* (29 August 1992).

Part 2: Class Teaching Plans

Case A

OVERVIEW

The suggested teaching format begins with an assessment of the growing customer dissatisfaction with McDonald's environmental practices, particularly regarding packaging. From a strategic perspective, McDonald's reputation in terms of image, brand recognition, and franchise commitment is critical. Image and brand equity are particularly important to a company such as McDonald's that has outstanding name recognition. Maintaining a strong and committed distribution channel—the franchisees is equally critical.

From this, the discussion should move into issues relating to the creation of the Joint Task Force between McDonald's and EDF. The case presents the task force as a "first" collaborative effort between a major business and an environmental group. The discussion should be facilitated in order help the students understand the benefits and risks of such an arrangement to both parties. Next, students should discuss whether McDonald's lack of environmental credibility was unique or is an emerging problem across industries. Would issues differ between regulated versus non-regulated industries (consumer products versus chemical industry)? The case should generate a lively conversation of how to pick partners and how to structure the partnership for the best results.

For discussion purposes, it may be useful to assign students either the role of McDonald's or EDF and then discuss the following questions from their assigned perspective.

Why did EDF approach McDonald's?

Students typically will respond with a number of issues that can be categorized by pro or con as follows:

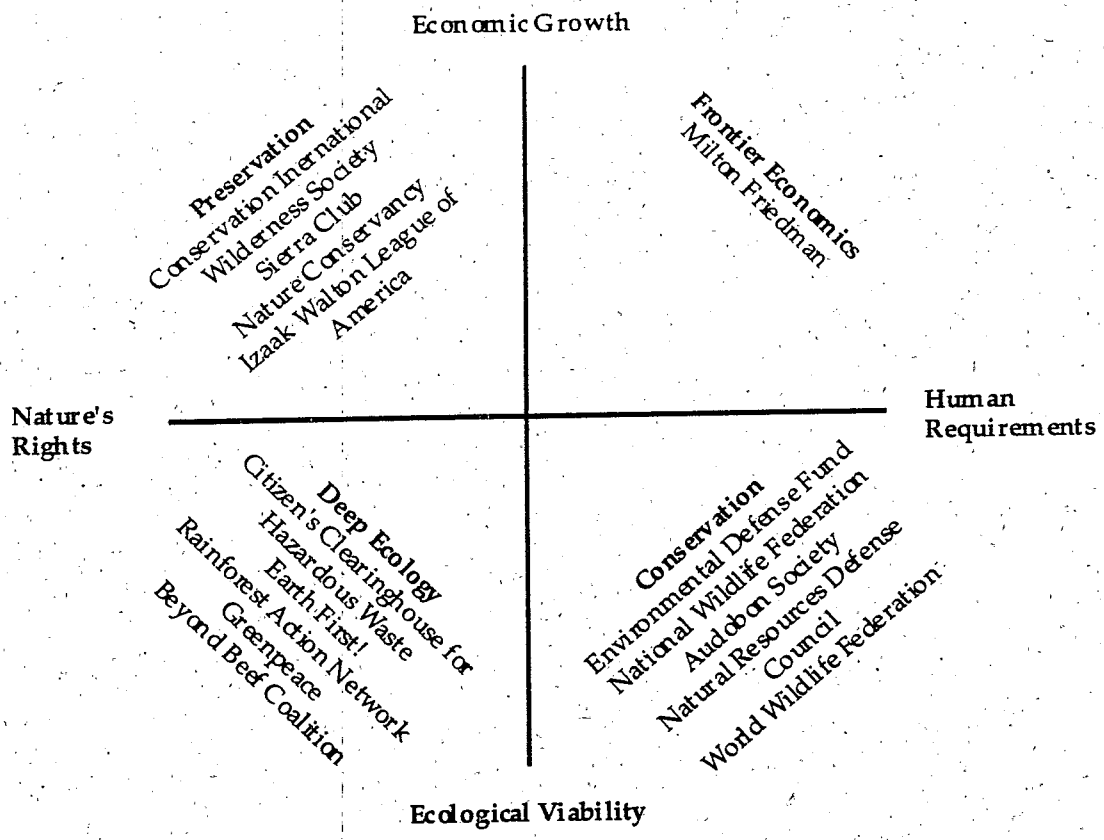
Pros	Cons
Potential high impact/good educational opportunity —McDonald's serves 18 million customers/day plus suppliers—worldwide	Potential risk to reputation—EDF could be accused by other environmental groups of "selling out"
Opportunity to test the practicality of the EPA hierarchy	
A cooperative venture would start to diffuse "watchdog" image	
If you can influence the industry leader, you influence the industry	

Why did McDonald's agree to the Task Force? Was EDF the right choice?

Exhibit 9 in Case A provides students with a synopsis of the twelve largest environmental groups. These groups could be viewed as falling into the following four categories of environmental management. This typology could be developed through class discussion.

It should be noted in the class that it is unlikely that the groups in either the "preservation" or "deep ecology" quadrants could be developed into collaborative partners. In fact, McDonald's was being targeted by some of them for direct action (e.g., CCHW and the "McPuff" campaign). This leaves the "conservation" groups as the best choice. EDF clearly falls into this category.

Pros	Cons
McDonald's was under fire from consumer and environmental groups "McToxic/McPuff."	Opening the company up to scrutiny could be potentially embarrassing.
They needed credibility as they had already switched from paper to polystyrene (clamshell) once based on the SRI study ; EDF had expertise.	If the Task Force could not agree, the publicity could be damaging.
EDF was perceived as a "mainstream" environmental group (conservation).	EDF may not be able to "deliver" the environmental community, if that community feels that EDF has compromised their position.
Joint Task Force could improve their image with franchisees and suppliers.	



How well does the structure of the Joint Task Force serve as a model for future partnerships? What guidelines would you establish in creating a partnership like this one?

- Credibility
  - mixed team of participants includes operations people
  - task force given authority to make decisions
- Independence
  - each side covers their own expenses
  - each side may issue separate reports if agreement cannot be reached
  - McDonald's cannot refer to the task force in advertising unless authorized by EDF

Has the Task Force worked?

- EDF was able to convince McDonald's to give up their recycling efforts and focus on issues such as waste reduction that are higher on the waste management hierarchy.
- McDonald's credibility improved, letters and protests stopped.

Case B

Case B focuses on the task force's specific decision on whether or not to discontinue use of the polystyrene clamshell sandwich container. Using the information provided on packaging trends both in the U.S. and within McDonald's as a backdrop, students are asked to reach a decision by analyzing the same life cycle data the task force used to reach their decision The discussions should focus on how to use life cycle data effectively by understanding its limitations and underlying assumptions.

Although each student should come to class prepared to make a decision about whether or not to discontinue the clamshells, it may improve the discussion to have a pre-selected team of students present their analysis and recommendation to the class (approximately 10–15 minutes). A discussion can then be generated around the assumptions and constraints of LCA as used in their analysis.

Should McDonald's discontinue use of the polystyrene clamshells?

Student teams should present their logic in reaching a decision. The discussion will raise many more questions than answers; however, the students will learn from the complexity of these issues that there is no single, clear-cut answer. Issues that should be addressed include:

- Boundaries
  - Were the boundaries considered by the Joint Task Force the appropriate ones? Why wasn't container reuse (dishwashing) included?

- Comparison of pollutants
  - How many pollutants should be considered in the inventory? Were the right ones included in the report?
  - How should pollutants be compared? Does it make sense to add them up to a lump sum or are some more harmful than others? Is water pollution more or less serious than air pollution or the volume of solid waste? Should they be compared based on their contribution to specific problem—greenhouse gases versus groundwater contamination?

- Comparisons between companies/industries
  - Is there a uniform or consistent way to evaluate products or packaging across companies or industries?
  - How do the assumptions related to boundaries and pollutants affect comparisons between companies? Is each inventory unique to the company being analyzed?
  - Reported pollutant data is based on emissions generated assuming the national "mix" of disposal methods including incineration, landfilling, and recycling. What if a particular business has a substantially different mix—can it be compared?

- Data Sources
  - Is the inventory credible if the company itself provides the data? Should a third party conduct the analysis? Who should pay for it?
  - If industry data is used is it specific enough to produce valid results? If proprietary data is used the company may not want to share it with others in an industry study.
  - What about the objectivity of studies supported by either the paper or polystyrene industries?

- What is lost by canceling recycling efforts?
  - Since carry-out business is at least 60 percent of total volume and the best-case scenario for recycling is 40 percent, is this still worthwhile?
  - McDonald's could play a major role in recycling education due to its 18 million customers/day — what lessons should they teach?
  - McDonald's would have been a major/stable materials contributor to the struggling recycling industry — what will be the impact on this group?

Is there one best environmental solution?

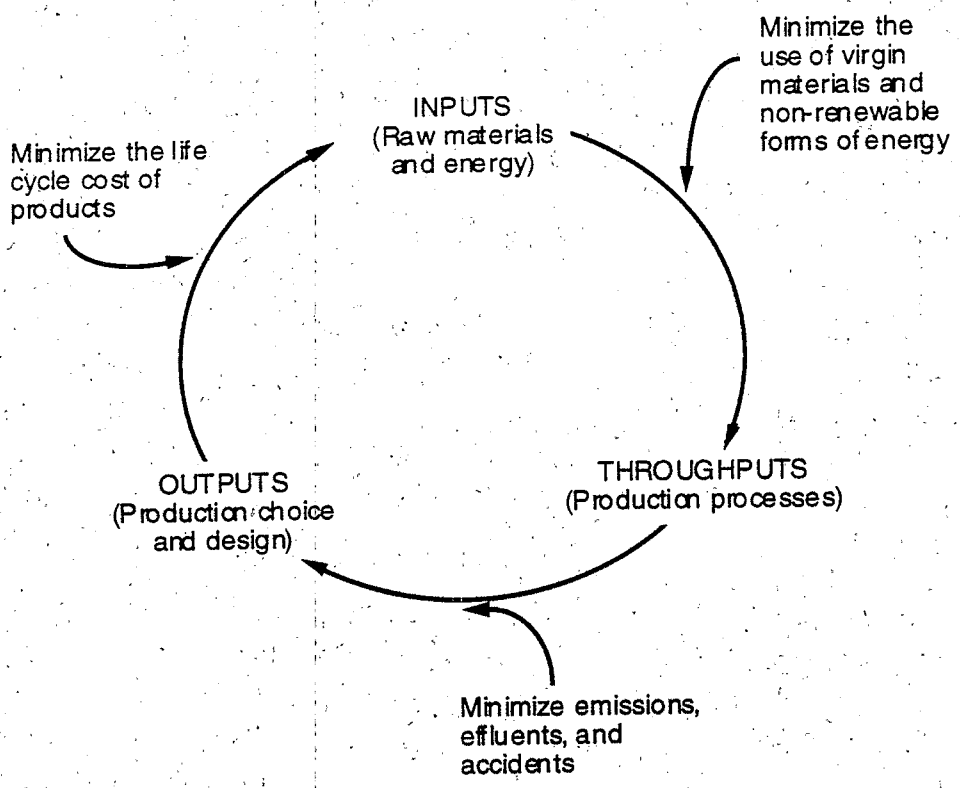
The students should discuss the balance between needless flip-flopping in decision-making and necessary flexibility. Issues that are likely to be raised include the evolution of scientific knowledge, changes in public perception, changes in technologies that alter environmental impacts (e.g., non-chlorine bleached paper), and changes in our understanding of impacts (long-term effects of pollutants on employees).

The instructor might consider closing the discussion with the "Closing the Loop" figure which summarizes the underlying logic of LCA and its implication for the corporation. The model depicts how environmental management must be a process of continuous improvement that encompasses all stages of the product's life cycle. Increasingly products and corporations are being judged using the above criteria. This model may be used to put McDonald's packaging decisions in perspective in order to address the question, "Are they done?"

Case B2

Case B2 is a one-page "what happened" case that should be handed out near the close of the second session. Case B2 presents the decision made by the joint task force to drop the clamshells and highlights reactions to the decision from various newspaper editors, suppliers, and the national polystyrene recycling center. Reactions differ greatly and students are faced with the question of whether they made the "right" decision.

CLOSING THE LOOP



Published by:
The National Pollution Prevention Center for Higher Education
University of Michigan, Dana Building
430 East University Ave.
Ann Arbor, MI 48109-1115
• Phone: 313-764-1412
• Fax: 313-936-2195
• E-mail: nppc@umich.edu

The mission of the NPPC is to promote sustainable development by educating students, faculty, and professionals about pollution prevention; create educational materials; provide tools and strategies for addressing relevant environmental problems; and establish a national network of pollution prevention educators. In addition to developing educational materials and conducting research, the NPPC also offers an internship program, professional education & training, and conferences.

Your Input is Welcome!
We are very interested in your feedback on these materials. Please take a moment to offer your comments and communicate them to us. Also contact us if you wish to receive a documents list, order any of our materials, collaborate on or review NPPC resources, or be listed in our *Directory of Pollution Prevention in Higher Education.*

We're Going Online!
The NPPC provides information on its programs and educational materials through the Internet's World Wide Web; our URL is: http://www.snre.umich.edu/

We may also update the NPPC information available through gopher (gopher.snre.umich.edu) and anonymous FTP (ftp.snre.umich.edu). Please contact us if you have comments about our online resources or suggestions for publicizing our educational materials through the Internet. Thank you!

Case A: McDonald's Environmental Strategy

Susan Svoboda, manager of the University of Michigan Corporate Environmental Management Program (CEMP), prepared this case under the guidance of Stuart Hart, director of CEMP and assistant professor of Corporate Strategy and Organizational Behavior at the U-M School of Business Administration, as the basis for class discussion rather than to illustrate either effective or ineffective handling of an adminstrative situation. This document may be used by either students or faculty for background information.

Introduction

Rooted in Ray Kroc's founding principles of Quality, Service, Cleanliness & Value (Q.S.C.&V.), McDonald's management has always believed in being a leader in issues that affect their customers. This philosophy is evident in McDonald's involvement in various community projects regarding education, health care, medical research, and rehabilitation facilities. These activities help the corporation to extend their image beyond fun and entertainment into social responsibility.

However, in the late 1980s, McDonald's began to face criticism for its environmental policies, especially those surrounding polystyrene clamshell containers. In 1987, McDonald's replaced CFCs, the blowing agent used in clamshell production, with weaker HCFC-22's after facing public criticism that CFC usage was contributing to ozone depletion. But this change was not enough for many grass-roots environmental groups that, led by the Citizens Clearinghouse for Hazardous Waste (CCHW), united in establishing a "Ronald McToxic Campaign" consisting of restaurant picketers and an organized effort to mail clamshells back to Oak Brook headquarters. When McDonald's later tested trash-to-energy on-site incinerators, CCHW quickly named the project "McPuff." By 1989, school children, the backbone of McDonald's customer base, founded a group called "Kids Against Polystyrene." Although they were not the only fast-food restaurant facing criticism for disposable packaging, McDonald's could not afford to let this situation escalate. One of their primary competitors, Burger King, was winning praise for its paperboard containers, which were claimed by some to be biodegradable.

Company Background

McDonald's Corporation grew from a single drive-in restaurant in San Bernardino, California, in 1948, to the largest food-service organization in the world. In 1991, McDonald's owned $13 billion of the $93 billion fast-food industry, operating 12,400 restaurants in 59 countries including company-owned restaurants, franchisees, and joint ventures. In the U.S. alone, more than 18 million people visit a McDonald's daily. [1] **Exhibits 1–3** contain McDonald's 1991 income statement and balance sheet as well as an 11-year financial summary for the company. McDonald's management intends to continue growing by: 1) maximizing sales and profits in existing restaurants, 2) adding new restaurants, and 3) improving international profitability.

Ray Kroc based his empire on the fundamental principles of Quality, Service, Cleanliness, and Value (Q.S.C.&V.) and developed tangible goals and specific operating practices to carry out his vision. An extensive team of field auditors monitor these practices, which are communicated to employees through continuing education that includes videotaped messages from Kroc himself. These values were integrated into McDonald's three strategic priorities for 1991, stated in the Annual Report as follows:

- to enhance the message that McDonald's is value-driven on behalf of its customers by emphasizing their profitable value-meal combinations;

- to provide exceptional customer care by exceeding customer expectations, including finding ways to add personal touches that go beyond convenient locations, quick service, clean restaurants, and quality products;

- to remain an efficient producer while maintaining quality by looking to innovations in food processing, construction, and design operations that will increase global profits.

Approximately 80 percent of McDonald's restaurants are franchises, paying a percentage of their monthly revenue for centralized marketing research and R&D. Franchise fees cover roughly the costs of corporate services; thus, if the franchises are not making money, neither is the corporation. This mutual dependence is considered by management to be a corporate strength. McDonald's Corporation revenues are derived from franchise fees plus company restaurant sales. The Corporation operates approximately 16 percent of U.S. McDonald's restaurants, and a higher percentage of international restaurants since they usually enter new countries with company restaurants and then franchise them after they are well established. McDonald's typically receives over 20,000 franchise inquiries per year. Twenty-year franchises are awarded to applicants after extensive screening, and additional restaurants are allocated to franchisees with proven records of success.

McDonald's management style may be described as "tight-loose" — the corporation sets overall quality standards, but the franchisees are given the freedom to make localized decisions. Many new product innovations, such as the Filet O' Fish and the Egg McMuffin, originated with franchises. Recently, McDonald's has increased its new product development efforts, responding to customer's concern for nutrition. However, Tom Glasglow, Vice President and Chief Financial Officer, is concerned with maintaining the focus that has made McDonald's successful: in the 1991 Annual Report he stated, "We're in the business of serving a small number of products that have mass appeal. That's our niche."

McDonald's is the second-best-known global brand and intends to maintain this level of consumer awareness with a $1 billion marketing budget.[2] McDonald's launched a major new ad campaign in 1991, "Great Food at a Great Value," which was successful in promoting profitable value-meal combinations. High brand recognition is particularly important as many customers are impulse purchasers, often selecting McDonald's over competitors by the convenience of the location. Glasglow, discussing how McDonald's customers distinguish it from the competition, stated, "We are the easiest. The place that satisfies customers best, and gives them the best value." The emphasis McDonald's places on customer convenience is manifested in McDonald's self-description as a leader in the quick-service industry, rather than the fast-food industry.

A typical McDonald's may serve as many as 2,000 people per day, 60–70 percent of whom take their food outside the restaurant. McDonald's depends on the ability of their crew to be able to prepare hot, fresh food and to serve it to their customers within two minutes of the time they enter the restaurant. To do this, McDonald's engineering department has carefully designed the layout and equipment for its restaurants. **Exhibit 4** shows how all food flows from the back of the kitchen to the front as it is prepared, and is placed in a heated food "bin" awaiting customer delivery. Servers at the counter or drive-through window collect items from the bin and drink stations for customers. An important component of McDonald's operational strategy is to anticipate customer traffic patterns and food selection based on a detailed analysis of sales history and trends and to use this information to prepare various menu items in the right quantities and at the right times in order to have the food ready for their customers when they arrive. Food may be stored in the bin for up to ten minutes before it is discarded.

1991 marked the introduction of "Series 2000" design restaurants. These buildings are approximately half the size of traditional restaurants, designed to accommodate nearly the same level of sales but requiring a lower real estate investment. Series 2000 restaurants are targeted toward both small towns and major metropolitan areas.

All of McDonald's 600-plus suppliers are independent companies with whom long-term relationships have been developed. This strategy is intended to improve McDonald's ability to focus its efforts on its core business — restaurant operations. Most suppliers operate on a cost-plus basis. McDonald's often holds seminars and conferences for suppliers to discuss their needs.

JOINT TASK FORCE

Recognizing McDonald's potential to influence public opinion through its 18 million daily customers, the Environmental Defense Fund (EDF) approached McDonald's in 1989 to discuss environmental issues related to solid waste. At that time McDonald's was facing environmental protests in the form of demonstrations, letters, and customers mailing their polystyrene clamshells back to the company. Realizing that young people, traditionally loyal McDonald's customers, were demanding "greener" practices, McDonald's stepped up its recycling efforts. However, several U.S. cities were proposing a ban on polystyrene packaging altogether. Caught between seemingly conflicting environmental goals, McDonald's welcomed EDF's help.

EDF is a national nonprofit organization that links science, economics, and law to create innovative, economically sustainable solutions to environmental problems. It was founded in 1967 by scientists on Long Island, New York, to fight the spraying of the pesticide DDT. Today, EDF has a professional staff of more than 110 people located in six offices, and has support from over 200,000 members and 100 private foundations.

McDonald's and EDF created a joint task force to work together to understand the role of materials and packaging used at McDonald's (see Exhibit 5 for a list of task force participants). Each member spent one day working in a restaurant, and the task force held meetings with McDonald's food and packaging suppliers, toured McDonald's largest distribution center, and plastics and composting facilities.

McDonald's Environmental Strategy

One of the first results of the task force was the development of a strong company-wide environmental policy declaring that McDonald's is committed to protecting the environment for future generations, and that it believes that business leaders must also be environmental leaders. The policy takes a total lifecycle approach to reducing and managing solid waste: a sizable challenge, considering that each of McDonald's 8,600 U.S. restaurants [3] 238 pounds of waste per day and each of its 34 U.S. regional distribution centers disposes of another 900 pounds of waste per day.[4]

McDonald's has also been active in educating its customers about the company's environmental activities and positions. Brochures are available in restaurants informing customers about McDonald's position on such topics as ozone depletion, the rain forest, and packaging.

McDonald's is working to translate this environmental commitment into specific actions. In order to live up to its environmental policy, McDonald's Environmental Affairs Officer has been given the authority to enforce adherence to standards, and reports directly to the Board of Directors on a regular basis. McDonald's also plans to continue to seek counsel with environmental experts to take advantage of opportunities to improve its environmental performance on an ongoing basis. As part of its waste reduction action plan, McDonald's has committed to reviewing annually all food-service products and packaging items to identify opportunities for source reduction. McDonald's realizes that in order to achieve its waste reduction goals, it must collaborate with its suppliers. To promote collaboration, it has developed an annual environmental conference intended to train suppliers and has included environmental issues in its annual supplier reviews and evaluations.

The following initiatives were proposed by the task force.

Source Reduction

McDonald's had already initiated several waste reduction efforts when EDF contacted it, but the ensuing discussions led to a proposal calling for a joint task force to create "a framework, a systematic approach and a strong scientific basis for McDonald's solid waste decisions." [5] The EPA's waste management hierarchy became the foundation for task force efforts. [6]

In the joint task force report, "waste reduction" was defined as any action that reduces the amount or toxicity of municipal solid waste, prior to incineration or landfill. "Source reduction" takes an even stronger environmental position than recycling by reducing the weight, volume, or toxicity of products or packaging prior to their use. Because source reduction decreases or eliminates waste at its point of generation, thus creating less to be reused, recycled, incinerated, or landfilled, the EPA gave it the highest priority on the waste management hierarchy. The task force identified the source reduction projects shown in **Exhibit 6,** which are being implemented as a result of revised supplier specifications. Annual waste characterization studies will be conducted to determine a baseline against which to measure future goals.

Consistent with McDonald's management style, the task force reasoned that its waste management strategy would have to be implemented in a tight-loose fashion, as centralized plans alone could not take into account all the differing local and regional waste disposal practices, infrastructures, and costs. They also realized that in many cases there was not one obvious solution to a problem. In fact, trade-offs involving environmental impacts, costs, and performance requires complicated decision-making. For example, increasing the content of recycled paper in packaging may diminish the strength of the paper, requiring increased packaging thickness to compensate for decreased performance. In addition, when a packaging alternative significantly reduces the weight of material to be disposed, the material still might not have an existing recycling infrastructure.

McDonald's has made substantial progress in its source reduction efforts over the past 20 years. For example, McDonald's "average meal" in the 1970s — a Big Mac, fries and a shake — required 46 grams of packaging. Today, it requires 25 grams, a 46 percent reduction.[7] McDonald's has also reduced the weight of packaging in its sandwich wraps, hot cups, and napkins, removed corrugated dividers in some shipping cases, and switched to bulk containers wherever possible. A summary of source reduction accomplishments is provided in **Exhibit 7**, which lists packaging changes approved for implementation in 1990.

As an example, orange juice had been shipped, stored, and served in individual containers. These have been replaced by concentrate mixed at the restaurant, resulting in a packaging reduction of two million pounds per year. In addition, a new Coke delivery system that pumps syrup directly from delivery trucks to storage tanks eliminates the need for intermediate containers, saving an additional two million pounds of packaging annually. Weight reductions, reductions in secondary packaging, and increased use of bulk packaging has reduced packaging by 24 million pounds annually.[8]

Further, McDonald's purchases materials from suppliers that use more benign manufacturing processes, such as non-chlorine-bleached paper bags, and has switched to french fry cartons made from mechanically pulped rather than chemically pulped paper.

When new opportunities for source reduction have been identified, operating practices are engineered and researched using one to five restaurants as test sites. During this process, customer perceptions are carefully monitored; past reductions have been imperceptible to most customers.

Reuse

Identifying immediately feasible opportunities for the reuse of materials was a difficult assignment for the task force as the time required to handle, collect, and clean materials would impact McDonald's ability to provide high-volume fast food. In addition, the committee's investigation showed that opportunities varied greatly according to behind-the-counter and over-the-counter operations.

Over-the-counter options are currently limited as McDonald's customers expect fast service even at peak times of the day. McDonald's operations are designed to anticipate the content of customer orders and to prepare food just before the customers arrive. However, McDonald's does not feel it can anticipate *where* its customers will chose to eat, and most reuse options require different packaging for dine-in or take-out customers. Repackaging food after the customer arrives or delaying its preparation until the order is taken would lengthen service time. Further, sanitation issues were also a concern of the task force, as single-serve, disposable packaging had basically eliminated the potential of packaging-related contamination. Dishware storage, both in the restaurant and behind-the-counter, and the placement of dishwashing equipment are potentially difficult in McDonald's already tightly designed kitchens. Consideration was also given to the environmental trade-offs of the dishwashing process, as it would require energy, water, and detergents.

Behind-the-counter opportunities appeared more promising: an on-premise study indicated that that is where 80 percent of restaurant waste was generated. **Exhibit 8** shows the breakdown of over-the-counter and behind-the-counter waste based on a two-restaurant, one-week audit. Several easily implemented reuse options existed for behind-the-counter waste including the reuse of plastic (rather than cardboard) disposables, shipping trays for bakery items, and plastic shipping pallets that last at least three times longer than wooden pallets.

Recycling

Recycling efforts take two forms: use of products made from recycled materials, and the recycling of post-consumer/post-industrial waste. Many of the technical aspects of post-production recycling of both plastic and paper have already been exploited by suppliers' internal reuse operations for scrap. However, little recycling has been done of post-consumer plastic and paper materials due to contamination problems. Unlike glass and metal, where food residue and bacteria contamination can be burned off, foam and paperboard are not easily cleaned.

McDonald's tries to use recycled materials whenever possible. For example, it is one of the largest users of recycled paper in the U.S. However, packaging that has direct contact with food, which constitutes approximately 42 percent of McDonald's packaging, is strictly regulated by the FDA not to contain post-consumer recycled materials. Therefore, McDonald's strives to increase the recycled content for nonfood packaging, such as corrugated boxes, which must be made of 35% recycled material according to a 1990 mandate. In addition, it uses recycled paper for nonfood items such as Happy Meal boxes, carry-out drink trays, and paper towels.

In April 1990, McDonald's announced the McRecycle Program, a commitment to spend $100 million annually on the use of recycled materials, especially in the building and renovation of its restaurants. In 1991, it surpassed its goal, purchasing more than $200 million of recycled materials. It also created a clearinghouse of "environmental" product suppliers, which has received over 8,000 calls since the 800 number was published.

The focus of McDonald's recycling efforts on post-consumer, in-store waste has been polystyrene recycling. In 1989, McDonald's launched a polystyrene recycling effort followed by a 1990 packaging brochure stating, "Polystyrene foam is easily recycled." Ken Harman, chair of the National Polystyrene Recycling Center (NPRC), said,

> 1990 is going to be a pivotal year for polystyrene recycling. It will be the year that polystyrene recycling gains momentum due, in part, to the efforts of recycling facilities like our Plastics Again Center . . . and the commitment of institutional cafeterias, schools, and private companies.

However, implementation of McDonald's recycling program highlighted an inherent limitation of any recycling option — that is, benefits are only realized for the packaging that is actually collected and recycled.

McDonald's experimented with three different point-of-discard methods to educate and assist customers in separating their trash, but customers were generally either confused or overwhelmed by the instructions. In communities that did not have an existing curbside recycling program, participation was much lower than in communities where customers were already accustomed to sorting their trash.

Internal logistical problems increased recycling costs. A typical McDonald's restaurant produced five to ten bags of incorrectly separated materials, creating disposal problems. And the bulkiness of the clamshells made three pickup times a week a necessity, incurring expensive hauling costs as 90% of plastic is comprised of air. Further, the NPRC required incoming materials to be free of paper and food contamination, a standard that was not then being realized. To respond to this problem, McDonald's experimented with material recovery facilities to sort, clean, and consolidate materials, but the cost proved to be prohibitive.

Throughout this time, McDonald's continued to work with suppliers to develop packaging that was consistent with curbside recycling programs, to support the recycling of material that leaves the restaurant via takeout orders.

Composting

Composting is still in the formative stage. Therefore, much of the task force's work centered on gaining a better understanding of McDonald's composting options. Composting is an attractive disposal alternative as it diverts organic waste from landfills and incinerators and it improves soil quality.

Almost 50 percent of McDonald's waste stream consists of paper packaging and food organics that could be composted. McDonald's is reviewing the compostability of its packaging and studying materials such as the coatings used on its paper-based packaging to determine if they impair compostability. Where possible, it will replace materials that are not compostable with materials designed for compostability.

To make composting a viable option, McDonald's is investigating how to: 1) collect and separate materials, 2) balance the cost and environmental trade-offs of composting methods, and 3) identify markets for composted products.

McDonald's began testing the compostability of nine packaging items in January 1991. Several months later, nine McDonald's restaurants in Maine began sending their waste to Resource Conservation Services, a nearby composting company. Data from these tests will be used to determine the proper conditions for composting McDonald's waste and to determine the quality of the final compost product.

The Future

Environmental groups play an increasingly important role in influencing policy (See **Exhibit 9** for an overview of leading environmental groups). Furthermore, during the past decade, membership in many of the leading environmental groups doubled in size. This growth may be attributed to both the public's concern that industry and government are not adequately addressing environmental issues and to public confidence in environmental groups. In fact, a recent study conducted by Golin/Harris Communication, Inc. found that 80 percent of those studied believe "some" of what environmental groups report while less than 40 percent believe "some" of what businesses report. [9]

The joint task force was one of the first collaborative efforts involving a leading environmental organization and a major corporation aimed at improving corporate solid waste practices. It posed opportunities and challenges for both sides. EDF wanted to create a model approach that could be used by other companies, yet it risked criticism from other environmentalists. McDonald's needed a way to respond to public criticism of their environmental practices, but knew that potential task force disagreements could be embarrassing.

An early outcome of the task force was McDonald's adoption of the waste management hierarchy. The hierarchy served as a means to guide early decision making, but the long-term success of the program will depend on both parties' ability to manage the partnership.

EDF's President Fred Krupp said, "Environmentalists and industry alike will be waiting to see what McDonald's does with the task force options and recommendations. That will be the ultimate test of this effort's success."

END NOTES:

[1] Environmental Defense Fund and McDonald's Corporation. *Waste Reduction Task Force Final Report*. Oak Brook, IL: McDonald's, 1991. p. 22.

[2] McDonald's Corporation. *McDonald's 1991 Annual Report*. Oak Brook, IL: McDonald's. p. S4.

[3] The Task Force Study collected data for McDonald's 8,600 domestic restaurants only.

[4] Environmental Defense Fund. *Task Force Report*. pp. 31–34.

[5] Ibid., p. 3.

[6] The waste management hierarchy developed by the EPA — reduce, reuse, recycle, and incinerate/dispose — prioritizes solid waste practices and is widely accepted.

[7] Environmental Defense Fund. *Task Force Report*. p. 42.

[8] McDonald's Corporation. *McDonald's Packaging — The Facts*. Oak Brook, IL: McDonald's, 1990. p. 7.

[9] Foundation for Public Affairs. *Public Interest Group Profiles, 1992–93*. Washington: Congressional Quarterly, 1992.

EXHIBIT 1: MCDONALD'S CORPORATION CONSOLIDATED STATEMENT OF INCOME

(In millions of dollars, except per common share date)	Years ended December 31 1991	1990	1989
Revenues			
Sales by Company-operated restaurants	$4,908.5	$5,018.9	$4,600.9
Revenues from franchised restaurants	1,786.5	1,620.7	1,464.7
Total revenues	6,695.0	6,639.6	6,065.6
Operating costs and expenses			
Company-operated restaurants			
Food and packaging	1,627.5	1,683.4	1,560.3
Payroll and other employee benefits	1,259.2	1,291.0	1,174.4
Occupancy and other operating expenses	1,142.4	1,161.2	1,043.1
	4,029.1	4,135.6	3,777.8
Franchised restaurants-occupancy expenses	306.5	279.2	240.6
General, administrative and selling expenses	794.7	724.2	656.0
Other operating (income) expense-net	(113.8)	(95.3)	(46.5)
Total operating costs and expenses	5,016.5	5,043.7	4,627.9
Operating income	1,678.5	1,595.9	1,437.7
Interest expense-net of capitalized interest of $26.2, $36.0, and $29.8	391.4	381.2	301.9
Non operating income (expense)-net	12.3	31.6	21.4
Income before provision for income taxes	1,299.4	1,246.3	1,157.2
Provision for income taxes	439.8	444.0	430.5
Net income	$ 859.6	$ 802.3	$ 726.7
Net income per common share	$ 2.35	$ 2.20	$ 1.95
Dividends per common share	$ .36	$ .33	$ .30

The accompanying Financial Comments are an integral part of the consolidated financial statements.

Source: 1991 McDonald's Annual Report

EXHIBIT 2: MCDONALD'S CORPORATION CONSOLIDATED BALANCE SHEET

(In millions of dollars) December 31,	1991	1990
Assets		
Current assets		
Cash and equivalents	$ 220.2	$ 142.8
Accounts receivable	238.4	222.1
Notes receivable	36.0	32.9
Inventories, at cost, not in excess of market	42.6	42.9
Prepaid expenses and other current assets	108.8	108.3
Total current assets	646.0	549.0
Other assets and deferred charges		
Notes receivable due after one year	123.1	102.2
Investments in and advances to affiliates	374.2	335.2
Miscellaneous	278.2	250.0
Total other assets and deferred charges	775.5	687.4
Property and equipment		
Property and equipment, at cost	12,368.0	11,535.5
Accumulated depreciation and amortization	(2,809.5)	(2,488.4)
Net property and equipment	9,558.5	9,047.1
Intangible assets—net	369.1	384.0
Total assets	$11,349.1	$10,667.5
Liabilities and shareholders' equity		
Current liabilities		
Notes payable	$ 278.3	$ 299.0
Accounts payable	313.9	355.7
Income taxes	157.2	82.6
Other taxes	82.3	68.6
Accrued interest	185.7	133.2
Other accrued liabilities	201.4	194.9
Current maturities of long-term debt	69.1	64.7
Total current liabilities	1,287.9	1,198.7
Long-term debt	4,267.4	4,428.7
Security deposits by franchisees and other long-term liabilities	224.5	162.7
Deferred income taxes	734.2	695.1
Shareholders' equity		
Preferred stock, no par value; authorized-165.0 million shares;		
issued-9.9 and 6.9 million	298.2	199.7
Guarantee of ESOP Notes	(286.7)	(196.5)
Common stock, no par value; authorized-1.25 billion shares;		
issued-415.2 million	46.2	46.2
Additional paid-in capital	201.9	173.7
Retained earnings	5,925.2	5,214.5
Equity adjustment from foreign currency translation	32.3	46.7
	6,217.1	5,484.3
Common stock in treasury, at cost; 56.5 and 56.1 million shares	(1,382.0)	(1,302.0)
Total shareholders' equity	4,835.1	4,182.0
Total liabilities and shareholders' equity	$11,349.1	$10,667.5

The accompanying Financial Comments are an integral part of the consolidated financial statements.

EXHIBIT 3: 11-YEAR SUMMARY

(Dollars rounded to millions, except per common share data and average restaurant sales)

	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981
System-wide sales	$19,928	$18,759	$17,333	$16,064	$14,330	$12,432	$11,001	$10,007	$8,687	$7,809	$7,129
U.S.	12,519	12,252	12,012	11,380	10,576	9,534	8,843	8,071	7,069	6,362	5,770
Outside U.S.	7,409	6,507	5,321	4,684	3,754	2,898	2,158	1,936	1,618	1,447	1,359
System-wide sales by type											
Operated by franchisees	12,959	12,017	11,219	10,424	9,452	8,422	7,612	6,914	5,929	5,239	4,788
Operated by the Company	4,908	5,019	4,601	4,196	3,667	3,106	2,770	2,538	2,297	2,095	1,916
Operated by affiliates	2,061	1,723	1,513	1,444	1,211	904	619	555	461	475	425
Average sales, restaurants open at least 1 yr. (in 1,000s)	1,658	1,649	1,621	1,596	1,502	1,369	1,296	1,264	1,169	1,132	1,113
Revenues, frnchsd. rstrnts.	1,787	1,621	1,465	1,325	1,186	1,037	924	828	704	620	561
Total revenues	6,695	6,640	6,066	5,521	4,853	4,143	3,694	3,366	3,001	2,715	2,477
Operating income	1,679	1,596	1,438	1,288	1,160	983	905	812	713	613	552
Inc. before prov. for inc. taxes	1,299	1,246	1,157	1,046	959	848	782	707	628	546	482
Net income	860	802	727	646	549*	480	433	389	343	301	265
Cash provided by operations	1,423	1,301	1,246	1,177	1,051	852	813	701	618	505	434
Financial position at year-end											
Net property and equipment	9,559	9,047	7,758	6,800	5,820	4,878	4,164	3,521	3,183	2,765	2,497
Total assets	11,349	10,668	9,175	8,159	6,982	5,969	5,043	4,230	3,727	3,263	2,899
Long-term debt	4,267	4,429	3,902	3,111	2,685	2,131	1,638	1,268	1,171	1,056	926
Total shareholder equity	4,835	4,182	3,550	3,413	2,917	2,506	2,245	2,009	1,755	1,529	1,371
Per common share											
Net income	$ 2.35	$ 2.20	$ 1.95	$ 1.71	$ 1.45*	$ 1.24	$ 1.11	$ .97	$ .85	$ .74	$ .65
Dividends declared	.36	.33	.30	.27	.24	.21	.20	.17	.14	.12	.09
Year-end shareholder equity	13.48	11.65	9.81	9.09	7.72	6.45	5.67	4.94	4.38	3.78	3.37
Market price at year-end	38	29 1/8	34 1/2	24 1/8	22	20 1/4	18	11 1/2	10 1/2	9	6 1/2
System-wide restaurants at year-end	$12,418	$11,803	$11,162	$10,513	$9,911	$9,410	$8,901	$8,304	$7,778	$7,259	$6,739
Operated by franchisees	8,735	8,131	7,573	7,110	6,760	6,406	6,150	5,724	5,371	4,911	4,580
Operated by the Company	2,547	2,643	2,691	2,600	2,399	2,301	2,165	2,053	1,949	1,846	1,746
Operated by affiliates	1,136	1,029	898	803	752	703	586	527	458	502	413
Systemwide restaurants at year-end:											
U.S.	8,764	8,576	8,270	7,907	7,567	7,272	6,972	6,595	6,251	5,918	5,554
Outside U.S.	3,654	3,227	2,892	2,606	2,344	2,138	1,929	1,709	1,527	1,341	1,185
Number of countries at year-end	59	53	51	50	47	46	42	36	32	31	30

*Before the cumulative prior years' benefit from the change in accounting for income taxes.

EXHIBIT 4: SCHEMATIC OF MCDONALD'S EXISTING FOOD DELIVERY SYSTEM

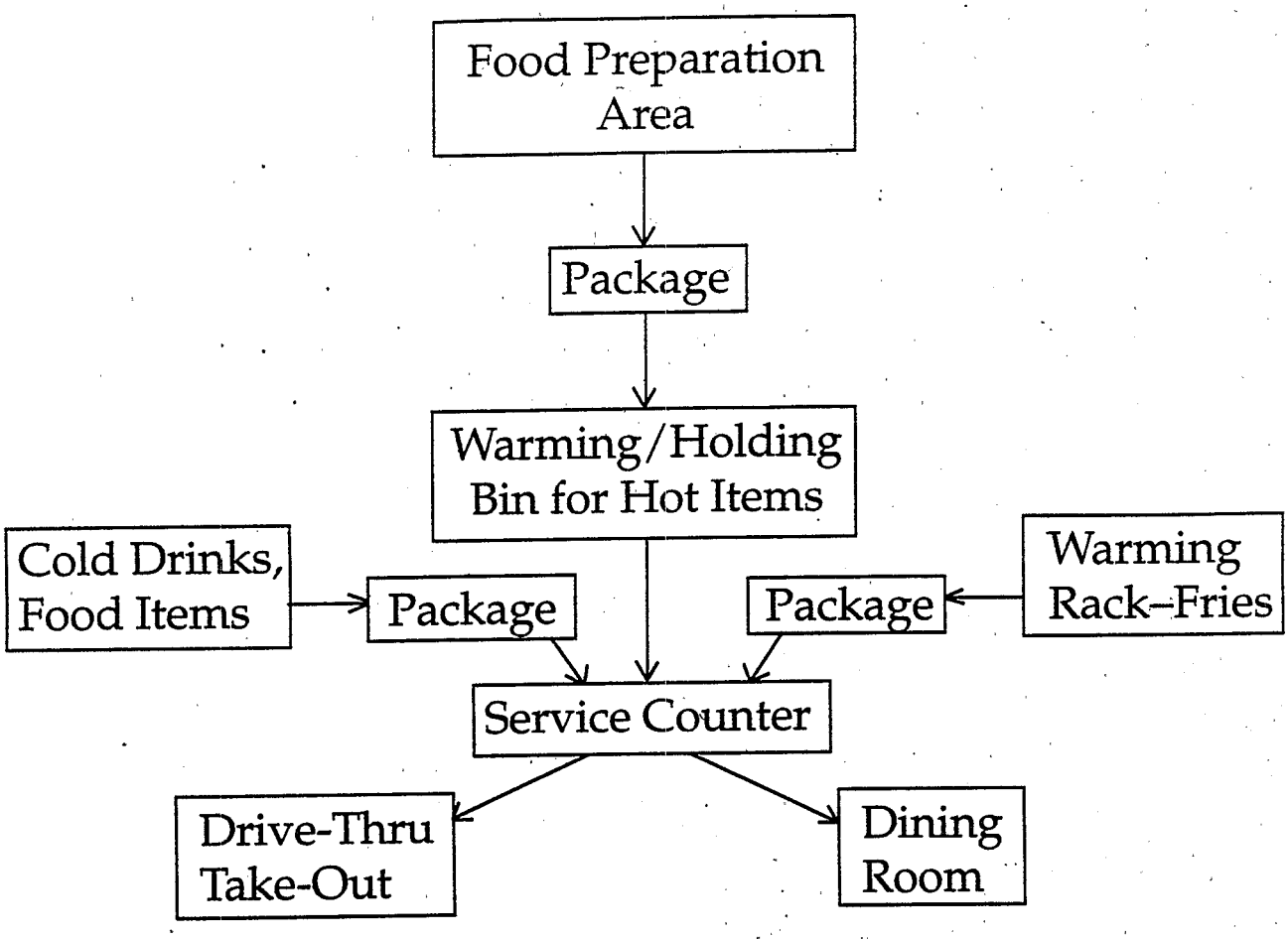


EXHIBIT 5: BIOGRAPHIES OF TASK FORCE MEMBERS

Terri K. Capatosto, Director of Communications, **McDonald's Corporation.** Ms. Capatosto joined the Corporation in 1984 and is responsible for managing McDonald's interaction with local and national news media as well as providing communications counsel, support, and training to the company's corporate and regional management and local owner-operators. Since 1988, she has also held specific responsibility for environmental issues, working with Operations, Purchasing, Environmental Affairs, and other key departments within McDonald's on the company's environmental initiatives. Ms. Capatosto has received numerous awards for leadership and outstanding performance, including McDonald's President's Award in 1987. Before joining McDonald's, Ms. Capatosto was a Captain in the U.S. Marine Corps. She holds B.A. degrees in Psychology and Music from the University of Utah.

Richard A. Denison, Senior Scientist, EDF. Mr. Denison, who holds a Ph.D. in Molecular Biophysics and Biochemistry from Yale, specializes in hazardous and solid waste management issues ranging from waste reduction and recycling to the health effects and regulatory requirements of landfilling and incineration. Prior to joining EDF in 1987, Mr. Denison was an Environmental Analyst at the U.S. Congress' Office of Technology Assessment and also conducted cancer research in a postdoctoral position at the University of California, San Francisco. He has authored numerous papers and reports on solid and hazardous waste management, and a recent book, *Recycling and Incineration: Evaluating the Choices.*

Robert L. Langert, Director of Environmental Affairs, The Perseco Company. Bob Langert is responsible for managing projects related to source reduction, recycling and other waste management alternatives for the Perseco Company, the exclusive packaging purchaser for McDonald's. His responsibilities include assisting in the coordination of McDonald's recycling initiatives across the country, and working with an extensive group of packaging suppliers on waste reduction initiatives. Prior to joining the McDonald's family, Mr. Langert was an operations manager for a McDonald's distributor, Perlman-Rocque, and served as Midwest logistics manager for the American Hospital Supply Corporation. He holds an M.B.A. degree from Northwestern University.

Keith Magnuson, Director, Operations Development Department, McDonald's. Mr. Magnuson works on developing new operating systems and improving store operations for the company's restaurants worldwide. Most recently, he has been involved in the development of McDonald's in-store recycling programs, packaging source reduction, and other environmental initiatives. Over the past 17 years, his positions have included store manager, area supervisor, field consultant, and operations development manager. He attended the University of Maryland.

S. Jackie Prince, Staff Scientist, EDF. Ms. Prince conducts research on a variety of solid waste issues, including recycling technologies and the use of product life cycle assessments in evaluating consumer products. Ms. Prince holds Master's degrees in Public and Private Management and Environmental Studies, and received her B.S. in chemical engineering, all from Yale. She is a former Project Manager/Engineer for the Waste Management Division of the U.S. Environmental Protection Agency, Region I, where she received the 1986 EPA Award For Excellence. She is the author of *Wetlands Assessments at Hazardous Waste Sites* and *Assessment of PCB Contamination in New Bedford Harbor.*

John F. Ruston, Economic Analyst, EDF. With a Master of City Planning degree from MIT, Mr. Ruston works on issues that link economic development and environmental quality. He is co-author of *Coming Full Circle: Successful Recycling Today; Recycling and Incineration: Evaluating the Choices;* and *The Economic Case for Recycling: Evidence From the Brooklyn Navy Yard Hearings.* Mr. Ruston received his B.S. from the University of California at Davis, where he also completed graduate work in economics and computer modeling.

Dan Sprehe, Environmental Affairs Consultant, Government Relations Department, McDonald's. Mr. Sprehe's duties include internal research on recycling and source reduction issues as well as serving as a McDonald's corporate spokesperson to environmental and government groups. He was previously a legislative analyst for the Illinois General Assembly's Senate Energy and Environmental Committee, where he helped draft legislation on numerous environmental issues, including the Illinois Solid Waste Management Act. Mr. Sprehe holds a B.S. in Political Science from Eastern Illinois University.

EXHIBIT 6: CURRENT SOURCE REDUCTION PROJECTS

Project/Idea/Concept	Potential % Reduction
1. Cold Cups:	
A. Use unbleached/non-chlorine bleached paper.	TBD*
B. Eliminate lids on in-store purchases.	TBD
C. Drink-thru lid.	TBD
2. Sandwich Wraps:	
A. Explore different compostable barriers/coatings.	TBD
B. Use unbleached/non-chlorine bleached paper.	–
3. Cartons:	
A. Replace medium and large fry cartons with bags.	75%
B. New glue seam on cartons.	TBD
C. Replace hash brown carton with bag.	75%
D. Reduce amount of paperboard used in Happy Meal boxes.	20%
4. Straws:	
A. Reduce gauge.	6%
B. Convert to unwrapped bulk.	20%
5. Cutlery:	
A. Evaluate polypropylene.	TBD
B. Test and evaluate starch-based materials.	TBD
6. Foam Cups & Breakfast Entrees:	
A. Look for environmentally preferred alternatives to polystyrene foam.	TBD
7. Corrugated Shipping Containers:	
A. Continue examining ways to reduce amount of corrugated used in boxes.	TBD
B. Test reusable plastic containers (distribution center to restaurant and raw material supplier to distribution center).	TBD
C. Test recyclable coating for meat boxes.	TBD
8. Inner Pack PE Film Wrap:	
A. Color-tint only those which are not recyclable.	–
B. Convert all possible wraps to LDPE to enhance recyclability.	–
9. Condiment Packaging:	
A. Convert to 17 g. ketchup packet from current 11 g. packet.	–
10. Other Unbleached Products:	
A. Coffee Filters	TBD
B. Prep Pan Liners	–

*TBD = To be determined

Source: Task Force Report

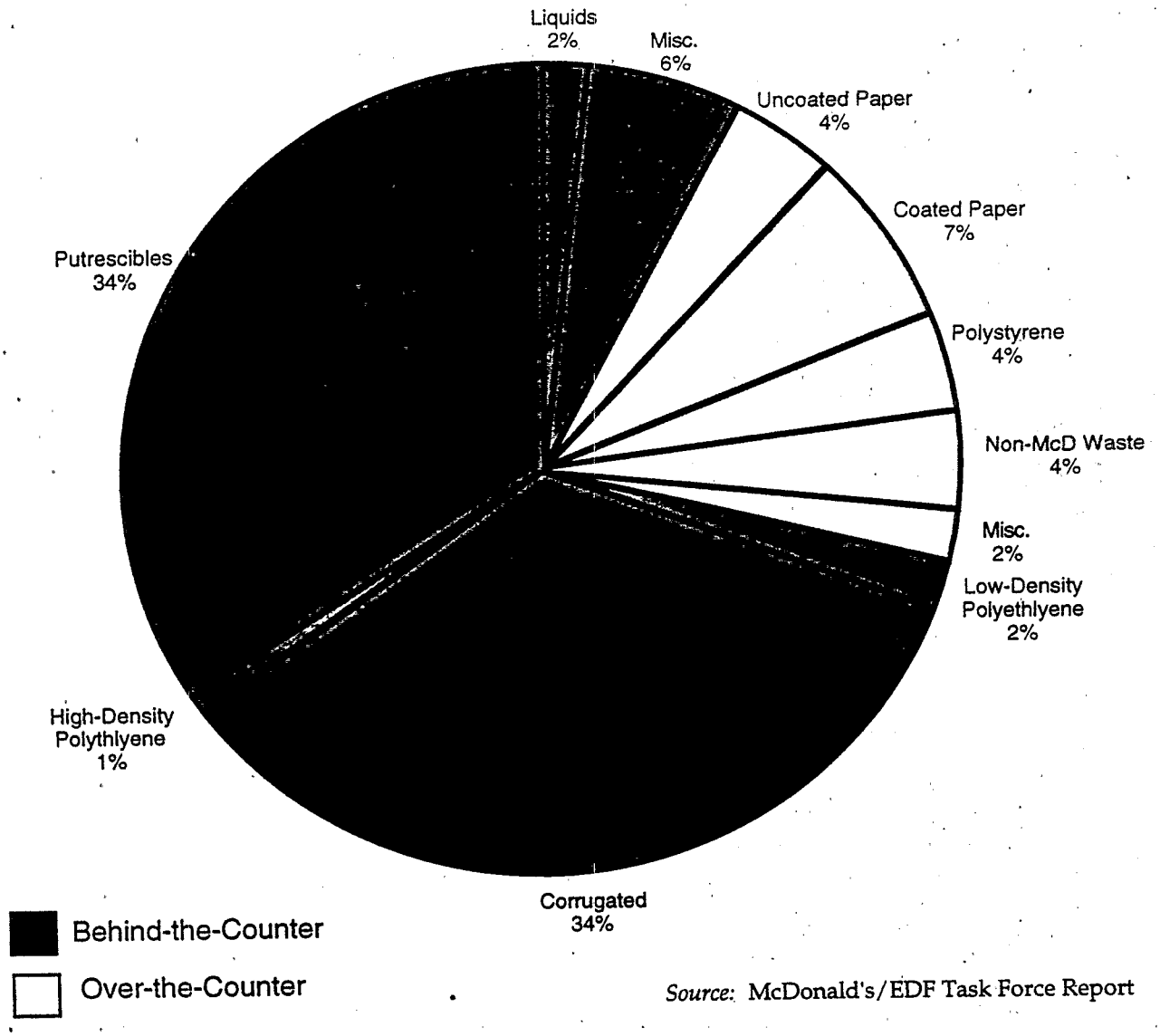
EXHIBIT 7: 1990 SOURCE REDUCTION ACCOMPLISHMENTS

Accomplishments	% Weight Reduction
• Redesign 16-oz. cold cup (one supplier).	10.2%
• Reduce large cold cup.	6.0%
• Reduce density of breakfast lids.	14.5%
• Reduce density of slant McChicken package.	6.6%
• Reduce density of small clamshell.	8.5%
• Smaller napkin.	21.0%
• Oriented unwrapped bulk cutlery.	11.0%
• Convert to jumbo roll toilet tissue.	23.0%
• Reduce gauge of sundae cup.	9.0%
• Replace breakfast sandwich foam with sandwich wrap.	59.0%
• Increase corrugated usage for 10:1 meat boxes.	15.0%
• Replace sandwich foam with wraps:	
- weight	1.0%
- volume	90.0%
• Down-sized McD.L.T. package	32.0%

*Note: Each change is based on its annual impact for that particular product line.

Source: Task Force Report

EXHIBIT 8: MCDONALD'S ON-PREMISE WASTE STUDY



Source: McDonald's/EDF Task Force Report

EXHIBIT 9: DESCRIPTIONS OF SOME ENVIRONMENTAL GROUPS

Citizen's Clearinghouse for Hazardous Waste (1981)
Mission: To assist grassroots leaders in creating and maintaining local community organizations that fight toxic polluters and environmental hazards.
Budget: $689,908 (1990)
Membership: Not available

Conservation International Foundation (1987)
Mission: To help develop the capacity to sustain biological diversity, ecosystems, and ecological processes that support life on Earth.
Budget: $8.9 million (1991)
Membership: 55,000 individuals

Earth First! (1980)
Mission: The preservation of natural diversity.
Budget: None
Membership: Not available

Environmental Defense Fund (1967)
Mission: Committed to a multidisciplinary approach to environmental problems, combining the efforts of scientists, economists, and attorneys to devise practical, environmentally sustainable solutions to these problems.
Budget: $15.1 million (1990)
Membership: 150,000 individuals

Friends of the Earth (1990)
Mission: To work at the local, national, and international levels to protect the planet; preserve biological, cultural, and ethnic diversity; and empower citizens to have a voice in decisions affecting their environments and lives.
Budget: $3 million (1990)
Membership: 50,000 individuals

Greenpeace USA (1971)
Mission: To preserve the environment through international campaigns in the areas of toxic waste, disarmament, ocean ecology, energy and atmospheric preservation, and rainforest preservation.
Budget: $34 million (1990)
Membership: 2.1 million individuals

Izaak Walton League of America (1922)
Mission: To defend America's soil, air, woods, waters, and wildlife through its local chapters, state divisions, and a national headquarters in the U.S. capitol.
Budget: $1.8 million (1990)
Membership: 52,700 individuals

National Audubon Society (1905)
Mission: Long-term protection and the wise use of wildlife, land, water, and other natural resources; the promotion of rational strategies for energy development and use; the protection of life from pollution, radiation, and toxic substances; and solving global problems caused by overpopulation and the depletion of natural resources.
Budget: $35.8 million (1990)
Membership: Not available

Natural Resources Defense Council (1970)
Mission: Dedicated to conserving natural resources and improving the quality of the human environment.
Budget: $16 million (1990)
Membership: 170,240 individuals

The Nature Conservancy (1951)
Mission: To preserve plants, animals, and natural communities that represent the diversity of life on Earth by protecting the land and waters they need to survive.
Budget: $68 million (1990)
Membership: 580,000 individuals; 405 corporations

Sea Shepard Conservation Society (1977)
Mission: To protect and preserve marine wildlife and habitats for future and present generations.
Budget: $600,000 (1990)
Membership: 17,000 individuals

Sierra Club (1892)
Mission: To explore, enjoy, and protect the wild places of the earth; to practice and promote the responsible use of the earth's ecosystems and resources; to educate and enlist humanity to protect and restore the quality of the natural and human environment; and to use al lawful means to carry out these objectives.
Budget: $35 million (1990)
Membership: 650,000 individuals

Wilderness Society (1935)
Mission: Devoted primarily to the preservation of wilderness and the proper management of our country's public lands and natural resources.
Budget: $17.9 million (1990)
Membership: 383,000 individuals

World Wildlife Fund
Mission: To conserve nature by using the best available scientific knowledge and advancing that knowledge to preserve the diversity and abundance of life on earth and the health of ecological systems by protecting natural areas and wild populations of plants and animals, including endangered species; to promote sustainable approaches to the use of renewable natural resources; and to promote more efficient use of resources and energy and the maximum reduction of pollution.
Budget: $54 million (1991)

Published by:
The National Pollution Prevention Center for Higher Education
University of Michigan, Dana Building
430 East University Ave.
Ann Arbor, MI 48109-1115
• Phone: 313-764-1412
• Fax: 313-936-2195
• E-mail: nppc@umich.edu

The mission of the NPPC is to promote sustainable development by educating students, faculty, and professionals about pollution prevention; create educational materials; provide tools and strategies for addressing relevant environmental problems; and establish a national network of pollution prevention educators. In addition to developing educational materials and conducting research, the NPPC also offers an internship program, professional education and training, and conferences.

Your Input is Welcome!
We are very interested in your feedback on these materials. Please take a moment to offer your comments and communicate them to us. Also contact us if you wish to receive a documents list, order any of our materials, collaborate on or review NPPC resources, or be listed in our *Directory of Pollution Prevention in Higher Education.*

We're Going Online!
The NPPC provides information on its programs and educational materials through the Internet's World Wide Web; our URL is: http://www.snre.umich.edu/nppc

We may also update the NPPC information available through gopher (gopher.snre.umich.edu) and anonymous FTP (ftp.snre.umich.edu). Please contact us if you have comments about our online resources or suggestions for publicizing our educational materials through the Internet. Thank you!

Pollution Prevention in Corporate Strategy
NATIONAL POLLUTION PREVENTION CENTER FOR HIGHER EDUCATION

Case B1: The Clamshell Controversy

Susan Svoboda, Manager of the Corporate Environmental Management Program, University of Michigan, prepared this case under the guidance of Stuart Hart, Director of the Corporate Environmental Management Program and Assistant Professor of Corporate Strategy and Organizational Behavior at the Michigan Business School, as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.
We would like to thank the National Pollution Prevention Center for supporting the development of this case.

Introduction

The Joint Task Force of McDonald's Corporation and the Environmental Defense Fund (EDF) was in its third month of collaboration when a decision needed to be made about the expansion of McDonald's polystyrene recycling program. The task force, formed through a mutual agreement between the parties, had been charged with finding ways to reduce McDonald's solid waste through source reduction, reuse, recycling, and composting. However, one aspect of McDonald's operations seemed to attract the public's attention — the polystyrene "clamshell" sandwich containers. Although these packages represented only a minute fraction of total municipal solid waste[1], to the public they symbolized the "throw-away" society.

Debate over McDonald's packaging materials started in the 1970s when the public became concerned that too many trees were being cut down to make packaging. In response to this interest, Ray Kroc, McDonald's founder, commissioned the Stanford Research Institute (SRI) to conduct an environmental impact study comparing the paperboard packaging McDonald's was then using to polystyrene packaging. By analyzing all aspects of the two alternatives from manufacturing though disposal, SRI concluded that plastic was preferred. They reasoned that the coating on the paperboard made it nearly impossible to recycle, while polystyrene was recyclable and used less energy in production.

As a result, McDonald's switched to polystyrene for their cups and sandwich containers, and launched an environmental education program to communicate to the public their rationale for the switch from paperboard to plastic. In 1989, McDonald's piloted a recycling program in 450 of their New England restaurants by asking in-store customers to sort their trash into designated trash bins. The polystyrene was then shipped to one to eight plastic recycling plants formed in a joint venture of eight plastics companies. The program gained enough success that soon it was expanded to California and Oregon at the request of state officials, and involved a total of 1,000 stores. McDonald's began planning a national expansion of the program. However, EDF Director Fred Krupp told Ed Rensi, Chief Operating Officer and President of McDonald's USA, that he would publicly refuse to endorse the recycling program, because he did not regard it as the best environmental solution.

Packaging in the Waste Stream

Packaging is essential to a product's performance. It protects the product throughout production, distribution and storage, provides consumers with product and usage information, and differentiates the product. Food manufacturers and distributors also expect packaging to extend the product's shelf life and to preserve the appearance, freshness, flavor, and moisture content of food. Effective packaging reduces food spoilage-rates and diverts more than its own weight from disposal.

The composition of solid waste has changed significantly over the past three decades. Paper and plastics have grown to a combined total of 50 percent, while metal, food and yard waste, and glass have decreased. See **Exhibit 1** for a breakdown of municipal solid waste (MSW). Further, the total weight of packaging in MSW doubled between 1960 and 1990. However, as shown in **Exhibit 2**, the EPA estimates source reduction efforts will reduce the packaging content of MSW to 30 percent by the year 2000 (from a high of 36 percent in 1970).

The growing trends of single-parent families and dual-career couples have popularized single-use and microwave containers for which no recycling infrastructure currently exists. These packages offer convenience but often replace more durable or reusable options. If the present rate of growth continues, the proportion of plastics in packaging is expected to be 15 percent by the year 2000 (see **Exhibit 3**). Both manufacturers and consumers value the flexible, durable, and insulating properties of plastics. However, plastics have become a topic of debate as citizens try to reconcile the desire for convenience with "greening" attitudes.

Recent *Greenwatch* studies by J. Walter Thompson indicate that 78 percent of those surveyed say that they are willing to pay extra for products with recyclable or biodegradable components, and 77 percent report that their purchase decisions are influenced by a company's reputation on environmental issues. Although actual consumer behavior may not necessarily match intended behavior, this growing sentiment is prompting manufacturers to search for new technologies to make their packages thinner or lighter in order to "green" their packaging. In addition, many companies are looking to find ways to overcome the diminished performance characteristics of recycled materials so that they can replace virgin materials with recycled ones.

Clamshells, Paperboard, and Quilt-wrap

McDonald's selects packaging based on long-standing criteria derived from its founding principles of Quality, Service, Cleanliness, and Value (Q.S.C.&V.) considering: packaging availability, its ability to keep food insulated and control its moisture level, its ease of handling, its customer appeal, and its cost. McDonald's packaging philosophy is to "evolve as new applications and materials that meet our customer's needs become available. If there is a better package...we'll use it!"

Perseco, an independent and privately owned company that purchases from over 100 suppliers, handles the procurement of all McDonald's paper and plastic food-service packaging, including direct food packaging as well as utensils, cups, bags, and napkins. McDonald's packaging must provide customers with a convenient way to take food out while keeping it fresh, hot, and moist, since a typical McDonald's restaurant serves 2,000 people per day, 60–70 percent of whom take their food outside the restaurant.

As the task force began reviewing sandwich packaging options, they basically had two alternatives: paperboard containers costing approximately 2.5–3 cents per sandwich and polystyrene clamshells at approximately 2–2.5 cents per sandwich.[2] To help the joint task force understand how packaging was used in McDonald's operations, Perseco was requested to perform an audit of all packaging — primary, secondary, and tertiary — used in a restaurant. Secondary packaging, used to contain and ship supplies, includes corrugated cardboard, inner wraps, packs, and dividers. Tertiary packaging includes customer-related packaging such as utensils, napkins, carry-out bags, etc. The results, shown in **Exhibit 4**, indicated that paper products constitute 81 percent of McDonald's primary packaging.

As the task force members contemplated the complexity of the environmental issues before them, they knew that they must develop a comprehensive framework that would enable them to assess the advantages and disadvantages of various options. For example, some options aimed at improving one particular aspect of a package may have other detrimental environmental impacts. Foremost, the clamshell issue needed to be resolved. Although current public opinion opposed the clamshells, McDonald's had selected polystyrene clamshells over 20 years before because they were shown to be more environmentally "friendly" than coated paperboard, which could not be recycled. In the meantime, McDonald's had made a strong commitment to recycling polystyrene in both its relationship with the National Polystyrene Recycling Center and in its efforts to educate the public. Also, plain paper wraps had been eliminated as a viable alternative since they did not satisfactorily insulate the sandwiches.

The task force decided to let the waste management hierarchy and the life cycle assessment methodology guide their analysis. Life cycle assessment gives consideration to all impacts that occur during each stage of

the product's or packaging material's life cycle, from extraction of the raw materials through manufacturing, transportation, use, and disposal. In addition, the team found that time spent learning about McDonald's operations, suppliers, and customers was invaluable to their decision-making when factoring in qualitative measures of public perception of the magnitude of an option's impact on the environment; the health or safety risk to McDonald's employees, customers, or the communities they serve; and how an option could be integrated into both pilot tests and full-scale operations. Finally, they considered the feasibility of the option being replicated in the many local conditions of the McDonald's restaurants and supporting communities.

Task Force Adopts Life Cycle Methodology

Understanding the important linkages between different stages of a package's or product's "life" is a dynamic process where, for example, a change in an input to the manufacturing process would result in corresponding changes in disposal figures. The analysis is further complicated by the fact that many inputs or releases have not been measured and tracked over time, and some are not even quantifiable. The task force turned to Franklin Associates Ltd., specialists in life cycle analysis, for a complete review of the relative merit of packaging materials. See the **Note on Life Cycle Analysis** for background on this methodology.

Franklin Associates Ltd. gathered data from a number of sources including: material manufacturers, product manufacturers, published literature, government sources, and Franklin's existing materials and manufacturing database. Data from a 1990 Franklin Associates study, prepared for the Council of Solid Waste Solutions, that compared polystyrene clamshell to bleached paperboard containers at various recycling rates is shown in **Appendix A**. Also included as **Appendix B** is data from a second study that compares clamshells to a new "quilt-wrap" packaging developed by the James River Corporation. Quilt-wrap is a layered paper package that was introduced while the task force was in progress. The inner tissue-paper layer protects the sandwich from absorbing grease. The middle layer is a thin polyethylene film that acts as a barrier to moisture and insulates the food. The outer layer of plastic gives the paper strength. This wrap is not recyclable and is estimated to cost 1.5–2 cents per sandwich.[3]

As both the public and government agencies have become more environmentally concerned over the past 20 years, several studies have been conducted to evaluate the impact of containers. However, confusion remains over how to measure and compare all the environmental risks associated with them. In many cases, impacts such as pollution emissions have not been measured, and in other cases the long-term risks have not been determined. Assumptions and limitations of the life cycle assessment methodology have spurred debate over the value of such assessments. Franklin Associates provides only life cycle inventories — listings of quantifiable environmental inputs and releases. Such inventories usually lead clients to develop improvement assessments — studies that use inventory results to pinpoint opportunities for improvement.

Other groups such as Green Cross and Green Seal have used life cycle data to attempt to estimate a product's environmental impact. However, consumer labeling efforts often attempt to make product comparisons of products for which comprehensive data have yet to be collected. Currently, no general formula is available to make this comparison, and comparison of entire categories such as plastics versus paper is virtually meaningless. The validity of environmental labelling without a scientific basis or widely accepted standard continues to be debated by environmental, business, and consumer groups.

Life Cycle Inventory Data — The Clamshell Decision

The life cycle inventories prepared by Franklin Associates to aid task force decision-making provided information on the systems that produce the products, in this case sandwich packaging. Here a system is defined as "the collection of operations that together perform some defined function." Each individual stage or process can be viewed as a subsystem of the total system, as shown in **Exhibit 5**. The following is a description of the systems used to produce polystyrene clamshell containers and paper-based sandwich wraps. Variations in the production of either paperboard or quilt-wrap are noted.

POLYSTYRENE PRODUCTION

Polystyrene containers result from a multistage process with several production and manufacturing subsystems (see **Exhibit 6**). A description of the various processes follows.

Raw Materials Acquisition

Crude Oil Production

Oil is produced by drilling into porous rock formations several thousand feet under the earth's surface that contain oil. Pumps are used to extract the oil and the accompanying "brine" water. The brine is separated from the oil at the surface. Approximately 90 percent of water with minimal oil residue is sent to separate wells that are specifically designed for its storage, and the remaining 10 percent is discharged into surface water. Hydrocarbons may also be emitted to the air in this process as many oil fields also contain natural gas. Crude oil passes through a distillation and desalting process in order to remove salt, sediment, and water.

Natural Gas Production

Although natural gas flows quite freely to the earth's surface, it requires energy to pump it to the surface. Hydrocarbons are released during the process. Since approximately 25 percent of natural gas is produced in combination with oil, brine water is produced at the same time as natural gas. Hydrocarbons are also produced with natural gas and are released into the air during venting at the well-site.

Transportation

Oil and natural gas may be shipped in truck or railroad tanks, by ocean tanker, or by pipelines. Oil leaks and spills are potential risks. Transportation of highly explosive natural gas necessitates special equipment and safety precautions.

Material Manufacture

Natural Gas Processing

Processing plants use compression, refrigeration, and oil absorption to extract light hydrocarbons. When components of the gas are removed they are stored in controlled conditions until being transported away. The primary pollutants in this process are hydrocarbons. In some cases, natural gas must undergo a "sweetening" process in which sulfur dioxide is emitted.

Ethylene Production

Ethylene is produced by a process called thermal cracking — hydrocarbons and steam are fed into the cracking furnace, where they are heated, compressed, and distilled. Typical feedstocks used in U.S. in this process are approximately 75 percent ethane/propane and 25 percent naphtha.

Benzene Production

Benzene is naturally produced from crude oil as it is distilled in the refining process. It can also be produced using a reforming operation that uses decontaminated naphtha from ethylene production. Benzene has been found to cause blood disorders and leukemia in workers exposed to high concentrations for a long period of time. It is regulated by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA/Superfund), the Resource Conservation and Recovery Act (RCRA), and the Occupational Safety and Health Administration (OSHA).

Styrene Production

Styrene is produced by combining benzene and ethylene using a catalyst and then dehydrogenating the resulting ethylbenzene. Ethylbenzene is listed as a volatile contaminant by the Environmental Protection Agency (EPA) and is a standard priority pollutant for monitoring of water discharges. Styrene is a clear, colorless liquid which is flammable and toxic and requires special precautions. Exposure to high levels may result in irritation to eyes, skin, and the respiratory tract. The Health Hazard Assessment Group and the EPA's Office of Drinking Water classifies styrene as a probable carcinogen; however, the Science Advisory Board refutes this claim. Styrene is regulated under Superfund and by OSHA and the Food and Drug Administration (FDA).

Polystyrene Resin

Styrene is converted to polystyrene by holding styrene in a chamber under controlled temperatures to remove solvents, unreacted materials, and other volatiles from the end product. It is then fed through a die where strands and pellets are formed.

Blowing Agent Production

Isopentane, n-pentane, isobutane, n-butane, CFCs, and HCFCs are all blowing agents for foam plastic. CFCs are commonly used in the production of polymer foams, but used only 2.3 percent of the time in the production of polystyrene. Of that 2.3 percent, most is used to produce insulation board. Common blowing agents for polystyrene include pentane and HCFCs. Pentane does not affect the ozone layer, but may contribute to low-level smog if not recovered. The EPA has endorsed HCFC-22 as an "excellent alternative" to CFCs as it reduces ozone depletion by 95 percent over CFCs. However, federal law requires a phase-out of all ozone-depleting chemicals, and by 1993 HCFC-22 will be prohibited by federal law from use in the production of foam packaging.[4]

Final Product Fabrication

Crystal polymers are combined with blowing agents under pressure in an extruder. The pressure drops as they exit the extruder, which causes the polystyrene to bubble and foam. Sheets are produced and thermoformed into desired shapes. Most of the solid waste generated during this stage is recycled.

Packaging and Transportation

Polystyrene products are typically wrapped in polyethylene sleeves and packaged in corrugated boxes and shipped by truck or rail.

Disposal

Landfilling

Plastics are an inert material that add stability to a landfill, first by acting as a liner that reduces leaching of toxins in landfills and second by not producing methane gas. Landfill characteristics do not foster the biodegradability of plastics. Plastics may take as long as 20 years to break down and even then will only break into smaller pieces, retaining the same volume. However, pressure within a landfill is estimated at 50 pounds per square inch, enough to compress all the air out of plastics, thereby reducing their volume.

Incineration

Plastics burn easily because the fuel value remaining in the plastic is released during incineration. The heat generated from combustion of polystyrene is much higher than that released by average MSW, and over twice that of paperboard containers. [5]

Recycling

After polystyrene is transported to the recycling facility, it is washed and food contaminants are removed as sludge. The polystyrene is ground, dried, re-extruded, and pelletized. Energy needed to melt plastics for recycling is 2–8 percent of the energy needed to make virgin plastics.[6] Recycling efforts are hampered by economic and operational factors. First, the sale of polystyrene waste to recyclers generates little revenue relative to hauling costs because recycled materials are generally purchased by weight and polystyrene is very light. Second, residual food contamination can hurt the quality of the recycled material making it potentially unsalable.

Operationally, cleaning is labor-intensive and requires large amounts of water. Recycled plastics are usually weaker or less durable than non-recycled plastics of the same weight, so they are often combined with additives or formed in multiple layers to increase strength. Biodegradable plastics complicate recycling efforts. Manufacturers are working to improve the degradability of plastics intended for landfill. However, biodegradable plastics, if recycled, may deteriorate while still in use. Finally, recycling postpones disposal, but it does not eliminate eventual disposal.

PAPER PRODUCTION

Paper, paperboard, and quilt-wrap packaging result from multistage processes with several production and manufacturing subsystems (see **Exhibit 7**). The various processes are essentially the same for each of the packaging materials unless otherwise noted.

Raw Material Acquisition

Logging Operations

Logging operations can be divided into the following four stages:

Harvest Planning. Decreasing timber supplies relative to expected demand has made the planning stage increasingly important to improve wood utilization and to reduce environmental impacts. Planning decisions include logging techniques, the volume and species to be harvested, and road layout.

Cutting Practices. Trees are cut down as low to the ground as possible using power saws. Machines known as "feller-bunchers" cut the timber into smaller segments and gather them for transportation. The logs are then roughly scaled, classified for best usage, and graded and measured for length and diameter.

Yarding Practices. Logs are moved from the forest to a centralized loading area using either tractors to pull the logs or cable lines to transport logs above the forest.

Loading and Hauling. Logs are transported from the loading area to the manufacturing plant using truck, rail, or water.

Harvesting can lead to soil erosion, which causes the pesticides and fertilizer applied before harvesting to be washed into the water as well as the soil. Ongoing erosion may change the run-off patterns of a watershed. And the power tools, tractors, and trucks used all consume energy and release emissions.

Materials Manufacture

Pulping

Pulping is a process whereby cellulose fiber, the material used to make paper, is separated from the other components found in wood. Wood is comprised of 50 percent cellulose fiber, 30 percent lignin, and 20 percent oils and carbohydrates.

Mechanical Process. Logs that do not meet lumber-quality standards are debarked by a rotating drum that wears away the bark. Logs are chopped into blocks which are combined with wood chips in a continuous grinding machine. A stream of water flows through the grinder and washes the pulp away. The sludge pulp is pumped over several screens to remove coarse material and water, and is stored in tanks until needed. Mechanical pulping tears the cellulose into shorter fibers and allows more lignin to be included in the pulp, which creates weaker paper that yellows easily.

Chemical Process. Debarked logs are chipped and placed in large steel tanks called digesters where they are "cooked" with a combination of soda, sulfite, and sulfate at high temperatures. This pulpy substance is blown into cyclones to remove steam and gas and then sent to large tanks where the cooking chemicals are separated from the pulp. The pulp is pumped over screens to remove the water, which is usually 100 to 500 tons of water per ton of pulp. The pulp is thickened and rolled through presses to make sheets of pulp, or moved directly into papermaking operations.

Pulp and paper mills use an average of 50,000 gallons of water per ton of paper output. The industry reuses water to conserve usage. In fact, total water use is usually three times higher than actual intake. In addition, mills employ internal recovery systems that recover the liquors used in pulpmaking. Emissions into the air include particulates of sulphur dioxide and organic sulfur compounds. Scrubbers that "wash" the air to collect fly ash, and boilers and furnaces equipped with air pollution controls are used to reduce emissions.

Final Product Fabrication

Bleaching

If bleached paper is desired, the pulp is either treated with an oxidizing agent such as chlorine or a reducing agent such as sulfate dioxide. Salt, limestone, and sulfur mining processes extract the raw materials used in the bleaching process. In the bleaching process, approximately 10 percent of the chlorine used combines with organic molecules in the wood and produces toxic chlorine compounds called organochlorines. One organochlorine that has received particular attention is dioxin. Bleaching is done in several stages with continuous agitation and washing to achieve the desired brightness. The bleaching process can be skipped if natural brown paper is acceptable to the customer, or accomplished with non-chlorine processes such as oxygen bleaching.

Packaging and Transportation

Paper wraps are packaged in corrugated boxes and shipped by truck or rail.

Disposal

Landfilling

Biodegradability is not a factor in modern landfills since the sunlight and air required for quick decomposition does not exist. In fact, the "Garbage Project" at the University of Arizona has been investigating and exhuming landfills since the 1970s and has determined that 40–50 percent of garbage is paper which has not decomposed.

Composting

Paper is organic so it is compostable so long as it is not wax coated or laminated.

Recycling

Waste paper is pulped using the same processes as virgin paper and is passed through a filter to remove any foreign materials. If de-inking is required, the pulp is aerated so that the ink rises to the surface as foam and is removed by a vacuum. In some processes, heat and chemicals aid the de-inking process. The rest of the process is the same as for virgin papermaking.

Recycling waste paper consumes less energy than is consumed during the harvesting, production, and transporting of lumber required for virgin paper. However, this is somewhat offset by the energy used to collect and transport waste paper to the recycling center. Neither paperboard nor quilt-wrap packaging is currently recyclable due to wax and polyethylene content, and possible food contamination.

The Decision

As the task force members considered their decision of whether or not to endorse McDonald's recycling program for clamshells, they reviewed the data found in the Franklin studies. They knew that they were going to have to make some assumptions about future disposal methods, unmeasured impacts and consumer response.

Clamshells had become a high-profile decision. Not only would this decision affect McDonald's environmental image but it may also be used to judge the effectiveness of this type of joint task force. Should McDonald's continue clamshell recycling efforts, or drop clamshells altogether?

END NOTES:

[1] Municipal Solid Waste (MSW) is solid waste generated by residences, commercial establishments, and institutions.

[2] "The Greening of the Golden Arches," *Rolling Stone*, August 22, 1991, p. 36; personal communication with Jackie Prince, EDF, March 29,1993.

[3] Stillwell, J., Contz, C., Kopf, P., and Montrome, M., *Packaging for the Environment*, New York: American Management Association, 1991.

[4] Environmental Defense Fund and McDonald's Corporation. "Waste Reduction Task Force Final Report," Oak Brook, IL: McDonald's, 1991. p. 22.

[5] Personal Communication with Robert Langert, March 29, 1993.

[6] Ibid.

[7] Polystyrene Packaging Council, "Questions and Answers" literature, Washington, DC: PPC, 1992.

[8] Franklin Associates, *Resource and Environmental Profile Analysis of Foam Polystyrene and Bleached Paperboard Containers, Final Report*, Prairie Village, KS, June 1990.

[9] U.S. Congress, Office of Technology Assessment. *Facing America's Trash* (202-546-1029), p. 176.

Published by:
The National Pollution Prevention Center for Higher Education
University of Michigan, Dana Building
430 East University Ave.
Ann Arbor, MI 48109-1115
• Phone: 313-764-1412
• Fax: 313-936-2195
• E-mail: nppc@umich.edu

The mission of the NPPC is to promote sustainable development by educating students, faculty, and professionals about pollution prevention; create educational materials; provide tools and strategies for addressing relevant environmental problems; and establish a national network of pollution prevention educators. In addition to developing educational materials and conducting research, the NPPC also offers an internship program, professional education & training, and conferences.

Your Input is Welcome!
We are very interested in your feedback on these materials. Please take a moment to offer your comments and communicate them to us. Also contact us if you wish to receive a documents list, order any of our materials, collaborate on or review NPPC resources, or be listed in our *Directory of Pollution Prevention in Higher Education.*

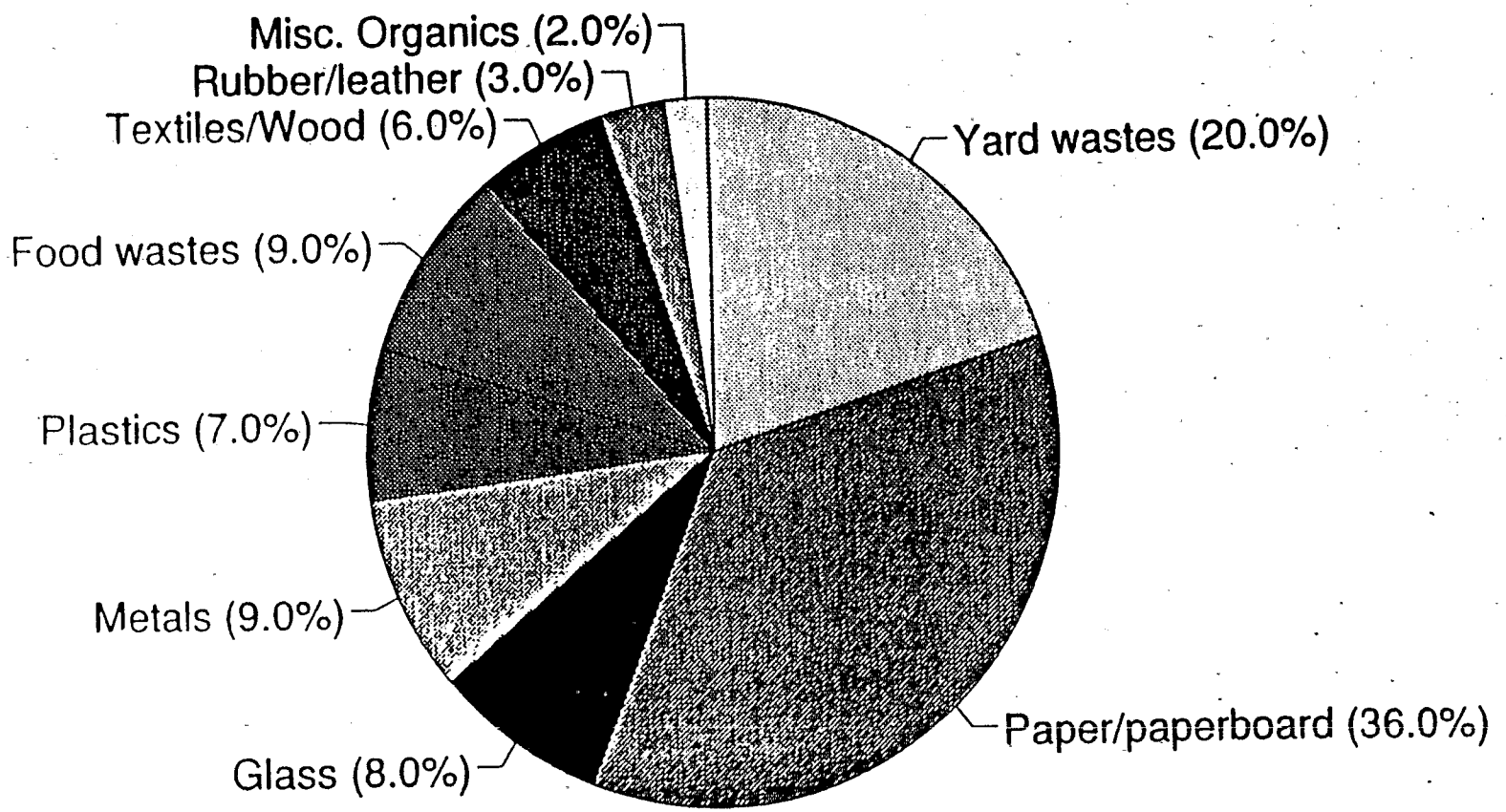
We're Going Online!
The NPPC provides information on its programs and educational materials through the Internet's World Wide Web; our URL is: http://www.snre.umich.edu/nppc

We may also update the NPPC information available through gopher (gopher.snre.umich.edu) and anonymous FTP (ftp.snre.umich.edu). Please contact us if you have comments about our online resources or suggestions for publicizing our educational materials through the Internet. Thank you!

EXHIBIT 1

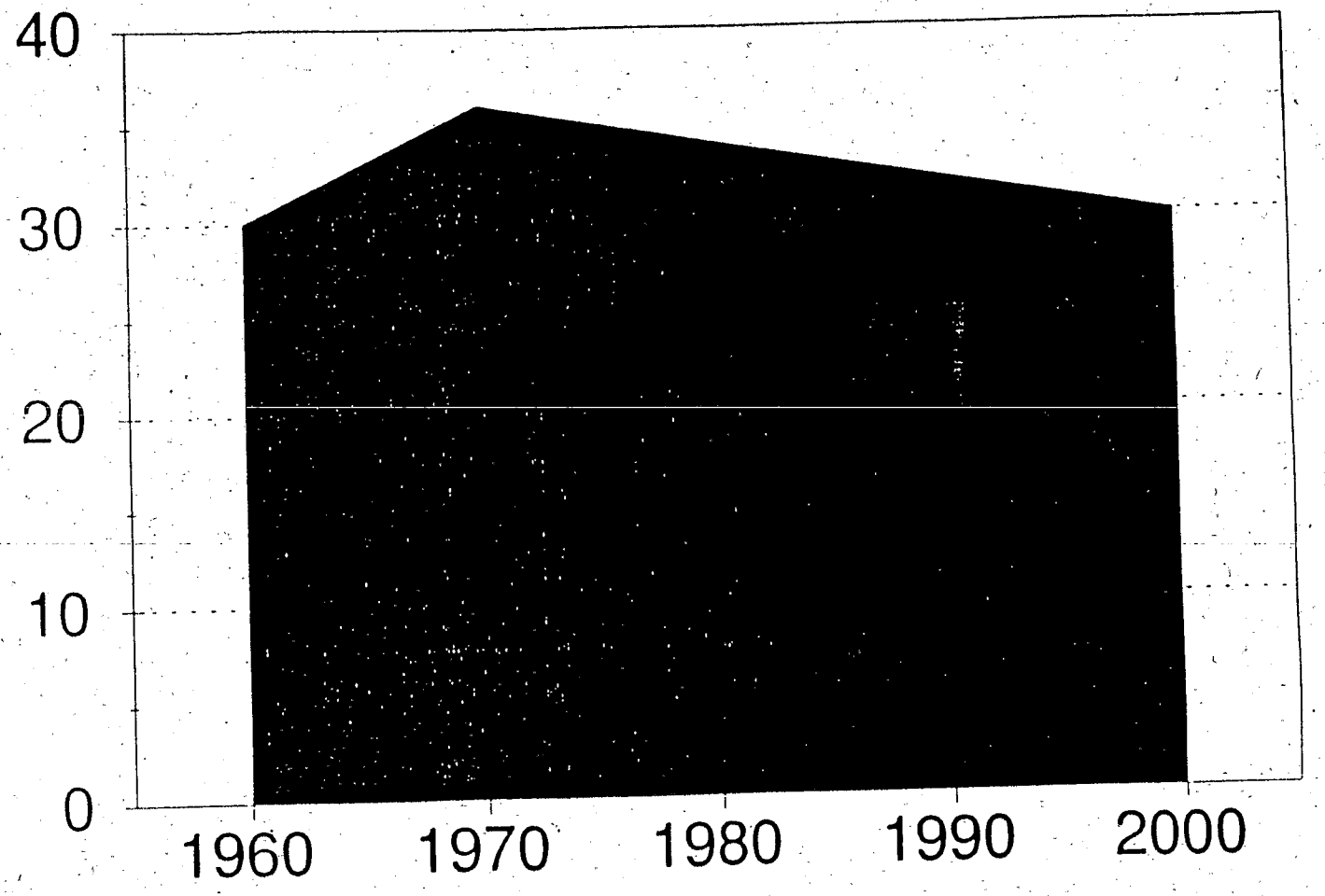
Materials in Municipal Solid Waste

In 1986, By Weight



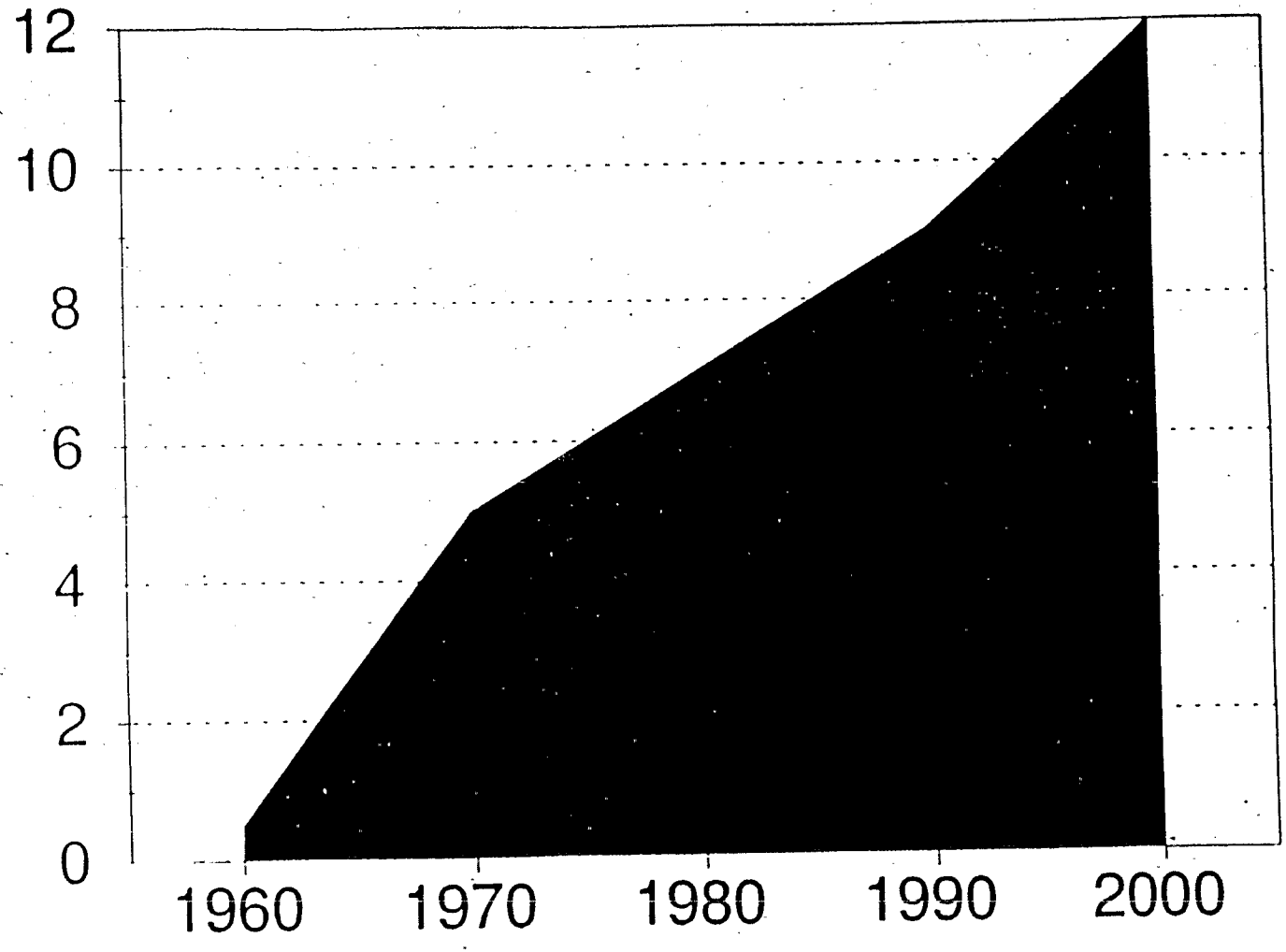
Source: Office of
Technology Assessment

EXHIBIT 2
Packaging in the Waste Stream



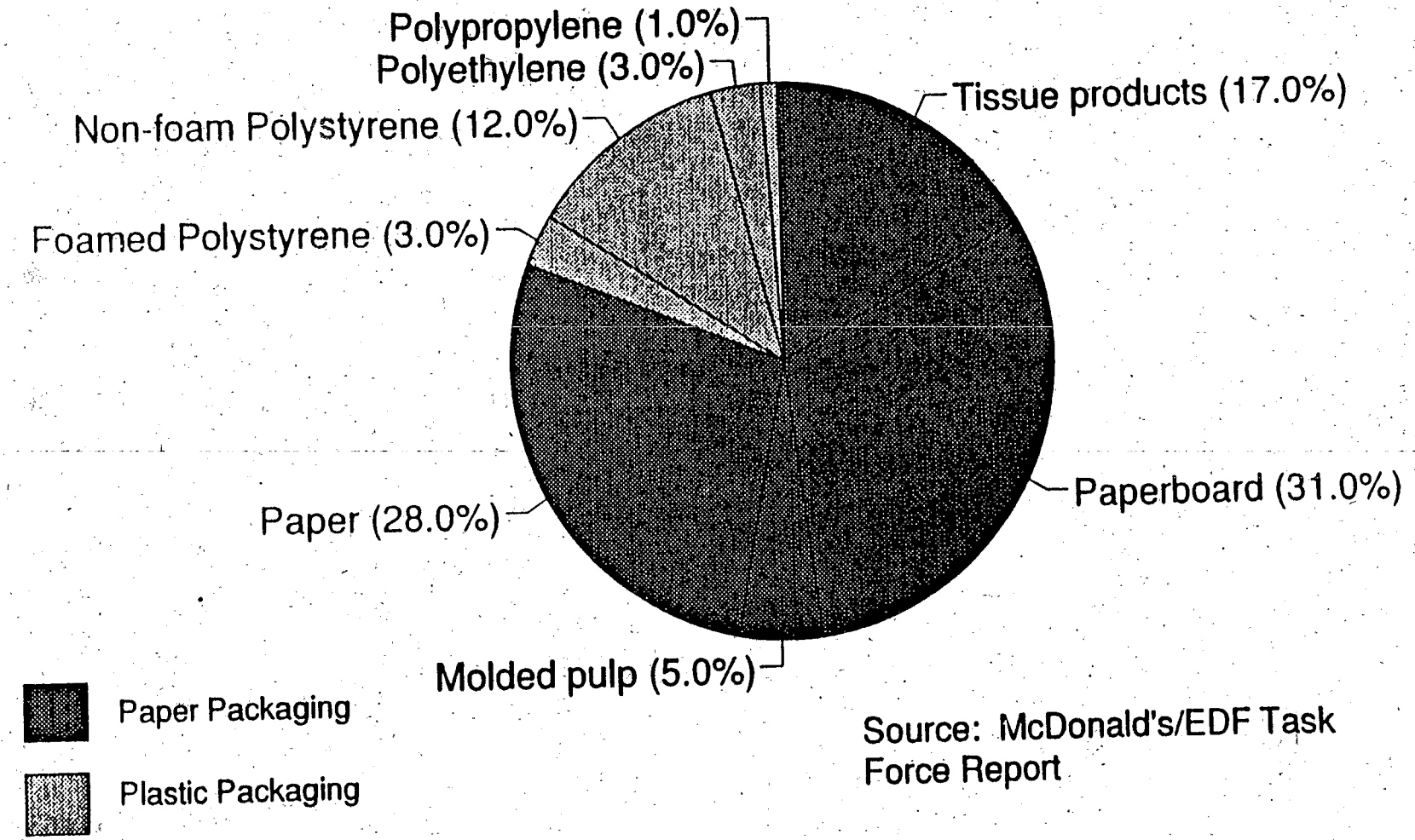
Source: EPA
1990 & 2000 are estimates

Exhibit 3
Plastics in Packaging



Source EPA
1990 & 2000 are estimates

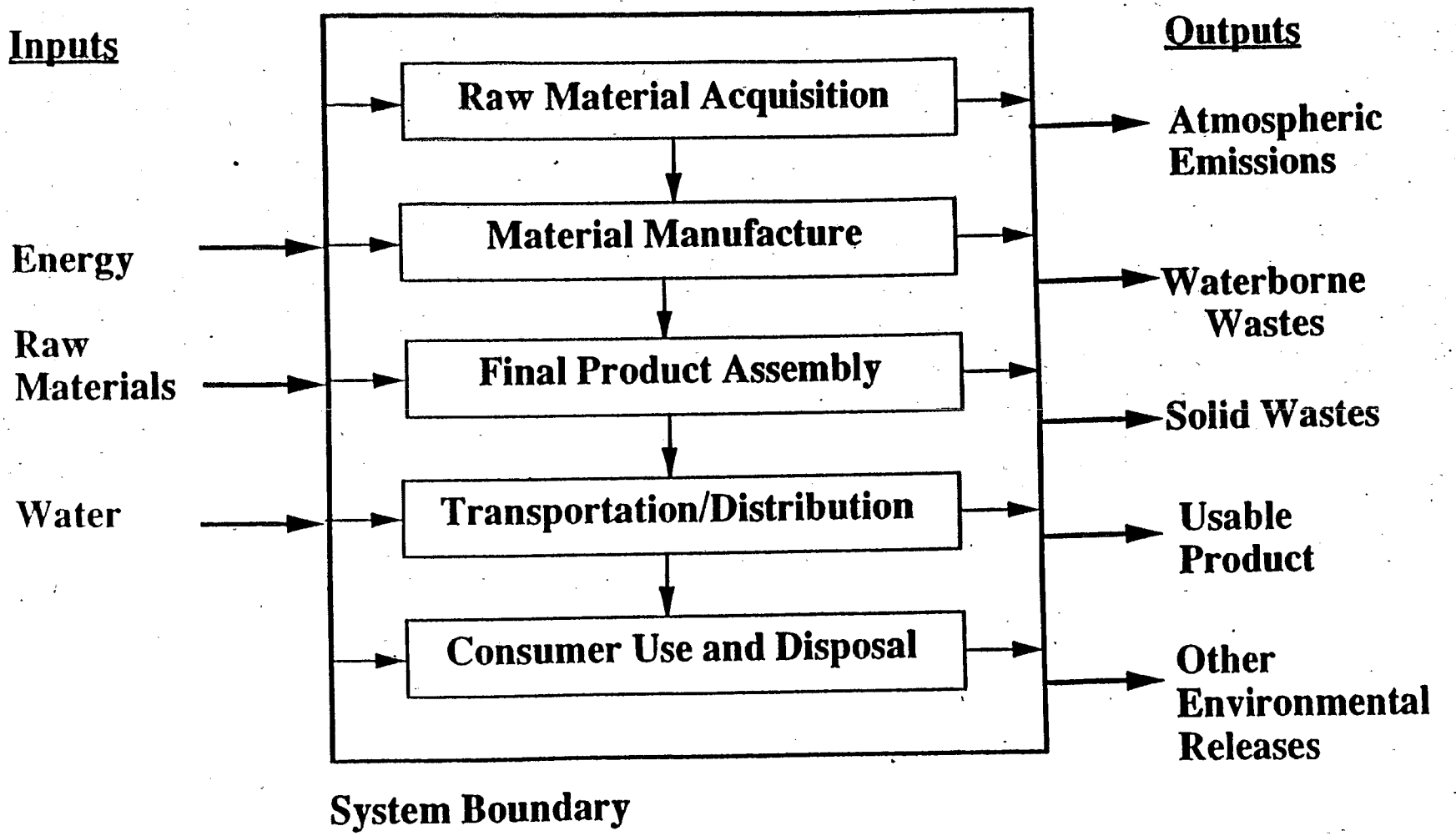
EXHIBIT 4
McDonald's Packaging Materials
In 1989, By Weight



Source: McDonald's/EDF Task Force Report

EXHIBIT 5

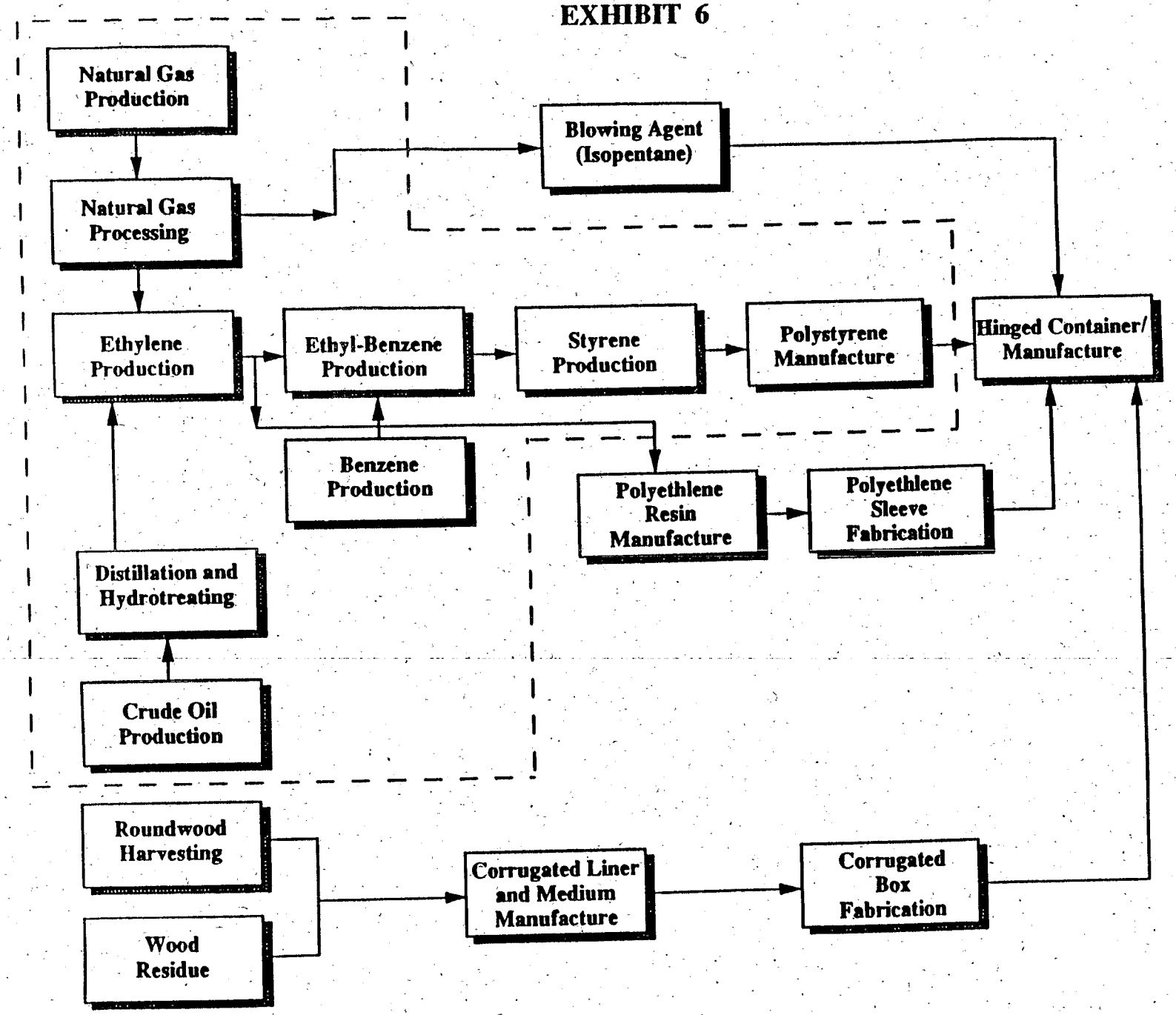
LIFE-CYCLE INVENTORY



Defining system boundaries

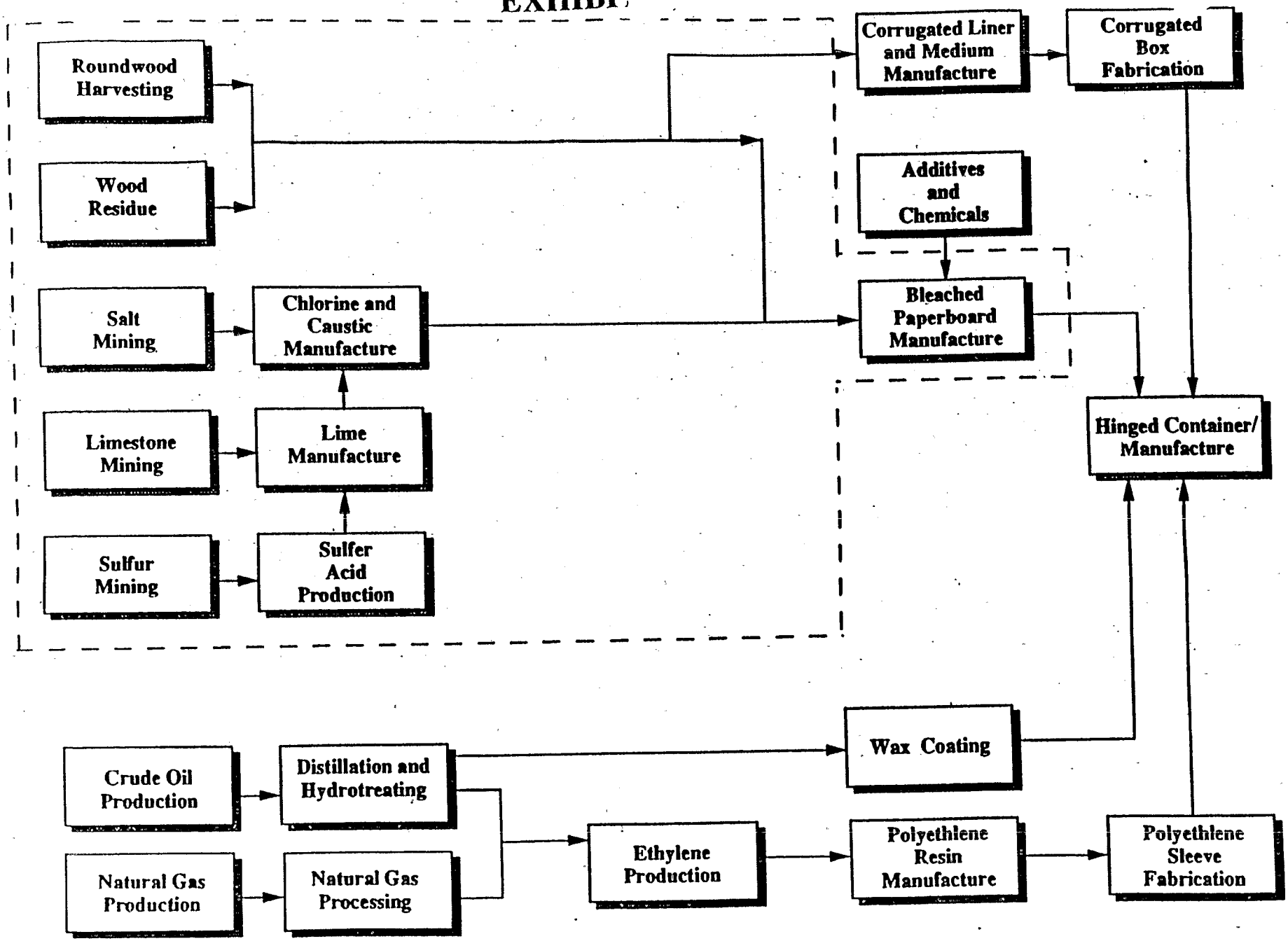
Source: Battelle & Franklin Associates, Ltd.

EXHIBIT 6



— — — dotted line indicates primary packaging,
boxes outside dotted lines show secondary packaging

EXHIBIT 7



— — — dotted line indicates primary packaging, boxes outside lines indicate secondary packaging

Appendix A:
Comparison of Polystyrene Foam and Bleached Paperboard

Selected data from Franklin Associates' *Resource and Environmental Profile Analysis of Foam Polystyrene and Bleached Paperboard Containers.* Prairie Village, Kansas, June 1991.

APPENDIX A-1: LANDFILL VOLUMES OF POLYSTYRENE FOAM AND PAPERBOARD FOOD CONTAINERS (PER 10,000 UNITS)

	Weight for 10,000 Units (pounds)	Landfill Density (lb/cu yd)	Landfill Volume (cu yd)
4-inch Hinged Containers			
PS foam	112.3	180	0.62
LDPE-coated paperboard	323.2	800	0.41

Source: Franklin Associates, Ltd.

APPENDIX A-2: ENERGY REQUIREMENTS BY COMPONENTS FOR HINGED CONTAINERS (MILLION BTU PER 10,000 HINGED CONTAINERS)

	0% recycled		100% recycled	
Containers	Energy	Percent	Energy	Percent
Foam Polystyrene				
Container	5.62	86.9	3.66	81.7
Secondary Packaging	0.80	12.4	0.80	17.9
Disposal	0.05	0.8	0.02	0.4
Total	6.47	100.0	4.48	100.0
Paperboard Container	8.88	96.3		
Secondary Packaging	0.34	3.6		
Disposal	0.00	0.0		
Total	9.22	99.9		

Source: Franklin Associates, Ltd.

APPENDIX A-3: ENERGY REQUIREMENTS FOR DELIVERY OF HINGED CONTAINERS (MILLION BTU PER 10,000 HINGED CONTAINERS)

	Total Energy Requirements	Energy Credit from Incineration[1]	Net Energy Requirements
Foam Polystyrene			
0% recycled	6.47	0.37	6.10
25% recycled	5.97	0.29	5.68
50% recycled	5.48	0.22	5.26
75% recycled	4.98	0.14	4.84
100% recycled	4.48	0.07[2]	4.41
Paperboard	9.22	0.47	8.75

[1]Assumes 15% incineration energy credit based upon solid waste available after recycling.

[2]Energy credit associated with secondary packaging which is not assumed to be recycled.

Source: Franklin Associates, Ltd.

APPENDIX A-4: SUMMARY OF ENVIRONMENTAL IMPACT DATA FOR POLYSTYRENE HINGED CONTAINERS (IMPACTS PER 10,000 CONTAINERS)

	Process Pollutants		Fuel-Related Pollutants		Total Pollutants	
	0% Recycling	100% Recycling	0% Recycling	100% Recycling	0% Recycling	100% Recycling
Atmospheric (lbs)						
Particulates	0.23	0.20	0.65	0.69	0.9	0.9
Nitrogen Oxides	0.086	0.065	2.0	1.7	2.1	1.8
Hydrocarbons	4.9	3.9	1.9	1.3	6.8	5.2
Sulfur Oxides	0.55	0.36	2.5	2.6	3.1	3.0
Carbon Monoxide	0.098	0.094	0.85	0.73	0.9	0.8
Aldehydes	0.010	0.0055	0.016	0.012	0.0	0.0
Other Organics	0.0038	0.0038	0.021	0.018	0.0	0.0
Odorous Sulfur	0.0022	0.0011	-	-	0.0	0.0
Ammonia	0.0076	0.0038	0.0015	0.0014	0.0	0.0
Hydrogen Fluoride	-	-	-	-	-	-
Lead	2.8E-04	2.8E-04	1.1E-05	1.1E-05	0.0	0.0
Mercury	-	-	-	-	-	-
Chlorine	-	-	-	-	-	-
Waterborne (lbs)						
Fluorides	-	-	-	-	-	-
Dissolved Solids	1.4	0.72	0.20	0.17	1.6	0.9
BOD	0.12	0.11	-	-	0.1	0.1
Phenol	9.2E-04	4.6E-04	-	-	0.0	0.0
Sulfides	0.0012	5.9E-04	-	-	0.0	0.0
Oil	0.027	0.014	-	-	0.0	0.0
COD	0.079	0.041	-	-	0.1	0.0
Suspended Solids	0.27	0.20	-	-	0.3	0.2
Acid	-	-	0.25	0.29	0.3	0.3
Metal Ion	-	-	0.033	0.037	0.0	0.0
Chemicals	-	-	-	-	-	-
Cyanide	-	-	-	-	-	-
Chromium	2.2E-05	1.1E-05	-	-	0.0	0.0
Iron	-	-	-	-	-	-
Aluminum	-	-	-	-	-	-
Nickel	-	-	-	-	-	-
Mercury	-	-	-	-	-	-
Lead	-	-	-	-	-	-
Phosphates	-	-	-	-	-	-
Zinc	-	-	-	-	-	-
Ammonia	1.4E-04	7.2E-05	-	-	0.0	0.0
Other	-	-	0.067	0.059	0.1	0.1

Source: Franklin Associates, Ltd.

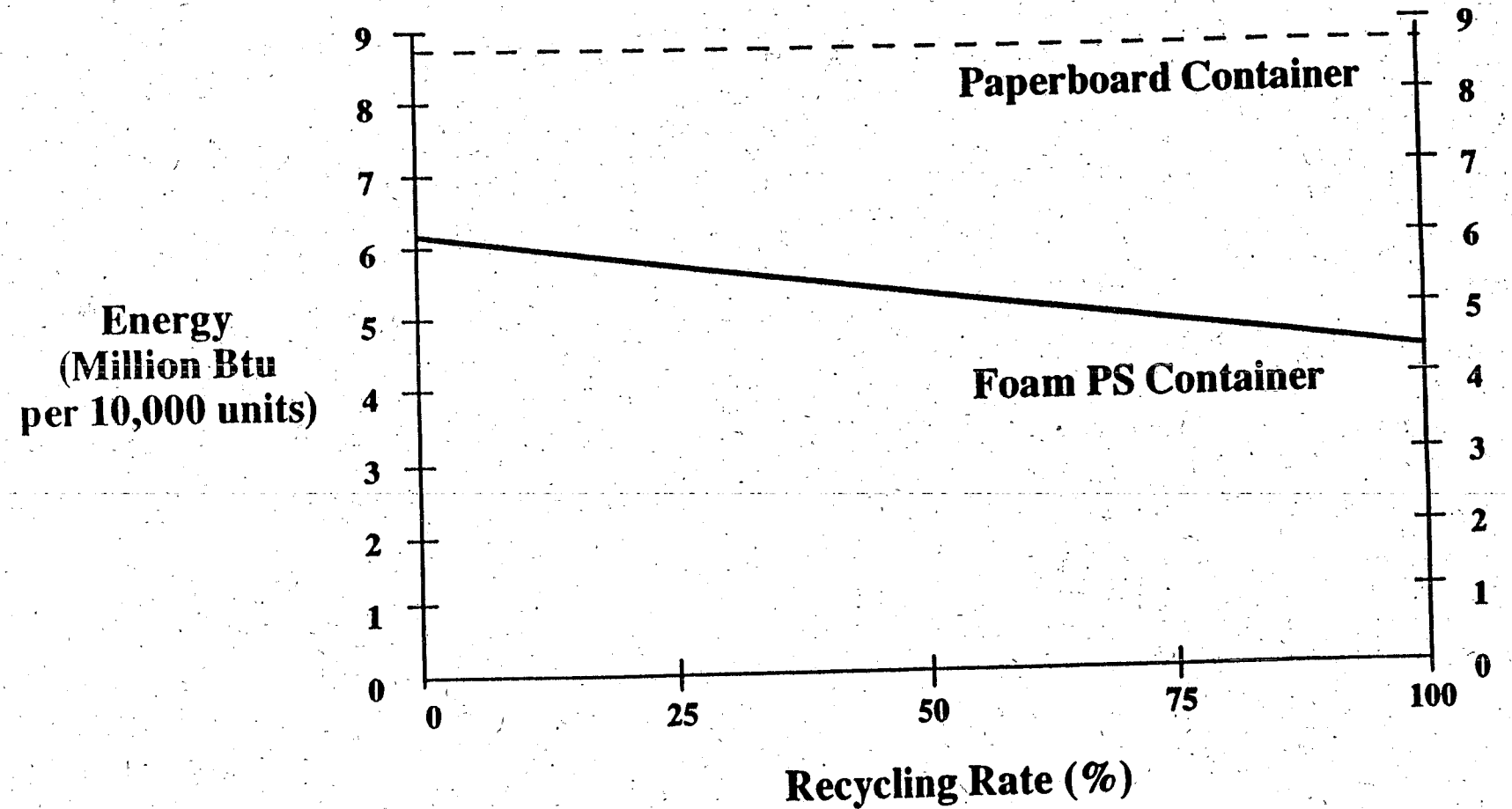
APPENDIX A-5: SUMMARY OF ENVIRONMENTAL IMPACT DATA FOR PAPERBOARD HINGED CONTAINERS 0% RECYCLING (IMPACTS PER 10,000 CONTAINERS)

	Process Pollutants	Fuel-Related Pollutants	Total Pollutants
Atmospheric (lbs)			
Particulates	3.0	2.1	5.1
Nitrogen Oxides	1.9	3.3	5.2
Hydrocarbons	1.3	2.2	3.5
Sulfur Oxides	3.2	6.5	9.7
Carbon Monoxide	0.62	1.2	1.8
Aldehydes	0.0077	0.017	0.0
Other Organics	0.026	0.035	0.1
Odorous Sulfur	-	-	-
Ammonia	2.4E-04	0.0042	0.0
Hydrogen Fluoride	-	-	-
Lead	0.0020	3.2E-05	0.0
Mercury	-	-	-
Chlorine	0.37	-	0.4
Waterborne (lbs)			
Fluorides	-	-	-
Dissolved Solids	0.41	0.24	0.7
BOD	0.90	-	0.9
Phenol	1.2E-06	-	0.0
Sulfides	-	-	-
Oil	0.0033	-	0.0
COD	0.029	-	0.0
Suspended Solids	1.5	-	1.5
Acid	0.058	1.0	1.1
Metal Ion	-	0.080	0.1
Chemicals	-	-	-
Cyanide	-	-	-
Chromium	2.4E-06	-	0.0
Iron	-	-	-
Aluminum	-	-	-
Nickel	-	-	-
Mercury	-	-	-
Lead	-	-	-
Phosphates	-	-	-
Zinc	-	-	-
Ammonia	1.5E-05	-	0.0
Other	-	0.093	0.1

Source: Franklin Associates, Ltd.

Appendix A-6

Energy Requirements for Two Hinged Containers At Various Recycling Rates * (Assumes 15 percent incineration.)

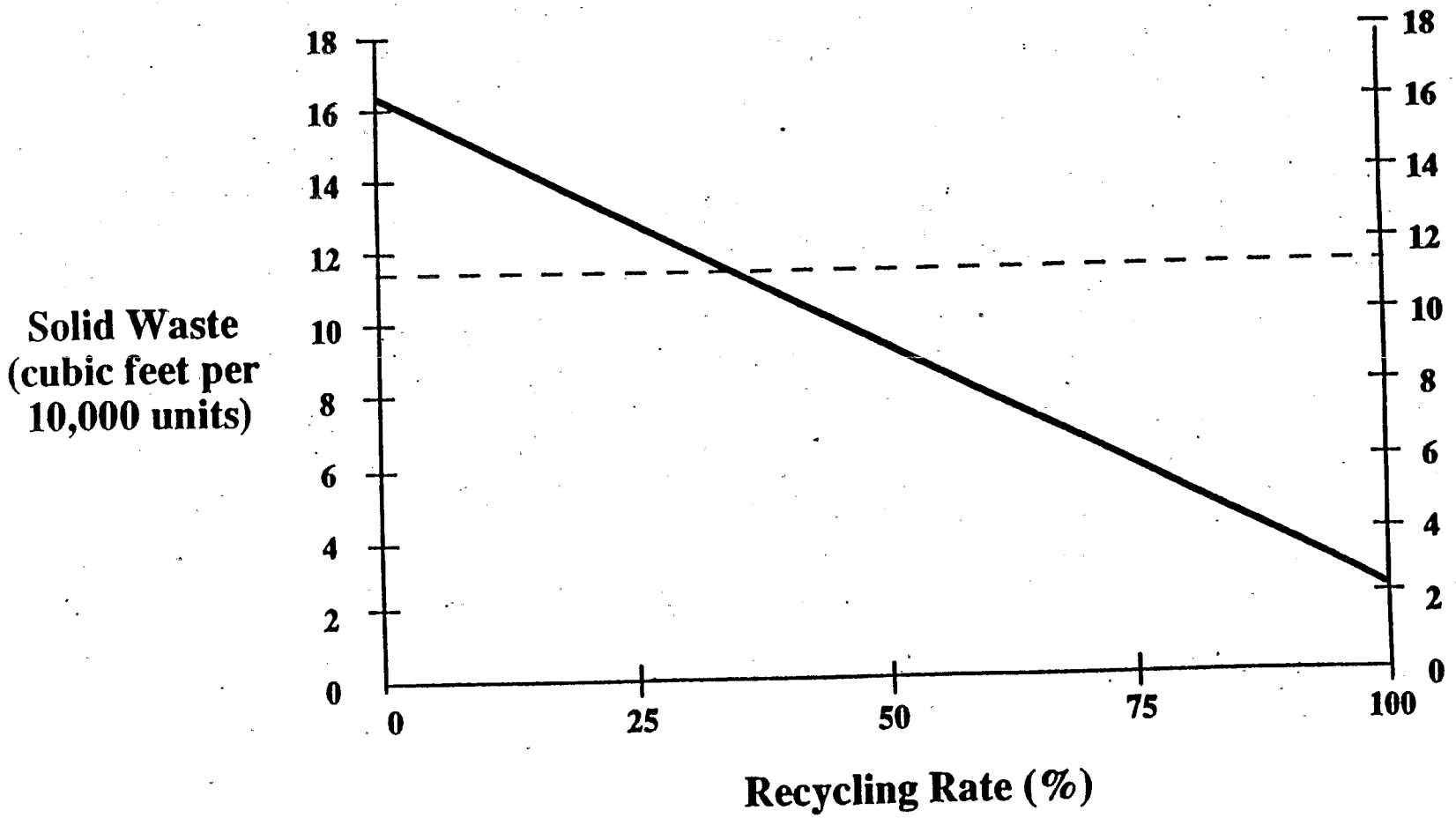


*Assumes no recycling for the paperboard hinged container.

Source: Franklin Associates, Ltd.

Appendix A-7

Total Solid Wastes of Hinged Containers at Various Recycling Rates*

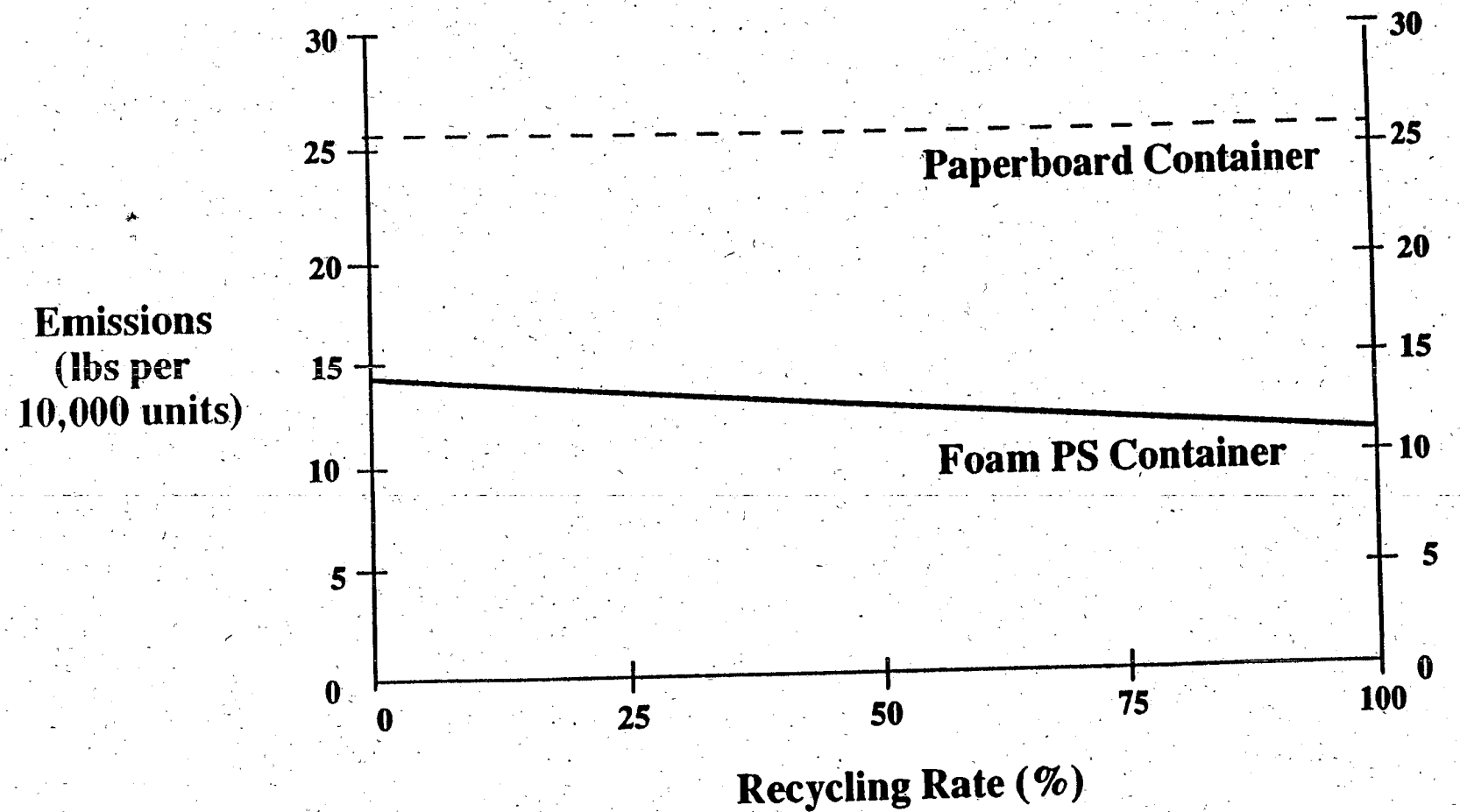


*Assumes no recycling for the paperboard hinged container.

Source: Franklin Associates, Ltd.

Appendix A-8

Atmospheric Emissions of Hinged Containers At Various Recycling Rates*

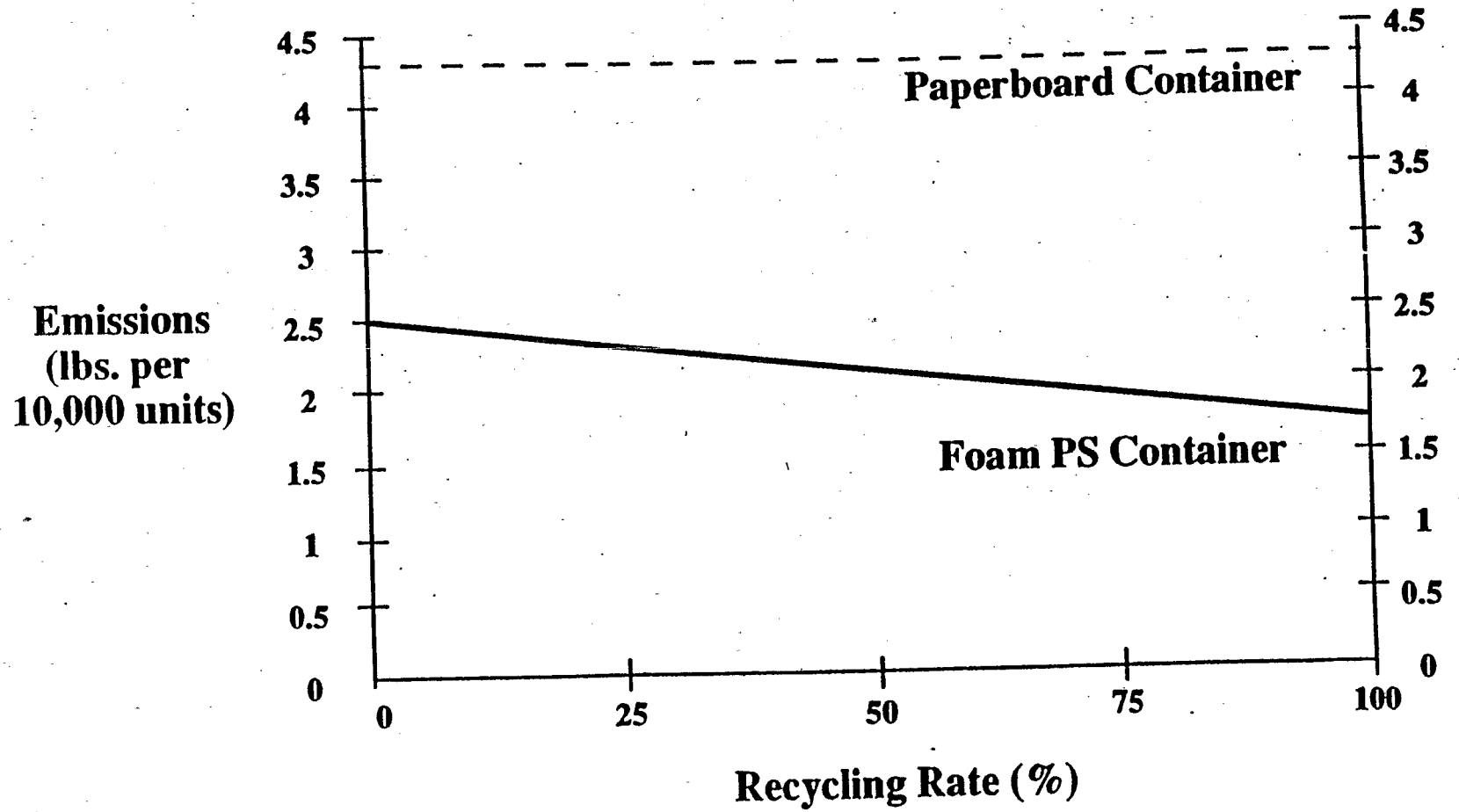


*Assumes no recycling for the paperboard hinged container.

Source: Franklin Associates, Ltd.

Appendix A-9

Waterborne Wastes of Hinged Containers At Various Recycling Rates *

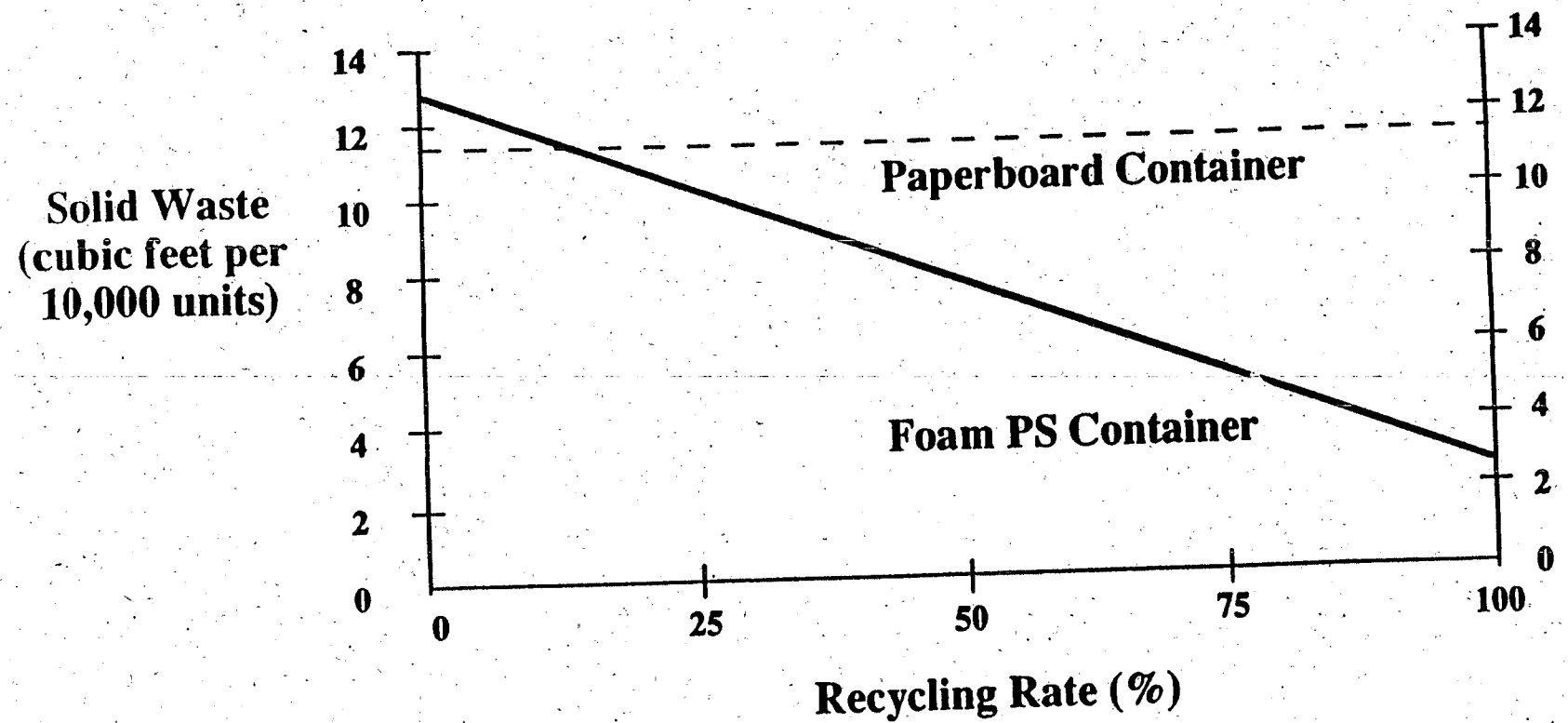


*Assumes no recycling for the paperboard hinged container.

Source: Franklin Associates, Ltd.

Appendix A-10

Sensitivity of Total Solid Waste Category for Hinged Containers At Various Recycling Rates * By Reducing the Weight of Polystyrene by 25 percent.



*Assumes no recycling for the paperboard hinged container.

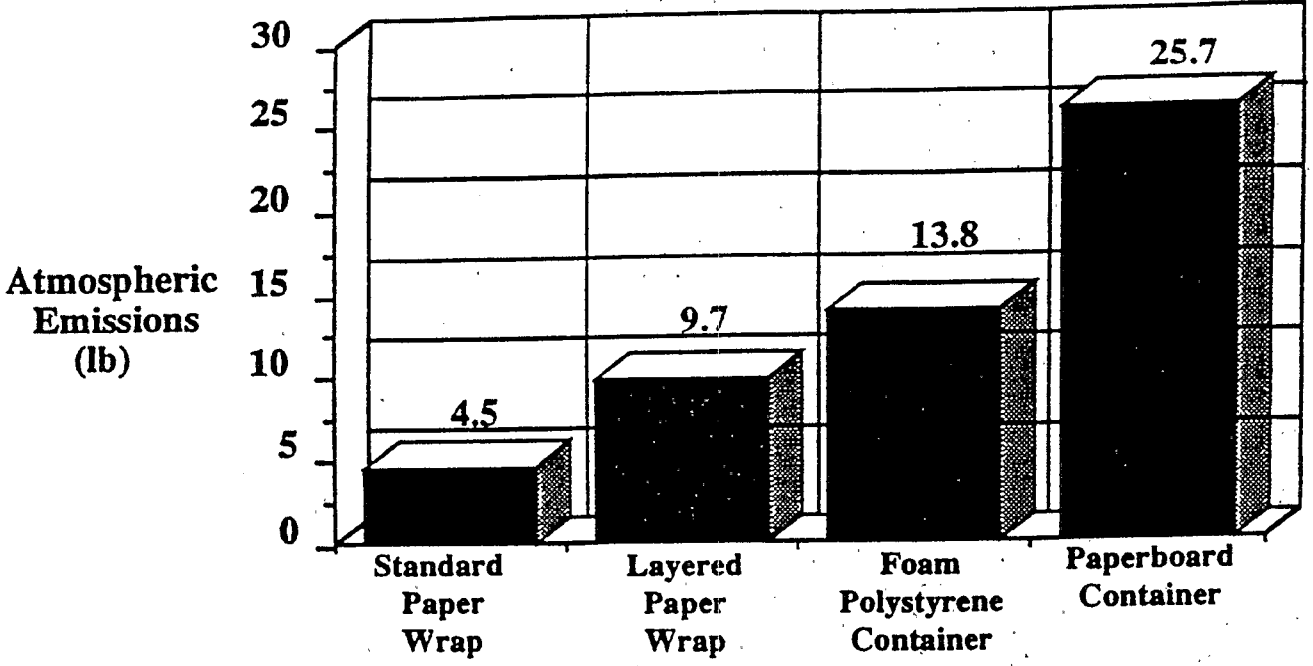
Source: Franklin Associates, Ltd.

Appendix B: Comparison of Polystyrene Foam, Paperboard, Wax-Coated Paper, and "Quilt-Wrap" Paper

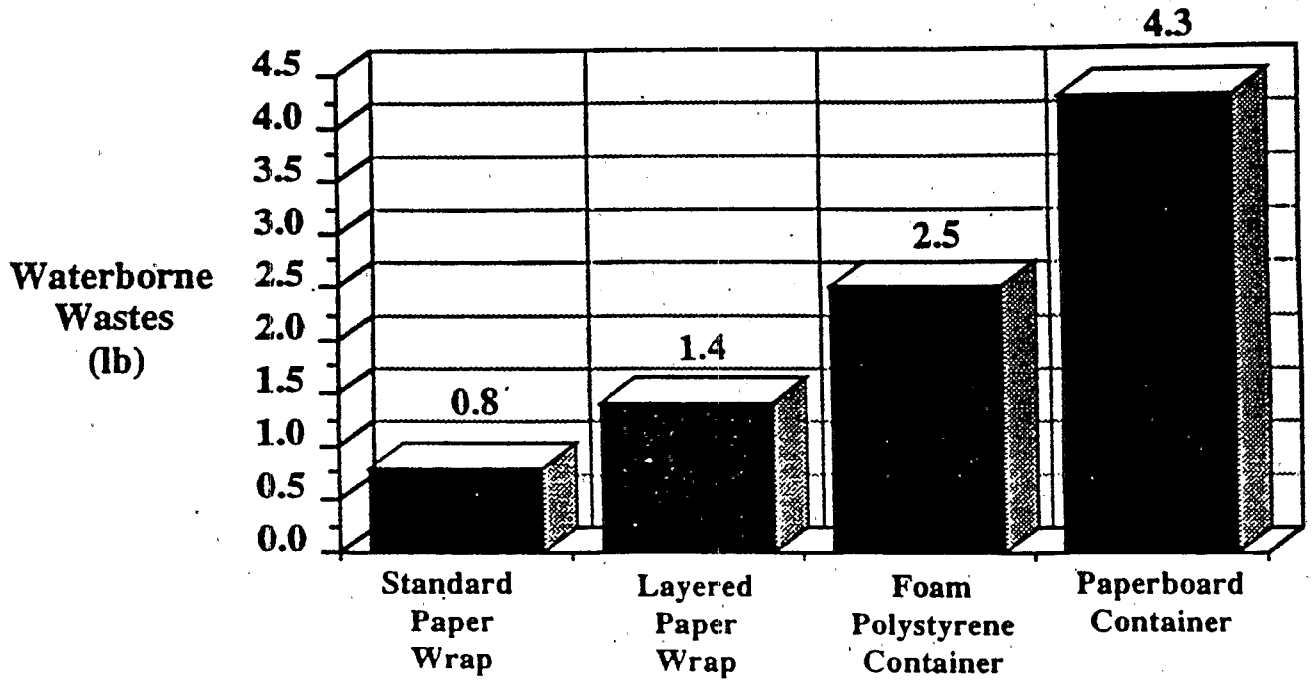
Selected data from Franklin Associates' *Summary of Life Cycle Analyses of Four Sandwich Packages.* Prairie Village, Kansas, 1991.

Appendix B-1

Atmospheric Emissions for Sandwich Packaging (per 10,000 units)



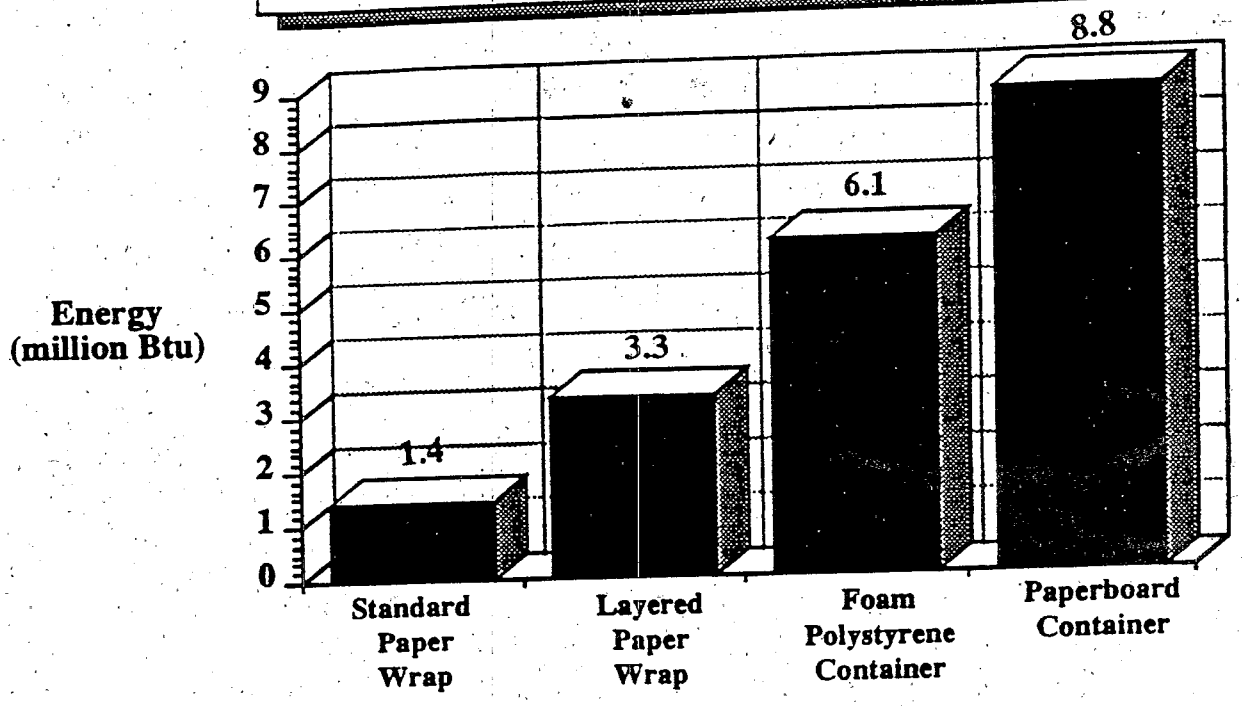
Waterborne Wastes for Sandwich Packaging (per 10,000 units)



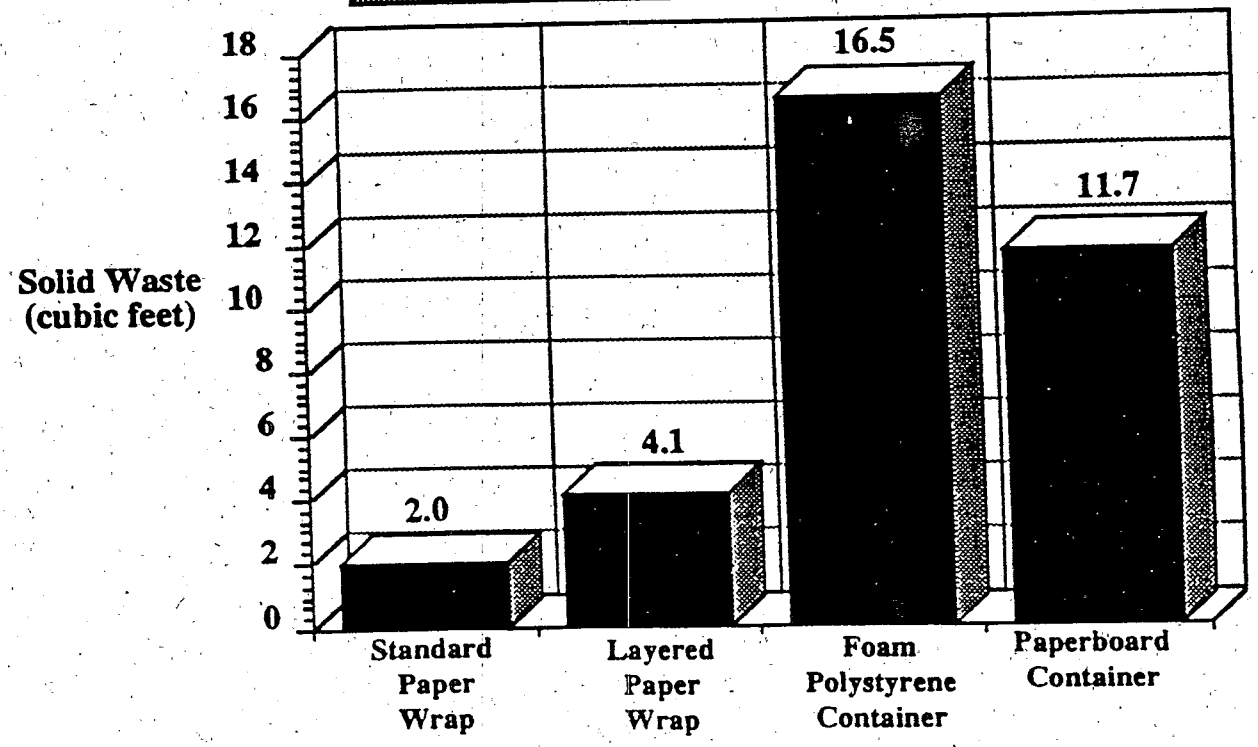
Source: Franklin Associates, Ltd.

Appendix B-2

Net Energy Requirements for Sandwich Packaging (per 10,000 units)



Total Solid Waste for Sandwich Packaging (per 10,000 units)



Source: Franklin Associates, Ltd.

APPENDIX B-3: ENERGY REQUIREMENTS AND ENVIRONMENTAL EMISSIONS FOR THE PRODUCTION, DELIVERY AND DISPOSAL OF 10,000 SANDWICH PACKAGING PRODUCTS

	Total Energy Requirement (MM Btu)	Energy Credit from Incineration* (MM Btu)	Net Energy Requirement (MM Btu)	Atmospheric Emissions (lb)	Waterborne Wastes (lb)	Total Solid Waste (lb)	Total Solid Waste (cu ft)
Standard Paper Wrap	1.5	0.1	1.4	4.5	0.8	63.7	2.0
Layered Paper Wrap	3.5	0.2	3.3	9.7	1.4	129.5	4.1
Polystyrene Foam Container	6.5	0.4	6.1	13.8	2.5	159.8	16.5
Paperboard Container	9.2	0.5	8.8	25.7	4.3	382.4	11.7
Paperboard Collar (optional; for use with either wrap)	2.7	0.1	2.5	8.3	1.4	117.1	3.5

*Based on approximately 16 percent of MSW being combusted for energy recovery and after materials recovery.

Note: All values represent conditions with no post-consumer recycling.

Source: Data summarized from studies by Franklin Associates, Ltd.

APPENDIX B-4: DATA FOR SANDWICH PACKAGING PRODUCTS

Material	Case Requirements	Weight per unit grams	Weight per unit ounces	Number per 10,000 units	Weight per 10,000 units (lbs.)
Standard Paper Wrap (10"x12")	Wrap (3,000/case)				
	Bleached Paper	1.9	0.07		41.7
	Wax/LDPE Coating	0.4	0.01		8.3
	Total	2.3	0.08	10,000.00	50.0
	LDPE(Sleeves and Shrink Film)	104.3	3.68	3.33	0.8
	Corrugated Container	453.6	16.00	3.33	3.3
Layered Paper Wrap (11.5"x13")	Wrap (2,500/case)				
	Bleached Paper	2.4	0.08		51.9
	Bleached Tissue	1.7	0.06		37.2
	LDPE Coating	0.8	0.03		17.3
	Total	4.8	0.17	10,000.00	106.4
	LDPE(Sleeves and Shrink Film)	104.3	3.68	4.00	0.9
	Corrugated Container	453.6	16.00	4.00	4.0
Polystyrene Foam Container	Containers (500/case)	5.1	0.18	10,000.00	112.3
	LDPE Sleeves* (10/50)	13.0	0.46	200.00	5.7
	Corrugated Container	998.0	35.20	20.00	44.0
Paperboard Container	Containers (900/case)				
	Bleached Paperboard	12.9	0.45		284.1
	LDPE Coating	2.0	0.07		44.1
	Total	14.9	0.52	10,000.00	328.2
	LDPE Sleeves* (6/150)	13.0	0.46	67.00	1.9
	Corrugated Container	816.5	28.80	11.00	20.0
Paperboard Collar (optional; for use with either wrap)	Collar (3,000/case)				
	Bleached Paperboard	4.3	0.15	10,000.00	94.5
	Corrugated Container	689.5	24.32	3.33	5.1
	Paperboard Divider	59.0	2.08	3.33	0.4

*An abbreviation used by the industry, with the first value representing the number of sleeves per case, and the second value representing the number of hinged containers per sleeve.

Source: Franklin Associates, Ltd.

Pollution Prevention in Corporate Strategy
NATIONAL POLLUTION PREVENTION CENTER FOR HIGHER EDUCATION

Case B2: McDonald's Decision

Susan Svoboda, Manager of the Corporate Environmental Management Program, University of Michigan, prepared this case under the guidance of Stuart Hart, Director of the Corporate Environmental Management Program and Assistant Professor of Corporate Strategy and Organizational Behavior at the Michigan Business School, as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

On November 2, 1990, McDonald's announced its decision to replace the polystyrene clamshell sandwich packaging with a paper-based "quilt-wrap" that was expected to reduce the volume of its packaging by 90 percent. Representatives also stated that the production process used to make the new wraps would result in reduction of energy consumption, air emissions, and water pollution. Burger King and Wendy's do not use polystyrene for their sandwich wraps; Burger King uses polystyrene only for coffee cups and has even begun to phase out this use.

EDF's January membership newsletter reported the news of McDonald's switch from clamshells, calling it a "major victory for environmentalists." However, it referred to the quilt-wrap replacement an "interim step." EDF scientist and task force member Richard Denison was quoted as saying, "There's no question that paper has its own environmental problems. We're looking at other changes to reduce the impacts of the switch to paper" (e.g., using recycled or unbleached paper).

The press responded with mixed reviews of the decision. The *New York Times* story covering the decision ran a headline, "Packaging and Public Image: McDonald's Fills a Big Order." The *Chicago Tribune* ran an article saying McDonald's was "a lesson in environmental progress." The *New York Times* hailed the "Greening of the Golden Arch" saying that "McDonald's is at last showing some McSense on the environment." However, Adweek's *Marketing Week* accused McDonald's of "flip-flopping" again. And the *Los Angeles Times* said, "I guess the environmentalists won't be satisfied until McDonald's slaps the burger directly onto our outstretched hand. If it is a burger, an agreement with the animal-rights movement may be next. Anyone for McTofu?"

A November 26, 1990, *Los AngelesTimes* article called for government to set standards, practices, and definitions for recycling and incineration. Commenting on the assumptions underlying the decision to phase out the clamshells, the authors said that McDonald's "found itself doing the wrong thing for the wrong reason."

As part of McDonald's polystyrene recycling test conducted in New England, McDonald's supplied refuse to an industry-sponsored recycling center that was in the process of building plants in several cities. A spokesman for the center said that McDonald's decision would not change its plans to build the plants, but added, "The chief loss is [McDonald's] as an educational resource."

In the November 5, 1990, issue of *Business Week*, Amoco Chemical, one of McDonald's polystyrene suppliers, ran a full-page advertisement saying, "Some people believe that banning plastics and substituting other materials will solve the problem. We don't think they have all the facts . . . ." It continued with the points that "Recycling is growing" and "Amoco is helping."

As a result of the efforts of the joint task force, the environmental image of McDonald's has improved. An independent study by Cambridge Reports/Research International showed consumers ranked McDonald's as the most environmentally responsible U.S. company. Environmental experts awarded McDonald's second place in the same survey. Also, McDonald's received the President's 1991 Environment and Conservation Challenge Award for environmentalism.

Published by:
The National Pollution Prevention Center for Higher Education
University of Michigan, Dana Building
430 East University Ave.
Ann Arbor, MI 48109-1115
• Phone: 313-764-1412
• Fax: 313-936-2195
• E-mail: nppc@umich.edu

The mission of the NPPC is to promote sustainable development by educating students, faculty, and professionals about pollution prevention; create educational materials; provide tools and strategies for addressing relevant environmental problems; and establish a national network of pollution prevention educators. In addition to developing educational materials and conducting research, the NPPC also offers an internship program, professional education & training, and conferences.

Your Input is Welcome!

We are very interested in your feedback on these materials. Please take a moment to offer your comments and communicate them to us. Also contact us if you wish to receive a documents list, order any of our materials, collaborate on or review NPPC resources, or be listed in our *Directory of Pollution Prevention in Higher Education.*

We're Going Online!

The NPPC provides information on its programs and educational materials through the Internet's World Wide Web; our URL is: http://www.snre.umich.edu/nppc

We may also update the NPPC information available through gopher (gopher.snre.umich.edu) and anonymous FTP (ftp.snre.umich.edu). Please contact us if you have comments about our online resources or suggestions for publicizing our educational materials through the Internet. Thank you!

Pollution Prevention in Corporate Strategy
NATIONAL POLLUTION PREVENTION CENTER FOR HIGHER EDUCATION

Case C: Sustaining McDonald's Environmental Success

Susan Svoboda, Manager of the Corporate Environmental Management Program, University of Michigan, prepared this case under the guidance of Stuart Hart, Director of the Corporate Environmental Management Program and Assistant Professor of Corporate Strategy and Organizational Behavior at the Michigan Business School, as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

By the spring of 1993, Michael Quinlan, McDonald's CEO, felt quite confident about his company's environmental performance. A partnership with the Environmental Defense Fund (EDF) had won McDonald's praise from its customers, and its efforts at waste reduction, combined with its well-publicized switch from polystyrene "clamshells" to paper-based sandwich wraps, had repositioned it as a leader in protecting the environment. However, in April 1993 another non-profit environmental group, The Beyond Beef Coalition, targeted McDonald's in a campaign to reduce beef consumption. This time the environmental complaints launched against McDonald's did not criticize ancillary aspects of their business but, rather, focused on their primary products and growth markets. Quinlan did not want this campaign to diminish the reputation the company had solidified through the EDF partnership.

McDonald's Operating Strategy

Ray Kroc, the founder of McDonald's Corporation, based his empire on the fundamental principles of Quality, Service, Cleanliness, and Value (Q.S.C.& V.). The company, which started in 1948 as a single drive-in restaurant in San Bernardino, California, grew to become the largest food-service organization in the world. By June 1993, McDonald's ran 2,576 company-owned stores, 9,451 franchises and 1,362 joint ventures in 65 countries.[1] In the U.S. alone, more than 18 million people visited a McDonald's each day.[2] See **Exhibit 1** for a summary of McDonald's financials.

McDonald's was the second-best-known global brand, maintaining this level of consumer awareness with a $1 billion marketing budget.[3] McDonald's launched a major new ad campaign in 1991, "Great Food at a Great Value," which was successful in promoting profitable value-meal combinations. This was followed in 1992 with the largest outdoor advertising campaign ever undertaken by a single brand. Messages focused on value and customer satisfaction. High brand recognition was particularly important to McDonald's as many customers are impulse purchasers, often selecting McDonald's by the convenience of the location. Approximately 28% of company revenues were derived from franchisee fees, based on a percentage of sales collected to cover the costs of corporate services such as centralized marketing research and R&D.

Approximately 70% of McDonald's restaurants were franchises. McDonald's generally entered new countries with company-owned restaurants located in the center of major cities, franchising them after they were well established. Under the conventional franchise agreement, the franchisees supply capital, equipment, signs, seating, and decor with the company buying or leasing the land and building. The initial investment ranges from $430,000 to $560,000, 60% of which may be financed. Twenty-year franchises are awarded to applicants after extensive screening, and additional restaurants are allocated to franchisees with proven records of success.

New restaurant development was important to McDonald's growth strategy. In 1991 it introduced the "Series 2000"-design restaurants, which were about

half the size of traditional restaurants but designed to accommodate nearly the same level of sales at a lower real-estate investment. This has resulted in an approximately $400,000 reduction in development costs, which lowers the facility's breakeven point. Additional locations have been opened in small towns and "satellite sites," such as outlets inside Wal-Mart stores.

A typical McDonald's restaurant may serve as many as 2,000 people a day, 60-70% of whom take food outside the restaurant. McDonald's depends on the ability of its crew to prepare hot, fresh food and to serve it to its customers within two minutes of the time they enter the restaurant. To do this, McDonald's engineering department has carefully designed the layout and equipment for its restaurants. In 1993 it reported the development of an enhanced production system that improves McDonald's ability to serve hot food quickly. This system is currently used in 80% of McDonald's U.S. restaurants for breakfast; more than half are using a more extensive system for lunch and dinner. In accordance with Q.S.C.&V., specific operating practices and careful standardization help to assure uniformity among restaurants. For example, 10 hamburgers are to be made from each pound of beef, and they are to contain no more than 19% fat.[4]

An important component of McDonald's operational strategy is to anticipate customer traffic patterns and food selection based on a detailed analysis of sales history and trends. Restaurants use this information to prepare menu items in the right quantities and at the right times to have the food ready for customers when they arrive. To ensure freshness, all food not served within 10 minutes must be discarded.

McDonald's generally does not supply food, paper, or equipment to restaurants. Instead it refers franchisees to a network of more than 600 approved suppliers with whom long-term relationships have been developed. McDonald's often holds seminars or conferences for suppliers to discuss their needs. This strategy is intended to improve McDonald's ability to focus its efforts on its core business — restaurant operations.

Product Line

In 1993, McDonald's marketing efforts focused on value meals, composed of its mainstay items: a burger, fries, and a beverage. Burgers are central to the menu; indeed, McDonald's purchases more than 1% of all beef wholesaled in the U.S.[5] Although McDonald's stated goal is to provide a "limited menu of high-quality products consistent with customer tastes," it continues to test a variety of new menu items. McDonald's feels that it address public concern regarding nutrition through a

> . . . combination of stringent product standards, strictly enforced restaurant operating procedures, and close working relationships with suppliers to assure that McDonald's food is safe and of the highest quality.[6]

It also discloses nutritional and ingredient information regarding its menu items through in-store posters and brochures distributed upon request.

In the early 1990's, international expansion into new cultures and corresponding eating habits resulted in new product introductions in several locations. For example, fried egg sandwiches were available from McDonald's in Malaysia, and spaghetti was sold as a low-price alternative in the Philippines; pizza was tested in the U.S.[7] In India, where McDonald's will spend over $20 million on a chain of restaurants over the next seven years, an important new item may be a "lamburger."[8]

McDonald's was also testing Vegetable McNuggets and Cauliflower and Cheese McNuggets in a few restaurants in the UK in 1993. Burger King has offered an increasingly popular spicy bean burger in Britain for three years. McDonald's launched vegetarian burgers in Holland in 1992.[9] The burger, consisting of potato, peas, carrots, corn, onion and spices, sold for about $2.70, slightly less than a Big Mac. McDonald's new items generally receive no advertising and little sales promotion during the test period.

Fast-Food Industry

The total fast-food market in 1992 was estimated at $81.4 billion. Although the convenience offered by fast-food retailers was valued by growing numbers of families and travelers in the early 1990's, the recession and intense competition produced slower growth and sagging profits for the industry. Particularly hard-hit were independent restaurants, which found it difficult to compete with the burger chains' value-pricing strategies and large advertising budgets. As a result, independents comprised only 56% of all U.S. restaurants in 1993, down from 63% in 1986, according to Peter Oakes, a vice-president at Merrill-Lynch.[10] In fact, restaurant

industry reports suggest that saturation in the "limited-menu" segment of the restaurant industry was forcing growth-oriented chains to expand overseas and explore alternate outlets domestically. According to the Restaurant Business Growth Index, real sales growth for this segment during 1990–91 was only 0.3% in the U.S.[11]

Customer satisfaction, nutrition, and value seemed to form the basis for domestic competition, although the fastest-growing restaurant chains pursued varied strategies. For example, Rally's advertised "We get it right or you get it free," Boston Chicken emphasized nutrition by roasting, steaming, and baking its dishes, and Checkers, a double-drive-through burger chain, offered made-to-order burgers at lower prices. Drive-through window sales industry-wide reached $25 billion in 1992.[12]

In contrast to the domestic scene, the international market for fast food was exploding. From the Pacific Rim to South America, foreign cultures were being introduced to American-style fast food. In 1993, Burger King had more than 900 restaurants in 45 countries, Kentucky Fried Chicken had 3,712 in 63 nations, and Domino's had 566 in 30 countries.[13] The Eastern European market offered relatively easy entrance, and the Brazilian fast-food market grew 40% in 1992, to more than $700 million with no signs of slowing down.[14] In Asia, Western-style quick-service restaurants were perceived by customers to be positive and trendy, according to a Hong Kong consulting food firm that said, "[They are] not perceived to be junk food."[15]

The Hamburger Segment

Domestic competition in the hamburger market continues to intensify. Consumer demand for lighter, more nutritious food has recently caused the major burger chains to expand their menu, yet a new type of double-drive-through restaurant has emerged to challenge the "traditional" burger chains. On one hand, major burger chains face tough competition from the casual dining restaurants such as Outback Steakhouse, Chili's and Friday's, in providing a range of reasonably priced menu items. On the other hand, they face the fast-growing double-drive-through restaurants that offer consumers a basic burger menu more quickly and at a lower cost. These franchises, such as Checkers and Rally's, were expected to pursue aggressive domestic growth. For example, the Pepsi-owned chain of Hot'n'Now Hamburgers had plans to expand to 5,000 locations from the 700 it had in 1992. Hamburgers or cheeseburgers ranked as the most popular menu items and still accounted for 17% of all restaurant orders in the U.S. in 1992.[16] 1992 revenue from the burger chains totaled $39.5 billion. See **Exhibit 2** for a description of the top hamburger chains.

In addition to pressure from these new entrants, price wars served to dampen profit margins among the four major chains, which, by 1993, all offered value-priced items: Wendy's offered seven 99¢ items, while Burger King introduced its combination meals in 1993, followed a month later by Hardee's value-menu program.

Burger King, the world's second-largest hamburger chain, continued to expand aggressively, adding one restaurant per day throughout 1992 while trying to increase sales in existing U.S. restaurants through dinnertime table service complimented by an expanded dinner menu. Burger King achieved a 6% increase in profitability in 1992, compared to Rally's 41% increase in earnings during the same time period.

Wendy's enjoyed a 26% increase in net income in 1992, even though 30% of its sales were derived from its Super Value Menu. Improved operational efficiency and higher-than-average new-restaurant sales produced these results. Wendy's planned a minimum of 75 new international restaurants in 1993, with targets in Mexico, the Pacific Rim, and Saudi Arabia.

Competitive pressures have forced the chains to rethink their strategies. Many now consider themselves to be in competition with any business serving or selling food, such as quick-service eating establishments, mom-and-pop's, take-outs, pizza parlors, coffee shops, street vendors, convenience food stores, delis, supermarket freezers, and microwave ovens.[17] For example, McDonald's U.S. President, Ed Rensi, said he had mapped out a program to penetrate innovative domestic venues including supermarkets, airports, hospitals, stadiums, kiosks, and carts.[18]

Still, the most significant source of future growth was clearly abroad. Even with 3,355 units in 53 countries in 1991, McDonald's had barely scratched the surface of the global market. So, to ensure that the company's long-standing history of increased sales and earnings continued, Ed Rensi accelerated the international expansion in search of a greater share of the world market. Over the next several years, McDonald's expects to add 450–600 restaurants annually overseas.[19] See **Exhibit 3** for a listing of McDonald's international locations.

The Challenge of Sustainable Development

In June 1992, the United Nations Conference on Environment and Development (UNCED) held what has come to be known as the "Earth Summit" in Rio de Janeiro. While the meeting, which included representatives from nearly every nation in the world, focused on global environmental problems such as climate change and biodiversity, a central feature of the Summit was a proposed plan (Agenda 21) for industrial nations to help poor countries develop their economies without ruining the environment — to pursue "sustainable development" on a global scale.

The U.S., for example, had only 5% of the world's population, but used 25% of the energy, emitted 22% of all carbon dioxide, and accounted for 25% of the world's GNP. India, on the other hand, had 16% of the world's population, but used only 3% of the energy, emitted 3% of the carbon dioxide, and accounted for only 1% of the world's GNP.[20] Thus, developed nations, having reaped the comforts — and environmental costs — of industrialization, wanted others to avoid their mistakes. Developing nations, on the other hand, were anxious to raise their burgeoning populations out of poverty, and did not want to pay for environmental sins they did not commit.

In 1987, the World Commission on Environment and Development defined sustainable development as economic progress that "meets the needs of the present without compromising the ability of future generations to meet their own needs."[21] Although much attention had already been given to the environmental problems related to the industrialized nations, it was the first document to clearly link third-world development issues with environmental concerns: that is, population growth and poverty in the developing world were also identified as major causes of environmental degradation. Over the next 40 years, world population was expected to double to more than 10 billion, with nearly all of this growth (95%) coming in the developing world. With world GNP at about $20 trillion, economic activity would have to increase at least 5–10 fold to provide basic amenities for this population. The World Commission and the Earth Summit stressed that this level of economic production would be environmentally destructive with current technologies and business practices.[22]

While Agenda 21 was primarily aimed at national and international governments, the Earth Summit also featured a high-profile business consortium — the Business Council for Sustainable Development — led by Swiss industrialist and multibillionaire Stephan Schmidheiny. This group of 48 CEOs of multinational corporations produced a book, *Changing Course*, that emphasized that "while industry may be a big part of the problem, it must also be a big part of the solution."[23] Since the late 1980's, several other business groups aimed at altering corporate behavior consistent with the principles of sustainable development have formed, including the Global Environmental Management Initiative (GEMI), the Coalition for Environmentally Responsible Economies (CERES), and Businesses for Social Responsibility (BSR).

Beef and the Environment

In 1993, the beef industry was a $40-billion global business, comprising approximately 1.3 billion cattle occupying nearly one-quarter of the world's landmass. According to U.S. Department of Agriculture data in 1990, nearly 40% of the world's (70% of U.S.'s) grain was fed to livestock.[24] Half of the continental United States was used by the livestock industry for crops, pasture, and range. Approximately 260 million acres of arid public range in 11 western states were leased by the government to ranchers for grazing. Federal grazing fees averaged about $2 per month per head, whereas private-market grazing fees were closer to $9. Overgrazing of public land had resulted in significant soil loss and desertification. In 1990, the U.S. Bureau of Land Management reported that 70% of its holdings were in unacceptable condition, with 10% having degraded to desert conditions. Overgrazing of the range forces cattle to feed on the remaining vegetation along streambanks, resulting in floods that carry away soil and accelerate the decline of the land.

Globally, extensive overgrazing is leading to a steady decline in per-capita beef production. If feedlots are used to supplement beef production, grain harvests will need to grow by seven million tons annually, roughly two-thirds of the historical annual increase in the world grain harvest. However, there is little new fertile land to be farmed, and many existing farmers are already using advanced yield-raising technologies, reducing the likelihood that the gain will be achieved through increased productivity. If population grows as projected at 90 million people annually, and grain output does not increase over current levels, per-capita supplies of grain will continue to diminish by two percent annually.[25]

In 1993, the U.S. imported only five percent of its beef from Central America. However, since 1960 more than 25 percent of the forests in Central America have been cleared to create pastureland for cattle.[26] It has been estimated that each rain-forest hamburger requires the clearing of six square yards for pasture.[27] Such a swath would typically include one large tree, 50 saplings of 20–30 species, thousands of insects comprising hundreds of species, and an unknown diversity of mosses, fungi, and microorganisms.[28] Clearing the same piece of rain forest would release 165 pounds of carbon dioxide into the atmosphere — the amount released by a typical American car in a 20-day period.[29]

It is estimated that between 1966 and 1983, 15,000 square miles of Amazon rain forest were cleared for large-scale cattle production.[30] A United Nations report predicted that if deforestation of the Amazon continued at its 1987 rate until the year 2000, more than 15% of the plant species and an unknown but significant percentage of insect species would be lost.[31] The clearing of land for large-scale cattle production has also forced millions of rural peasants to the already overcrowded cities of Latin America. Worldwide, deforestation accounts for nearly one-third of all greenhouse-gas emissions, with the burning of fossil fuels accounting for the other two-thirds.[32] See **Exhibit 6** for more information on beef production in various countries.

The efficiency with which grain and feed is converted to meat varies greatly by animal. For example, in order to produce one pound of meat, chickens must consume 4.5 pounds of grain, pigs must consume 6.5 pounds, and cattle must consume 15.5 pounds.[33]

Large quantities of energy and water are also used to grow the grain required to feed livestock. Almost half of the energy used in American agriculture goes into livestock production, the majority of it for meat production. In fact, according to Cornell University data, the amount of energy used to produce one pound of beef is equivalent to .25 gallons of gasoline. In addition, according to an animal science expert at the University of California-Davis, half of the grain and hay fed to U.S. livestock grows on irrigated land. Each pound of grain-fed beef requires about 2,500 gallons of water. For the typical American, this is about 190 gallons/person/day — twice the amount used at home each day for all purposes.[34] See **Exhibit 4** for more information regarding water usage. In California, livestock production takes nearly one-third of all irrigation water used.

Pesticides and fertilizers used in grain production also place a burden on the environment, since much of the grain treated is fed to cattle. 1993 pesticide sales for corn, rice, cotton, soybeans, and wheat surpassed $21 billion globally. In 1993, 8.2 million tons of fertilizer were used in the production of corn, 1 million tons for soybeans, and 3 million tons for wheat. Pesticides and fertilizers used in grain production appeared to contaminate surface and ground water. Lumping together animal wastes and feed fertilizers, livestock production accounted for about 40% of the nitrogen and 35% percent of the phosphorus released into U.S. rivers, lakes, and streams.[35] Cattle and other ruminants also emit methane, a potent greenhouse gas, as they digest grass and other fibrous plants. Indeed, each head of cattle belches out about a third of a pound of methane for every pound of beef it yields.[36] See **Exhibit 5** for information regarding sources of methane.

While per-capita beef consumption in the U.S. has declined since 1976, the average American still eats 65 pounds of beef per year — 23% of all the beef produced in the world.[37] Only about 12.4 million Americans describe themselves as vegetarians, according to a 1992 survey by *Vegetarian Times*.[38] For most of the world, however, a low-meat diet is the norm. Worldwide, only about one in four people eat a meat-centered diet. Historically, as income rises, so does meat consumption. For example, per-capita consumption of red meat in Japan has doubled since 1975. Koreans and Taiwanese appear to be following a similar pattern. See **Exhibit 7** for information regarding per-capita beef consumption of several countries. To support the world's current population of 5.3 billion on an American-style diet would require as much energy as the world now uses for all purposes, along with 2.5 times as much grain as the world's farmers currently produce.[39]

Where's the Beef?

The Beyond Beef Coalition saw the spread of the "cattle culture" to the developing world as one of the greatest threats to the global environment. The Coalition was comprised of individuals and organizations interested in environmental protection, animal rights, public health, and world hunger (see **Exhibit 8** for a list of members). Like the Environmental Defense Fund, this group targeted McDonald's for its campaign because it was the industry leader, and one of the largest users of beef in the world.

The Coalition's goals were: to reduce individual beef consumption in the U.S. by at least 50%; to replace beef in the diet with organically raised grains, legumes, vegetables and fruits; to reform current cattle-industry practices; and to promote humanely and organically raised beef as an alternative for those who continue to include some beef in their diet.[40]

The goal for the McDonald's campaign was to inform at least 1 million McDonald's customers about beef's harmful impact of on the environment through an extensive in-person campaign at 1,000 locations across the country. On April 17, 1993, thousands of Beyond Beef volunteers gathered outside McDonald's restaurants to hand out leaflets and children's literature and to inform customers about the "real" social and environmental costs associated with beef. See **Exhibit 9** for a sample of campaign literature. They also collected names on petitions in an effort to encourage individuals to reduce their beef consumption by 50%, to encourage McDonald's to add a vegetarian item to their U.S. menu, and to commit 25% of advertising to the new item.

Reactions to the campaign were varied. "There's nothing wrong with eating beef— it's American" said one customer regarding the campaign.[41] However, another approached by a Beyond Beef campaigner said, "If McDonald's had it [a meatless burger], I would try it in a second."[42] Dave Santoro, a franchise owner, said, "If enough customers wanted it, we'd have it . . . We have salads, cereals, hotcakes. We didn't just dream those up. The consumers asked for them."[43]

Kim Poston, marketing manager for McDonald's in San Jose, said that the Beyond Beef campaign was "an assault on small business " and that Beyond Beef is a "fringe activist group that doesn't really reflect what our customers want."[44] McDonald's spokesperson Ann Connolly added, "Ultimately, it's our customers who decide what we serve, and our customers tell us they're not interested in that kind of a product."[45] Howard Lyman, former cattle rancher and current Executive Director of Beyond Beef, responded: "It's the same mentality as General Motors that said there's no market for small cars. Large corporations can't see the future because the present is so good for them."[46]

END NOTES:

[1] "Making Up for Lost Time." *Fortune*, Oct. 18, 1993; and *1993 Annual Report*, p. 3.

[2] EDF Task Force Final Report, p. 22.

[3] *McDonald's 1991 Annual Report*, p. S4.

[4] Rifkin, J. *Beyond Beef*, p. 269.

[5] Ibid., p. 267.

[6] *McDonald's 1993 Annual Report*, p. 5.

[7] "When Worlds Collide." *Restaurant Business*, July 1, 1993, p. 56.

[8] "Silver Lining, Golden Arches." *The Economist*, February 13, 1993, p. 41.

[9] "McDonald's Tests Vegetable McNuggets." *Marketing*, July 29, 1993. p. 5.

[10] "The Hunger Pangs Let Up a Little." *Business Week*, January 11, 1993, p.97.

[11] "25th Annual Growth Index: Limited Menu—Flat as a (Beef) Patty. *Restaurant Business*, September 20, 1992.

[12] Can Lightning Strike Twice?" *Restaurant Business*, Aug. 10, 1993.

[13] "When Worlds Collide." *Restaurant Business*, July 1, 1993.

[14] "Fast-food franchises fight for Brazilian aficionados." *Brandweek*, June 7, 1993.

[15] "Hot Wings Take Off." *Forbes*, January 18,1993, p. 74.

[16] "Hamburger Market Segment Report." *Restaurant Business*, January 1, 1992.

[17] *McDonald's 1993 Annual Report*, p. 7.

[18] "McDonald's Steps Up Overseas Push." *Restaurants and Institutions*, August 15, 1993, p.14.

[19] *McDonald's 1993 Annual Report*, p. 2.

[20] "Summit to Save the Earth." *Time*, June 1, 1992, p. 42-43.

[21] Schmidheiny, Stephan. *Changing Course*, p. 6.

[22] MacNeill, Jim. "Strategies for Sustainable Economic Development." *Scientific American*, September, 1989.

[23] "Business has Message for Rio Meeting." *New York Times*, June 2, 1992.

[24] Durning, Alan. "Fat of the Land." *World Watch*, 1991, p.11.

[25] *State of the World—1994*, Worldwatch Institute Report, pp. 181, 182, and 186.

[26] "A Reporter at Large: The Rain Forests." *New Yorker*, January 14, 1985, p. 79.

[27] Rifkin, p. 192.

[28] Durning, p. 15.

[29] Brown, Sandra, (University of Illinois forestry professor), cited in Durning, p. 15.

[30] Parsons, James. "The Whole Earth Review," Spring, 1988.

[31] *Our Common Future*, Oxford University Press, 1987.

[32] Steven Schneider. "The Changing Climate." *Scientific American*, September 1989.

[33] USDA Economic Research Service, 1994.

[34] Water Education Foundation.

[35] Durning, p. 16.

[36] Ibid.

[37] "Beyond Beef." *Utne Reader*, March/April 1992

[38] "For Folks Who Don't Care Where's the Beef," *The New York Times*, Dec. 9,1992

[39] Durning, p. 17.

[40] Beyond Beef campaign literature, Spring 1993, Vol.II, Issue I.

[41] "Activists to McDonald's: Where's the Beef Alternative?" *Reno Gazette-Journal*, April 18, 1993.

[42] " A Veggie Protest at Fast-Food Chain." *The Honolulu Advertiser*, April 18, 1993.

[43] " What's their beef? Gas." *Burlington County Times*, April 18, 1993.

[44] "Anti-Beef Group Lobbies McDonald's," *Santa Cruz Sentinel*, April 18, 1993, and "Area Protesters Have a Beef with McDonald's," *Times-Standard*, April 17, 1993.

[45] "Here's His Beef." *Chicago Tribune*, April 15, 1993.

[46] Ibid.

Published by:
The National Pollution Prevention Center for Higher Education
University of Michigan, Dana Building
430 East University Ave.
Ann Arbor, MI 48109-1115
- Phone: 313-764-1412
- Fax: 313-936-2195
- E-mail: nppc@umich.edu

The mission of the NPPC is to promote sustainable development by educating students, faculty, and professionals about pollution prevention; create educational materials; provide tools and strategies for addressing relevant environmental problems; and establish a national network of pollution prevention educators. In addition to developing educational materials and conducting research, the NPPC also offers an internship program, professional education & training, and conferences.

Your Input is Welcome!
We are very interested in your feedback on these materials. Please take a moment to offer your comments and communicate them to us. Also contact us if you wish to receive a documents list, order any of our materials, collaborate on or review NPPC resources, or be listed in our *Directory of Pollution Prevention in Higher Education.*

We're Going Online!
The NPPC provides information on its programs and educational materials through the Internet's World Wide Web; our URL is: http://www.snre.umich.edu/nppc

We may also update the NPPC information available through gopher (gopher.snre.umich.edu) and anonymous FTP (ftp.snre.umich.edu). Please contact us if you have comments about our online resources or suggestions for publicizing our educational materials through the Internet. Thank you!

EXHIBIT 1: 11-YEAR SUMMARY

(Dollars rounded to millions, except per common share data and average restaurant sales)

	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981
System-wide sales	$19,928	$18,759	$17,333	$16,064	$14,330	$12,432	$11,001	$10,007	$8,687	$7,809	$7,129
U.S.	12,519	12,252	12,012	11,380	10,576	9,534	8,843	8,071	7,069	6,362	5,770
Outside U.S.	7,409	6,507	5,321	4,684	3,754	2,898	2,158	1,936	1,618	1,447	1,359
System-wide sales by type											
Operated by franchisees	12,959	12,017	11,219	10,424	9,452	8,422	7,612	6,914	5,929	5,239	4,788
Operated by the Company	4,908	5,019	4,601	4,196	3,667	3,106	2,770	2,538	2,297	2,095	1,916
Operated by affiliates	2,061	1,723	1,513	1,444	1,211	904	619	555	461	475	425
Average sales, restaurants open at least 1 yr. (in 1,000s)	1,658	1,649	1,621	1,596	1,502	1,369	1,296	1,264	1,169	1,132	1,113
Revenues, frnchsd. rstrnts.	1,787	1,621	1,465	1,325	1,186	1,037	924	828	704	620	561
Total revenues	6,695	6,640	6,066	5,521	4,853	4,143	3,694	3,366	3,001	2,715	2,477
Operating income	1,679	1,596	1,438	1,288	1,160	983	905	812	713	613	552
Inc. before prov. for inc. taxes	1,299	1,246	1,157	1,046	959	848	782	707	628	546	482
Net income	860	802	727	646	549*	480	433	389	343	301	265
Cash provided by operations	1,423	1,301	1,246	1,177	1,051	852	813	701	618	505	434
Financial position at year-end											
Net property and equipment	9,559	9,047	7,758	6,800	5,820	4,878	4,164	3,521	3,183	2,765	2,497
Total assets	11,349	10,668	9,175	8,159	6,982	5,969	5,043	4,230	3,727	3,263	2,899
Long-term debt	4,267	4,429	3,902	3,111	2,685	2,131	1,638	1,268	1,171	1,056	926
Total shareholder equity	4,835	4,182	3,550	3,413	2,917	2,506	2,245	2,009	1,755	1,529	1,371
Per common share											
Net income	$ 2.35	$ 2.20	$ 1.95	$ 1.71	$ 1.45*	$ 1.24	$ 1.11	$ .97	$ .85	$ .74	$ .65
Dividends declared	.36	.33	.30	.27	.24	.21	.20	.17	.14	.12	.09
Year-end shareholder equity	13.48	11.65	9.81	9.09	7.72	6.45	5.67	4.94	4.38	3.78	3.37
Market price at year-end	38	29 1/8	34 1/2	24 1/8	22	20 1/4	18	11 1/2	10 1/2	9	6 1/2
System-wide restaurants at year-end	$12,418	$11,803	$11,162	$10,513	$9,911	$9,410	$8,901	$8,304	$7,778	$7,259	$6,739
Operated by franchisees	8,735	8,131	7,573	7,110	6,760	6,406	6,150	5,724	5,371	4,911	4,580
Operated by the Company	2,547	2,643	2,691	2,600	2,399	2,301	2,165	2,053	1,949	1,846	1,746
Operated by affiliates	1,136	1,029	898	803	752	703	586	527	458	502	413
Systemwide restaurants at year-end:											
U.S.	8,764	8,576	8,270	7,907	7,567	7,272	6,972	6,595	6,251	5,918	5,554
Outside U.S.	3,654	3,227	2,892	2,606	2,344	2,138	1,929	1,709	1,527	1,341	1,185
Number of countries at year-end	59	53	51	50	47	46	42	36	32	31	30

*Before the cumulative prior years' benefit from the change in accounting for income taxes.

EXHIBIT 2: TOP 10 HAMBURGER CHAINS

Rank	Chain	U.S. Sales ($000)	U.S. Units
1	McDonald's	12,519,400	8,764
2	Burger King	5,330,000	5,557
3	Hardee's/Roy Rodgers	3,580,000	3,954
4	Wendy's	2,940,000	3,414
5	Jack-in-the-Box	977,000	1,094
6	Carl's Jr.	629,000	210
7	Sonic Drive-Ins	518,765	1,112
8	Whataburger	338,000	446
9	White Castle	302,549	257
10	Rally's	221,100	333

Source: 1992 Technomic Top 100

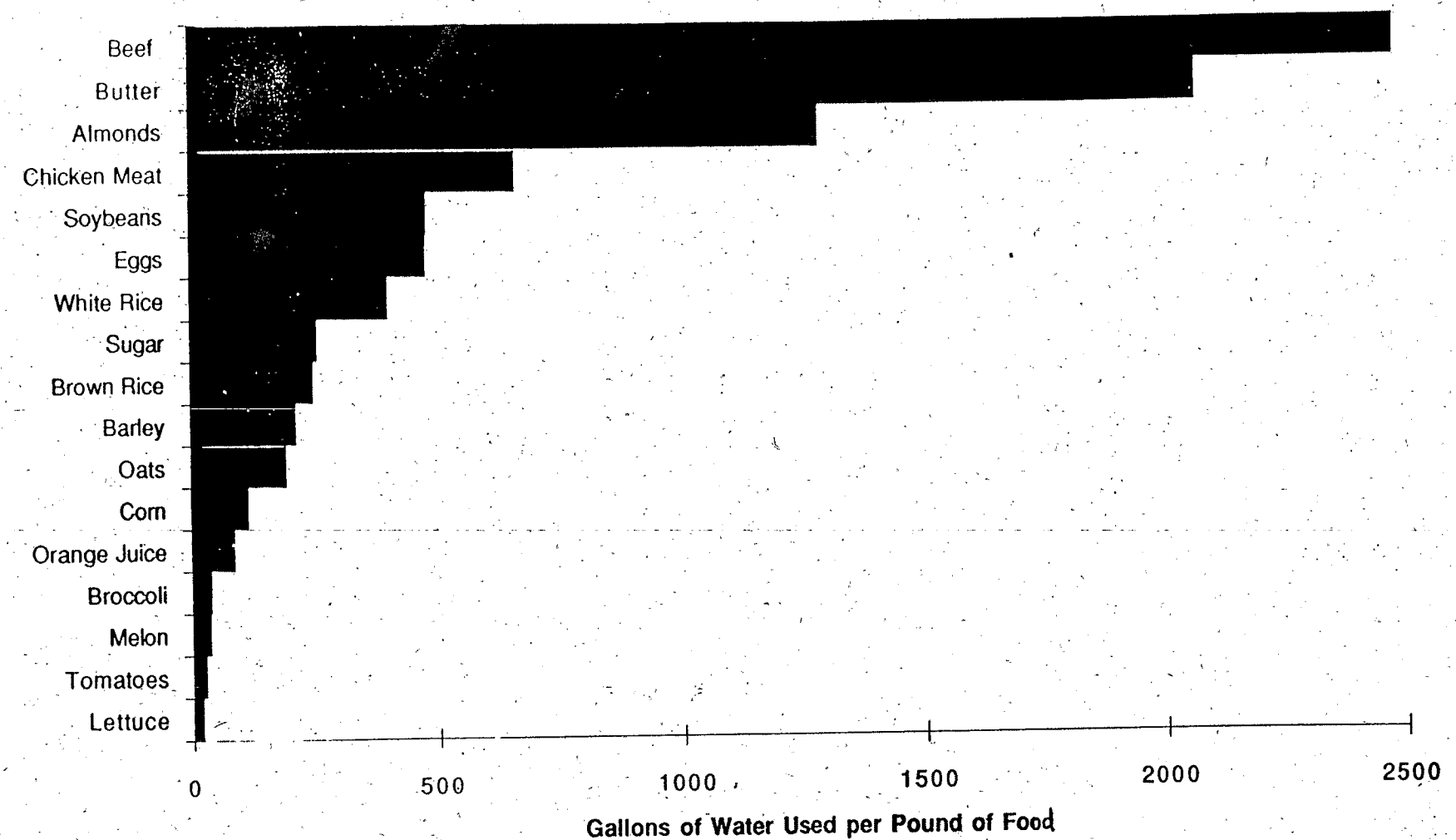
EXHIBIT 3: SYSTEM RESTAURANTS

	1992	1987
United States	8,959	7,567
Australia	338	204
Brunei	1	0
China	4	3
Guam	4	3
Hong Kong	62	36
Indonesia	5	0
Japan	956	604
Macao	3	1
Malaysia	31	15
New Zealand	61	28
Philippines	47	13
Singapore	44	23
South Korea	15	0
Taiwan	67	22
Thailand	16	2
Total Pacific	1,653	951
Andorra	1	1
Austria	35	20
Belgium	16	9
Czech Republic	3	0
Denmark	21	7
England	429	255
Finland	14	4
France	239	61
Germany	438	262
Greece	2	0
Hungary	10	0
Ireland	16	8
Italy	16	4
Luxembourg	2	2
Monaco	1	0
Morocco	1	0
Netherlands	83	43
Norway	10	2
Poland	3	0
Portugal	4	0
Russia	1	0
Scotland	24	1
Spain	50	25
Sweden	59	29
Switzerland	32	14
Turkey	14	2
Wales	15	6
Yugoslavia	6	0
Total Europe/Africa	1,549	755

	1992	1987
Canada	658	539
Argentina	18	3
Aruba	1	1
Bahamas	4	3
Bermuda	1	1
Brazil	107	37
Chile	3	0
Costa Rica	8	4
Cuba	1	1
El Salvador	3	2
Guadeloupe	1	0
Guatemala	6	3
Martinique	1	0
Mexico	56	5
Netherlands Antilles	3	3
Panama	10	8
Puerto Rico	40	22
Uruguay	2	0
Venezuela	6	3
Virgin Islands	3	3
Total Latin America	274	99
Outside of the U.S.	**4,134**	**2,344**
Systemwide Restaurants	**13,093**	**9,911**

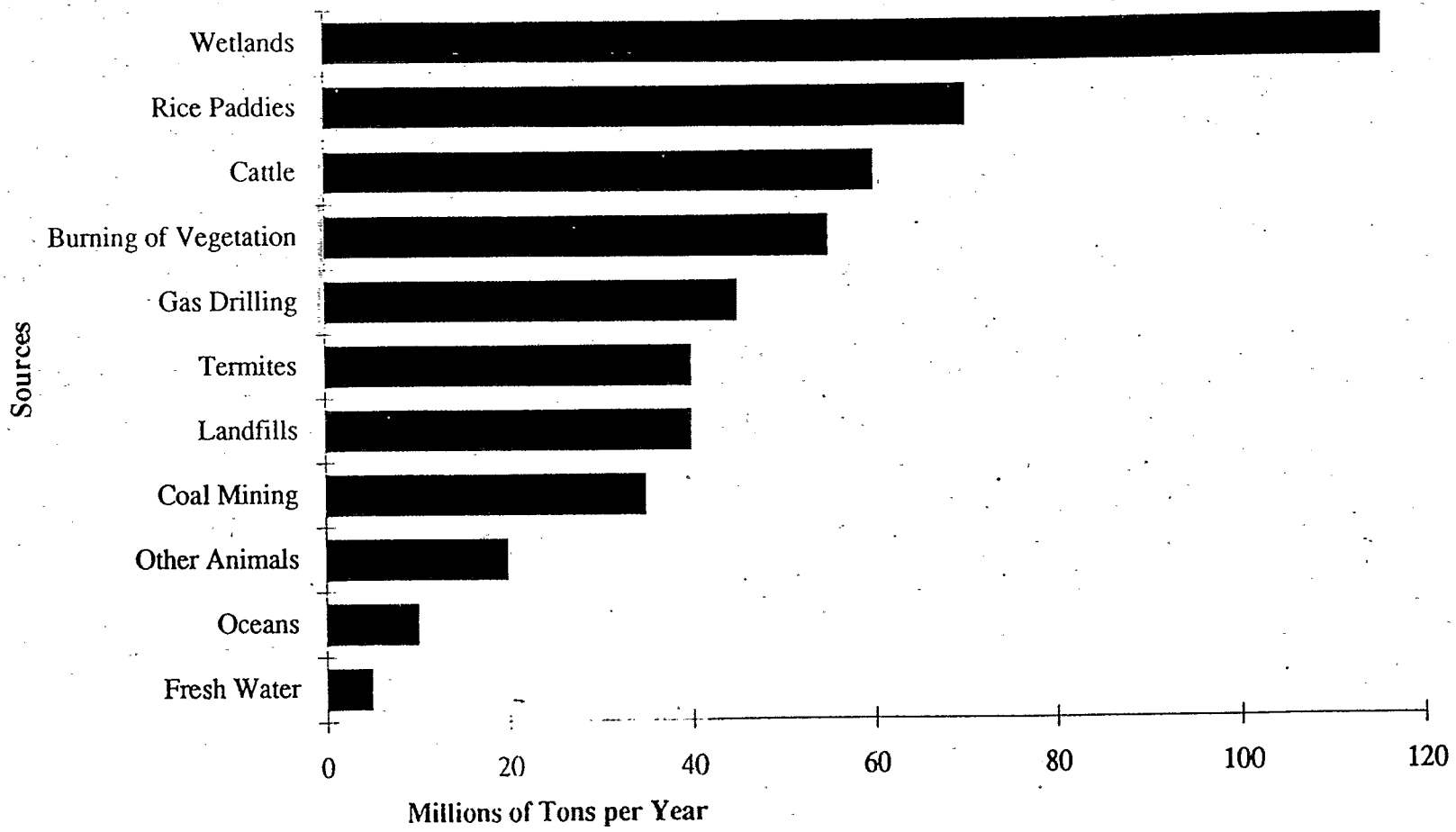
Source: McDonald's Annual Report, 1992, 1987.

EXHIBIT 4 - WATER USED IN PRODUCTION



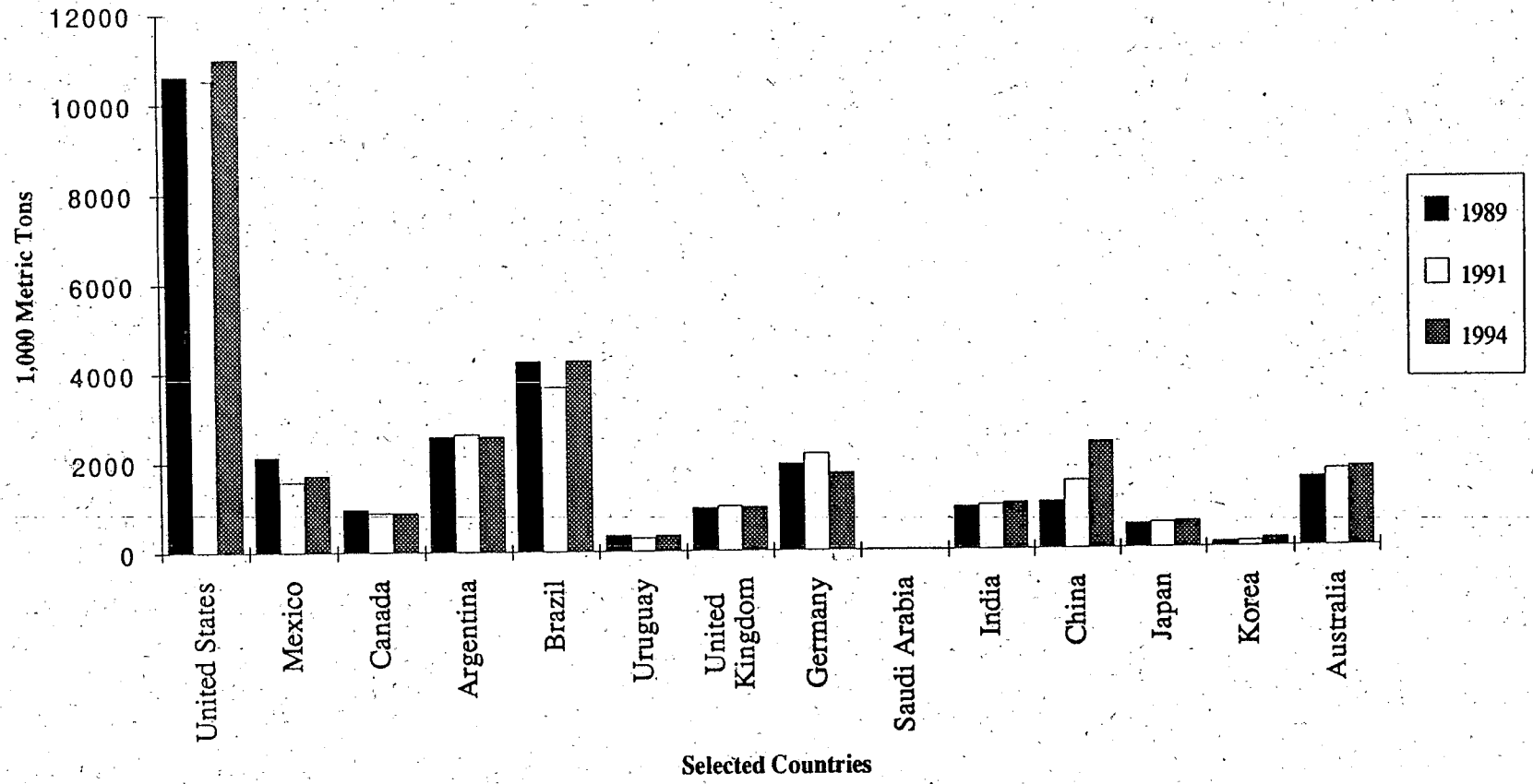
Source: Water Education Foundation

EXHIBIT 5 - SOURCES OF METHANE



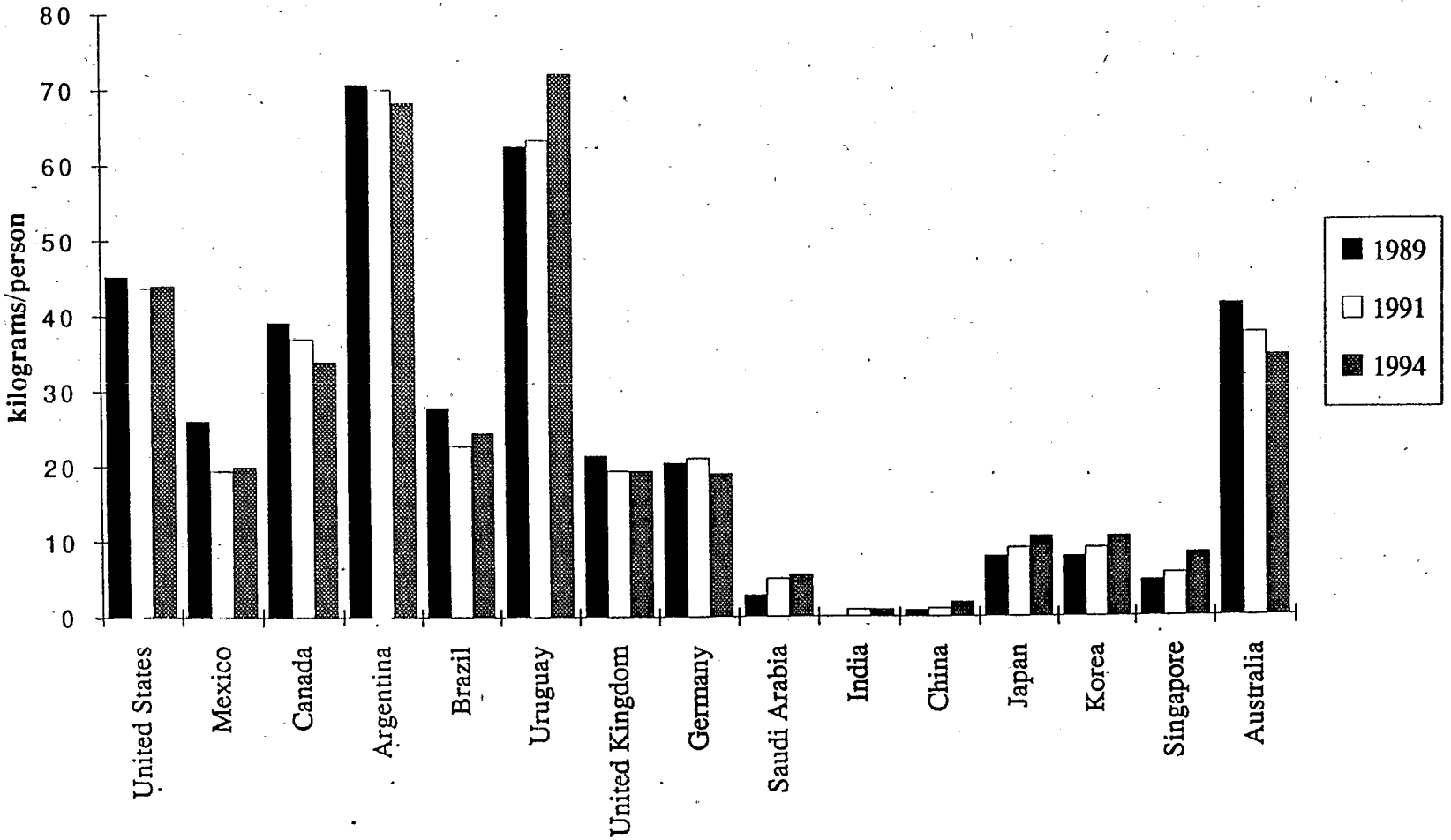
SOURCE: Cicerone Oremland, Biogeochemical Aspects of Atmospheric Methane

EXHIBIT 6 - BEEF PRODUCTION



Source: U.S. Department of Agriculture, Livestock: World Markets and Trade, March 1994

EXHIBIT 7 - PER CAPITA BEEF CONSUMPTION



Source: U.S. Department of Agriculture, Livestock: World Markets and Trade, March 1994

EXHIBIT 8

BEYOND BEEF COALITION

MEMBERSHIP - U.S.A.

Animal Welfare Institute
Earth Island Action Group
EarthKind
EarthSave
Food First/The Institute for Food and Development Policy
Farm Sanctuary
Free Our Public Lands
The Fund for Animals
Greenhouse Crisis Foundation
Greenpeace
International Rivers Network
The National Coalition Against the Misuse of Pesticides
Peoples Medical Society
Physicians for Responsible Medicine
Public Citizen
Public Lands Action Network
Rest the West
United Poultry Concerns

International Membership

Africa Rainforest Network/Kenya
Alternative Konsumenten Bond/Netherlands
Beyond Beef/Australia
Compassion in World Farming/England
De Kleine Aarde/Netherlands
Die Verbraucher/Germany
Earthwatch/Ireland
Erklarung Von Bern/Switzerland
Green Power/Hong Kong
Jungle Source/Mexico
KAG/Switzerland
Lega Per L'Ambiente/Italy
Milieudefensie/Netherlands
Network for Safe andSecure Food and Environment/Japan
NOAH/Denmark
Parents for Safe Food/England
Platform Biologische Landbouw & Voeding/Netherlands
Rainforest Information Centre/Australia
Research Foundation for Science, Technology, and Natural Resource Policy/India
Sahabat Alam Malaysia/Malaysia
Solidaridad/Netherlands
Tanzania Environmental Society/Tanzania
Uniao Protetora do Ambiente/Brazil
The Vegetarian Society/England
Vereniging Milieudefensie/Netherlands
Vereniging Voor Ekologische/Belgium
Walhi/Indonesia

THE REAL COST OF A HAMBURGER

Whether they're from McDonald's, Wendy's, Burger King or any other fast-food restaurant, hamburgers are no bargain. The next time you think about eating a hamburger, think about the real cost of eating beef.

World Hunger—At a time when nearly a billion people suffer from chronic hunger, more than one-third of all the grain grown in the world is fed to cattle and other livestock. That's enough to give every child, woman and man a meal a day.

Polluting and Depleting our Water—Cattle produce a billion tons of organic waste each year. Waste from livestock, and the pesticides and fertilizers used to grow feed, are the number one non-point source of water pollution in the U.S. Almost half the water used in the U.S. each year goes to grow feed and provide drinking water for cattle and other livestock. It takes 29 gallons of water to produce a pound of tomatoes; 139 gallons to produce a pound of bread; but 2,464 gallons to produce a pound of beef.

Animal Suffering—Each and every day, 100,000 cattle are slaughtered in the U.S. Their deaths are cruel and horrible—shocked with electric prods, beaten and kicked, shot with a stun-gun, hung by their feet, their throats cut.

Global Warming—Cattle are a major source of greenhouse gases. Tens of millions of tons of methane are released into the atmosphere by the world's 1.3 billion cattle. In addition, hundreds of millions of tons of CO_2 are released by burning forests to create cow pastures.

Destroying the Rain Forest—Cattle ranching is a primary cause of rain forest destruction in Central and South America. Since 1960, more than 25 percent of the forests of Central America have been cleared to create pasture land for grazing cattle. While some fast-food chains claim they no longer use Central American beef, for every quarter pound hamburger still being exported from this region, 55 square feet of rain forest is destroyed.

Creating Deserts—Cattle are major contributors to soil loss and destruction. As much as 85 percent of U.S. western rangeland, nearly 685 million acres, is being degraded by overgrazing and other problems. The U.S. has already lost a third of its topsoil; more than 80 percent of this erosion is directly attributed to grazing and unsustainable methods of producing feed crops for cattle and other livestock.

Human Health—Seventy percent of U.S. deaths are related to diet, particularly the overconsumption of beef and saturated animal fats. Red meat is directly linked to heart disease, strokes, and cancer of the colon and breast.

Children's Rights—Children, as well as adults, have a basic right to know the true facts about nutrition, health, and the social and environmental consequences of what they buy and consume. McDonald's and other fast-food giants have long targeted children with an advertising message that is both one-sided and misleading.

*How does all this add up when you buy a hamburger at your local fast-food restaurant?.....**read on...***

THE McDONALD's IMPACT

No single commercial entity has been more responsible for encouraging beef consumption in America than McDonald's.

More than 8,500 McDonald's restaurants in America—and thousands more around the world—proudly advertise more than 85 billion hamburgers sold. What's the real cost of 85 billion hamburgers? For starters:

- tens of millions of cows slaughtered;
- trillions of gallons of water used to grow their feed;
- millions of tons of methane, a greenhouse gas, released;
- millions of acres of public land eroded and destroyed;
- enough grain fed to cows to provide millions of hungry families with a daily meal.

Most McDonald's patrons are unaware of how their individual decisions as consumers add up to create such a devastating global impact.

But this April and May, through the **Adopt-A-McDonald's** Campaign—at more than 1,000 McDonald's outlets across the nation—more than 1,000,000 customers will get the facts about the real cost of buying a fast-food burger.

*To learn more about the campaign,.....**read on...***

HOW YOU CAN ADOPT-A-McDONALD's

BEYOND BEEF is helping to organize more than 1,000 **Adopt-A-McDonald's** teams. Each team of four or more people will be responsible for adopting at least one McDonald's restaurant in their community, and speaking with at least 1,000 McDonald's patrons as they enter or leave the restaurant.

Beginning April 17, each team will provide customers with leaflets, educational materials, and a children's coloring book. They'll hold press conferences and carry placards. They'll focus the attention of the country on the real environmental, health, and animal suffering costs of eating hamburgers.

If you want to join the *BEYOND BEEF* team and **Adopt-A-McDonald's** this spring, fill out the coupon, below.

■ **YES!**

I want to **Adopt-A-McDonald's.**
Get in touch with me immediately.

Name *(Please Print)*_____

Street _____

City _____ State _____ Zip _____

Phone _____

Return coupon to: Beyond Beef, 1130 Seventeenth Street, NW, Suite 300, Washington, D.C. 20036. Phone: (202) 775-1132 Fax: (202) 775-0074

Pollution Prevention in Corporate Strategy
NATIONAL POLLUTION PREVENTION CENTER FOR HIGHER EDUCATION

Note on Life Cycle Analysis

Prepared by Susan Svoboda, manager of the University of Michigan Corporate Environmental Management Program (CEMP). This document may be used by either students or faculty for background information.

As corporations seek to improve their environmental performance, they require new methods and tools. Life cycle analysis (LCA) is one such tool that can help companies to understand the environmental impacts associated with their products, processes, and activities. LCA is controversial and still evolving as a methodology. However, the principles behind LCA thinking are being adopted rapidly by manufacturers and service organizations alike as a way of opening new perspectives and expanding the debate over environmentally sound products and processes. The goal of LCA is not to arrive at *the* answer but, rather, to provide important inputs to a broader strategic planning process.

The Origin of LCA

LCA has its roots in the 1960s, when scientists concerned about the rapid depletion of fossil fuels developed it as an approach to understanding the impacts of energy consumption. A few years later, global-modeling studies predicted the effects of the world's changing population on the demand for finite raw materials and energy resource supplies.[1] The predictions of rapid depletion of fossil fuels and resulting climatological changes sparked interest in performing more detailed energy calculations on industrial processes. In 1969, the Midwest Research Institute (and later, Franklin Associates) initiated a study of the Coca-Cola Company to determine which type of beverage container had the lowest releases to the environment and made the fewest demands for raw materials and energy.[2]

In the 1970s, the U.S. Environmental Protection Agency (EPA) refined this methodology, creating an approach known as Resource and Environmental Profile Analysis (REPA). Approximately 15 REPAs were performed between 1970 and 1975, driven by the oil crisis of 1973. Through this period a protocol, or standard methodology, for conducting these studies was developed.[3]

In the late 1970s and early 1980s, environmental concern shifted to issues of hazardous waste management. As a result, life cycle logic was incorporated into the emerging method of risk assessment, which was used with increasing frequency in the public policy community to develop environmental protection standards.[4] Risk assessments remain controversial procedures: the public is often disinclined to trust them, especially when conducted after-the-fact to justify an activity or when performed by an organization with a vested interest in their conclusions.[5]

When solid waste became a worldwide issue in the late 1980s, the life cycle analysis method developed in the REPA studies again became a tool for analyzing the problem. In 1990, for example, a life cycle assessment was completed for the Council for Solid Waste Solutions, which compared the energy and environmental impacts of paper to that of plastic grocery bags.[6] A similar study comparing disposable diapers to washable cloth diapers was also conducted.

Environmental groups around the world have also adopted life cycle analysis; organizations such as Blue Angel, Green Cross, and Green Seal use and continue to improve LCA for the purpose of product labeling and evaluation. Thus, while initially limited to the public sector, LCA has been adopted by increasing numbers of corporations and nonprofit organizations as an aid to understanding the environmental impacts of their actions. And as demand for "green" products and pressures for environmental quality continue to mount, it is quite likely that industrial life cycle analysis will become in the 1990s what risk assessment was in the 1980s.

Components of Life Cycle Analysis

Life cycle analysis takes a systems approach to evaluating the environmental consequences of a particular product, process, or activity from "cradle to grave." By taking a "snapshot" of the entire life cycle of a product from extraction and processing of raw materials through final disposal, LCA is used to assess systematically the impact of each component process.

Ideally, a complete LCA would include three separate but interrelated components: an inventory analysis, an impact analysis, and an improvement analysis. The components are defined as follows:

- **Life Cycle Inventory.** An objective, data-based process of quantifying energy and raw materials requirements, air emissions, waterborne effluents, solid waste, and other environmental releases incurred throughout the life cycle of a product, process, or activity.
- **Life Cycle Impact Assessment.** An evaluative process of assessing the effects of the environmental findings identified in the inventory component. The impact assessment should address both ecological and human health impacts, as well as social, cultural, and economic impacts.
- **Life Cycle Improvement Analysis.** An analysis of opportunities to reduce or mitigate the environmental impact throughout the whole life cycle of a product, process, or activity. This analysis may include both quantitative and qualitative measures of improvement, such as changes in product design, raw material usage, industrial processes, consumer use, and waste management.

To date, most LCAs have focused on the inventory component, as it is the most "objective" (and therefore, least controversial) analysis to perform. Franklin Associates, an industry leader in LCA, has been improving inventory-analysis methodology over the past 20 years.[7] However, it encourages clients to extend the inventory and add the impact and improvement assessments.

Inventory Analysis

An inventory may be conducted to aid in decision-making by enabling companies or organizations to:

- Develop a baseline for a system's overall resource requirements for benchmarking efforts;
- Identify components of the process that are good targets for resource-reduction efforts;
- Aid in the development of new products or processes that will reduce resource requirements or emissions;
- Compare alternative materials, products, processes, or activities within the organization; or
- Compare internal inventory information to that of other manufacturers.

Managers using LCA to aid decision-making can improve the validity of the results and keep the analysis focused by precisely defining the scope of the "system" to be analyzed, considering practical constraints such as time and money. This step builds the foundation for the analysis that follows and should be understood and agreed upon by those responsible for commissioning the study. A system refers to a collection of operations that together perform some defined function. The system begins with all the raw materials taken from the environment and ends with the outputs released back to the environment (see **Exhibit 1**).

Within most systems, three main groups of operations may be defined: 1) operations for the production, use, transportation, and disposal of the product, 2) operations for the production of ancillary materials such as packaging, and 3) the energy production needed to power the system. A clearly defined scope will improve the results of subsequent steps when the total process is divided into subsystems. An example of typical subsystem categories is shown in **Exhibit 2.**

The linkages between subsystems make the process of collecting consistent measurements complex. For example, subsystems must be defined so that they are large enough to provide sufficient data for analysis but not so large that data is aggregated at a level that precludes detailed analysis. In addition, subsystems should be linked by a standard basis of comparison such as equivalent usage ratios. For example, two

products or subsystems may use resources at different rates, have different densities, or have different performance levels. To resolve these issues, typical usage patterns for products need to be determined so that logical comparisons can be made. For many of the system inputs, equivalent weights or volumes may need to be calculated.

Managers using LCA to aid decision making must understand that the collection of data is a complex process and that many assumptions are made in the process. Absent or incomplete data, differences in the way data were collected, variations in technologies, and the number, diversity, and potential interactions of processing steps all contribute to the complexity. Either industry- or plant-level data may be used, depending on the scope and purpose of the study; government documents, federal regulations, technical literature, industry reports, published studies, and plant visits are all important sources of data. However, the selection of the source of data can substantially affect the inventory results, and any analysis should include complete documentation of sources, assumptions, limitations and omissions. For example, comparisons should be made using data from similar time periods, as manufacturing processes often change over time as companies adopt more efficient practices.

An important step in the inventory is the creation of a process-flow diagram that will serve as the "blueprint" for the data to be collected. Each step in the system should be represented in the diagram, including the steps for the production of ancillary products such as chemicals and packaging. This step is important because it clearly depicts the relative contribution of each subsystem to the entire production system and the final product.

Overview of the Inventory Subsystems [8]

A thorough understanding of how an inventory analysis is conducted, and the limitations and assumptions inherent in the various stages is critical to effective use of LCA in decision making. The following is a synopsis of the various subsystems analyzed in an inventory analysis.

RAW MATERIALS ACQUISITION

Data are collected for this subsystem on all activities required to obtain raw materials, including transportation of the materials to the point of manufacture (see **Exhibit 3**). Typically, raw materials are traced for the primary product and all primary, secondary and tertiary packaging. Managers should review the data to make sure equivalent comparisons are used. For example, a package containing recycled materials may need increased thickness to compensate for the decreased strength of recycled materials. In this case, managers must make a tradeoff between weight of materials that will someday become part of the waste stream and virgin material content. The inventory should also include all inputs of energy, materials, and equipment necessary for acquiring each raw material. Because this dramatically increases the complexity of the analysis, criteria must be determined to eliminate insignificant contributions. This may be done by establishing a threshold for inclusion. For example, any component contributing less than five percent of inputs might be ignored.

Ecosystems are impacted in many ways by the extraction or harvesting of raw materials, but only those effects that can be quantified, such as pesticide run-off from agriculture or soil loss from logging, should be included in the inventory. Effects that cannot be easily measured, such as loss of scenic or aesthetic value, may be covered in the more subjective impact assessment. At this point, attempts to quantify renewable or nonrenewable resources for inventory calculations are subjective, as quantifiable data is not publicly available. However, maintaining separate lists of renewable and nonrenewable materials may be helpful if an impact assessment is later performed.

Energy acquisition is actually part of the materials-acquisition subsystem, but because of the complexity of the subject, it warrants its own analysis. Data collected should include all energy requirements and emissions attributed to the acquisition, transportation, and processing of fuels. This means that if gasoline is used as a transportation fuel, not only should emissions related to combustion be included, but also energy consumption and emissions due to extraction and refining. In the U.S., energy is derived from a number of sources including coal, natural gas, petroleum, hydropower, nuclear power, and wood. Utilities use many different types of energy sources to produce

electricity, so the energy analysis must include a determination of the fuel mix used to generate the electricity. Generally, the national average fuel mix may be used, but industry-specific information is preferred.

Some materials are made from energy resources and are therefore assigned an energy value. For example, plastics, made from petroleum and natural gas, release energy when burned. This energy value is credited against the system requirements for the primary product, resulting in a new energy requirement that is less than the total energy requirements for the system.

MANUFACTURE AND FABRICATION

Data collected for this subsystem includes all energy, material, or water inputs and environmental releases that occur during the manufacturing processes required to convert each raw material input into intermediate materials ready for fabrication. This process may be repeated for several streams of resources as well as several intermediate cycles before final fabrication of the product (see **Exhibit 4**).

Often co-products — outputs that are neither products nor inputs elsewhere in the system— are generated in the manufacturing process. Co-products are included in LCA until they are separated from the primary product being analyzed. Raw materials, energy, and emissions should be allocated between the primary product and the co-products by their proportionate weight or volume. If scrap within one subsystem is used as an input within the same subsystem, the raw material or intermediate material required from the outside is reduced and should be factored into the analysis. If industrial scrap is used in another subsystem, it is considered to be a co-product and should be allocated to the same consumption and emission rates required to produce the primary material. Some scrap is simply discarded and should be counted as solid waste.

Differences in technology throughout the industry require certain assumptions to be made at this stage. Comparisons between different-size facilities, differing ages of equipment, different capacity-utilization rates, and differing energy consumption per unit of production must be made explicit.

The data collected for final product fabrication assesses the consumption of inputs and the emissions required to convert all materials into the final product ready for consumer purchase. Calculations follow the same procedure as in converting raw material to intermediate materials and include the same limitations.

Data collected for fabrication of the final product includes the inputs and releases associated with filling and packaging operations. As this is a necessary step for virtually any product, this step focuses on differences between processes or materials being compared. If the filling procedure is identical for the two products being compared, this step can be ignored. Both primary and secondary packaging must be included in the calculations, taking care to keep packaging per unit consistent between alternatives.

TRANSPORTATION/DISTRIBUTION

An inventory of the related transportation activities of the product to warehouses and end-users may be simplified by using standards for the average distance transported and the typical mode of transportation used (see **Exhibit 5**). Inventory of the distribution process includes warehousing, inventory control, and repackaging. Environmental controls such as refrigeration are components of both transportation and distribution. As in previous stages, clear boundaries must be established to define the extent to which issues such as building and maintaining transportation and distribution equipment will be factored into the inventory results.

CONSUMER USE/DISPOSAL

Data collected for this subsystem cover consumer activities including use (product consumption, storage, preparation, or operation), maintenance (repair), and reuse (see **Exhibit 6**). Issues to consider when defining the scope of the subsystem include:

- Time of product use before it is discarded
- Inputs used in the maintenance process
- The typical frequency of repair
- Potential product reuse options

Managers should incorporate into the analysis any industry information on typical consumer usage patterns that may make the study's results more valid. For example, consumers may occasionally use two thinner paper cups to attain the strength of a single comparable polystyrene cup. Sources of data that may help this process include consumer surveys, published materials,

and assumptions. Inventory reports must include documentation of assumptions including the timeliness of the data, potential biases, and other limitations.

Various disposal alternatives exist such as reuse, recycling, composting, incineration, and landfilling. Transportation and collection of post-consumer waste should also be included in the analysis. Inventories often use a national estimate of waste management methods, citing current averages for the percentage of waste disposed of by landfilling, recycling, and incineration methods.

Recycling technology is expected to improve greatly in the future. Therefore, content levels and recycling rates should always be reported at current rates with documentation of study dates. Advances in technology will both increase rates and the number of products that are recyclable, altering both open- and closed-loop recycling options (see **Exhibit 7**).

Open-loop recycling means that a product is recycled into a different product that is disposed of after use. In these cases, the resource requirements and environmental emissions related to the recycling and final disposal of the recycled material is divided equally between the two products produced.

Closed-loop recycling refers to materials that can be recycled into the same product repeatedly. This means that the more times the product is recycled, the less virgin material is required and the greater the number of cycles over which the resources and emissions can be allocated. The environmental effects of a closed-loop product will approach zero over the life of the product. For some products, a recycling infrastructure already exists, providing data on the collection, transportation, and processing of its materials. But for many products such information does not exist, leading to the use of data extrapolated from pilot programs or forecasts.

Wastes may be defined as materials that have no intrinsic or market value. Waste occurs in some form at every stage of the life cycle. Careful analysis of waste management issues is required as disposal options vary with the seasons, geography, and the technology used by a particular facility. Further complicating the inventory is the fact that many waste streams are combinations of materials derived from several subsystems, and that waste treatment facilities may produce a variety of releases including air, water, and solid wastes. For example, reported waterborne waste data should include an analysis of the water treatment system, the land associated with the treatment system, and atmospheric and solid wastes associated with the system. Information about emissions from solid waste is more difficult to find as there is no existing method to determine the emissions of a particular product once it has been mixed with municipal waste in a landfill or incinerator. If, however, a disposal process is being used for only one type of product (e.g., composting for yard waste or recycling for aluminum cans), accurate measures are available.

Impact Assessment and Improvement Analysis

All life cycle analyses collect inventory data on raw material consumption, energy and water use, and waste production. However, a meaningful LCA should contain more than a mere inventory of inputs and outputs — it should also consider the overall contributions and risks to the environment and public health, as well as the social, cultural, and economic impacts of each option. In short, the products and processes being assessed should be seen in the context of the society they are intended to serve.

An impact assessment and improvement analysis thus *evaluates* the impacts caused by the proposed products, processes, or activities. The final result of an impact assessment is an environmental profile of the system. Impact assessment is one of the most challenging aspects of LCA since current methods for evaluating environmental impacts are incomplete at best.[9] Even when models exist, they can be based on many assumptions or require considerable data beyond that associated with the inventory.[10] Evaluating the importance and meaning of the data collected during the inventory requires judgement and interpretation. Thus, impact assessment inherits all the problems of inventory analysis while also introducing new methodological and measurement challenges.

ENDNOTES:

[1] For example, D. Meadows, D. Meadows, and J. Randers. *Limits to Growth.* New York: Universe Books, 1972.

[2] Franklin Associates. *Product Life-Cycle Assessment: Guidelines and Principles* (EPA Report #68-CO-0003). 1991.

[3] Hunt, R., J. Sellers, and W. Franklin. "Resource and Environmental Profile Analysis: A Life Cycle Environmental Assessment for Products and Procedures." *Environmental Impact Assessment Review*, Spring 1992.

[4] Stilwell, J., R. Canty, P. Kopf, and A. Montrone. *Packaging for the Environment.* New York: American Management Association, 1991.

[5] See, for example, Lowrance, W. 1976. *Of Acceptable Risk.* Los Altos, CA: William Kaufmann, 1976.

[6] Council for Solid Waste Solutions. "Resource and Environmental Profile Analysis of Polyethylene and Unbleached Paper Grocery Sacks." CSWS (800-243-5790), Washington, DC, June 1990.

[7] Franklin Associates, Ibid.

[8] For details, see Franklin Associates, Ibid.

[9] U.S. EPA, Risk Reduction Engineering Lab. *Life Cycle Design Guidance Manual: Environmental Requirements and the Product System* (EPA #600/R-92/226). Prepared by Keoleian, Gregory A., and Dan Menerey. Cincinnati: EPA, 1993.

[10] For examples of the range of methods available, see Hart, S., G. Enk, and W. Hornick. *Improving Impact Assessment.* Boulder, CO: Westview Press, 1984.

EXHIBIT 1: INPUTS AND OUTPUTS OF A SYSTEM

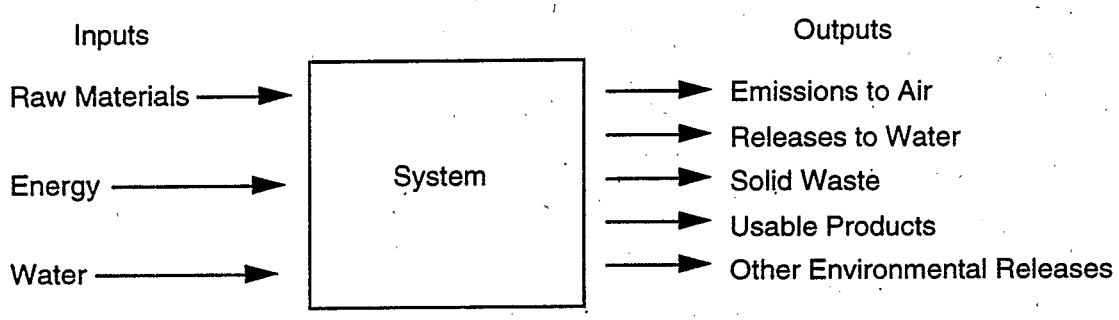
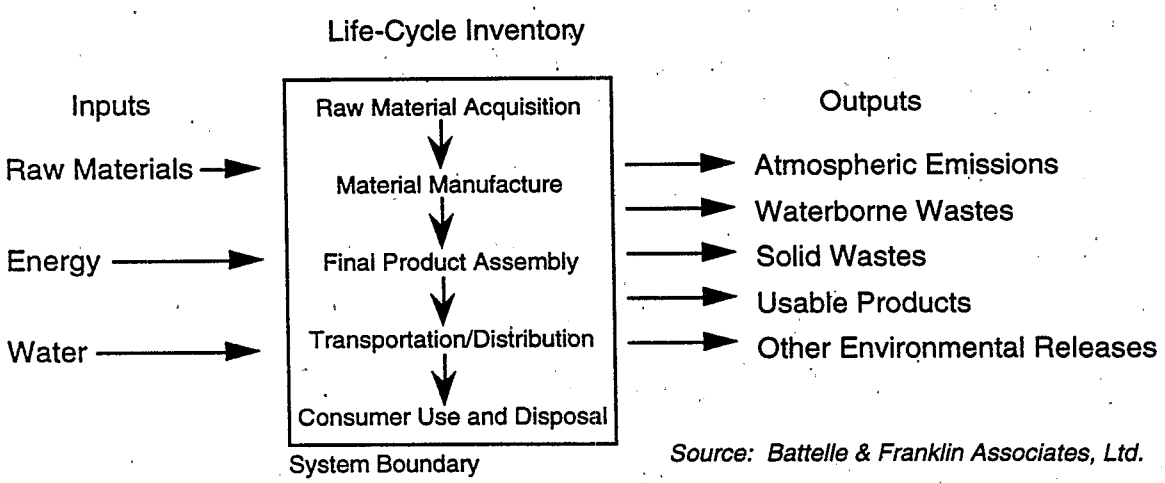


EXHIBIT 2: DEFINING SYSTEM BOUNDARIES



Source: Battelle & Franklin Associates, Ltd.

EXHIBIT 3: RAW MATERIAL ACQUISITION SUBSYSTEM

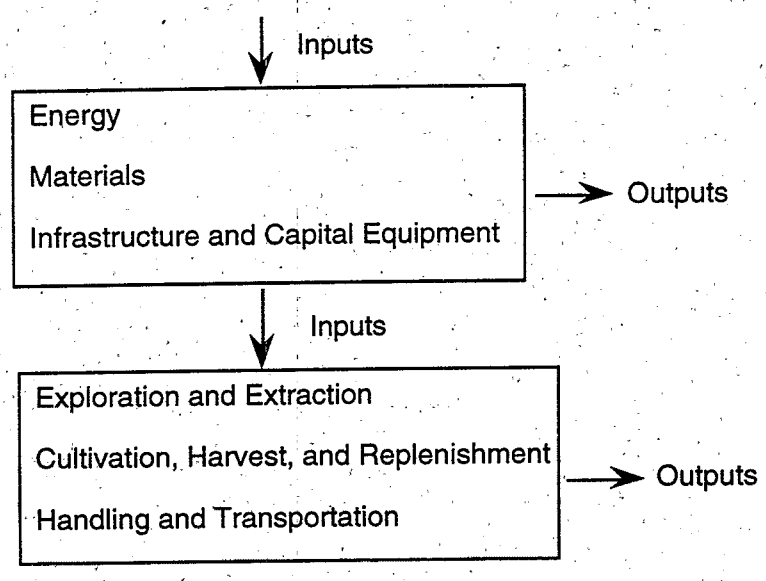


EXHIBIT 4: MANUFACTURING AND FABRICATION SYSTEM

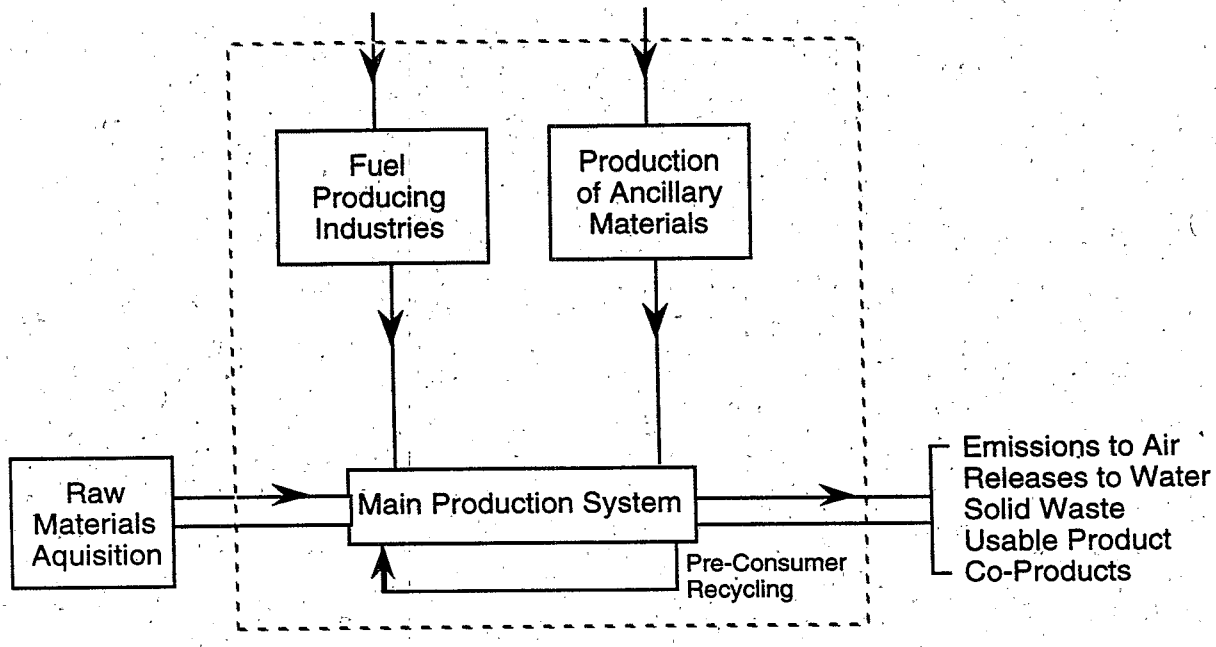


EXHIBIT 5: TRANSPORTATION/DISTRIBUTION SYSTEM

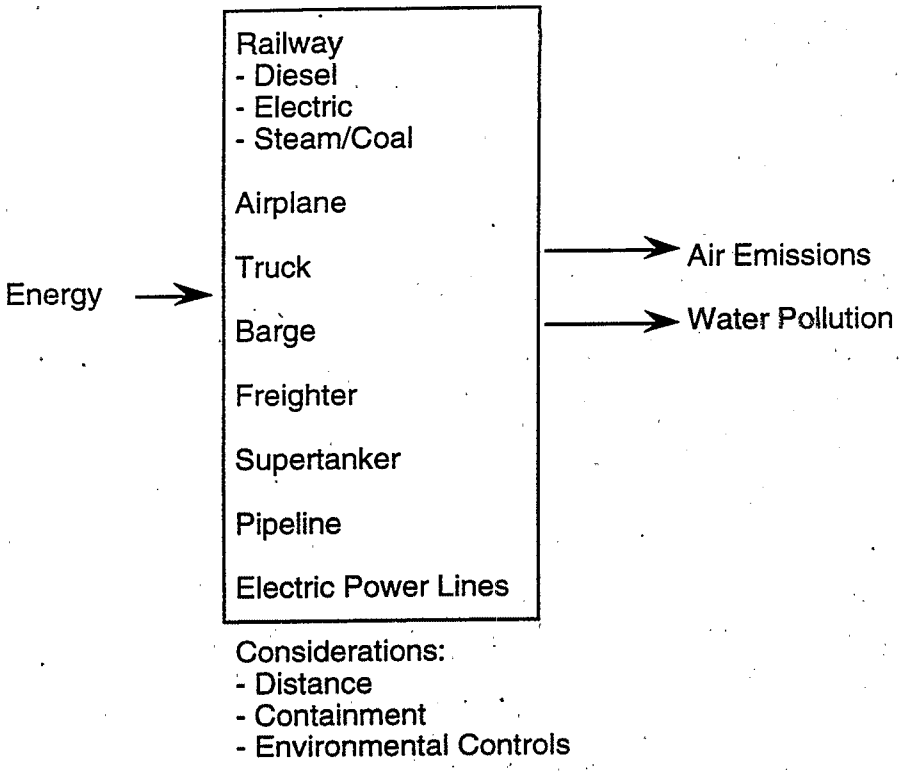


EXHIBIT 6: CONSUMER USE/DISPOSAL SYSTEM

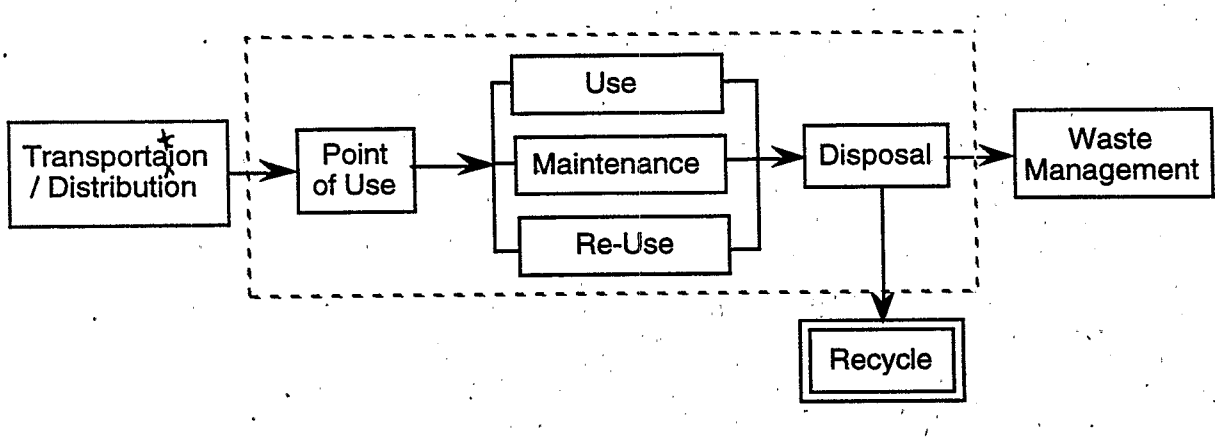
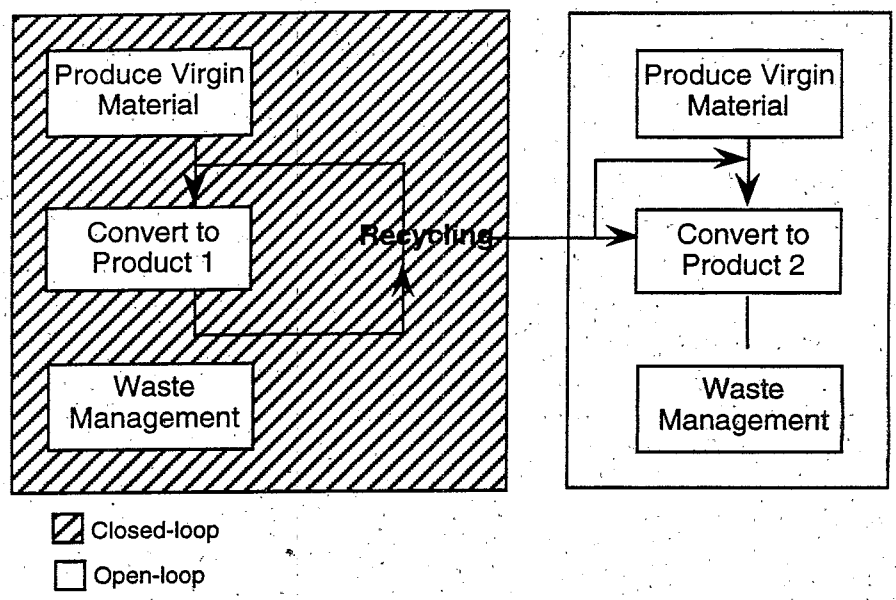


EXHIBIT 7: RECYCLING SUBSYSTEM



Published by:
The National Pollution Prevention Center for Higher Education
University of Michigan, Dana Building
430 East University Ave.
Ann Arbor, MI 48109-1115
• Phone: 313-764-1412
• Fax: 313-936-2195
• E-mail: nppc@umich.edu

The mission of the NPPC is to promote sustainable development by educating students, faculty, and professionals about pollution prevention; create educational materials; provide tools and strategies for addressing relevant environmental problems; and establish a national network of pollution prevention educators. In addition to developing educational materials and conducting research, the NPPC also offers an internship program, professional education and training, and conferences.

Your Input is Welcome!
We are very interested in your feedback on these materials. Please take a moment to offer your comments and communicate them to us. Also contact us if you wish to receive a documents list, order any of our materials, collaborate on or review NPPC resources, or be listed in our *Directory of Pollution Prevention in Higher Education.*

We're Going Online!
The NPPC provides information on its programs and educational materials through the Internet's World Wide Web; our URL is: http://www.snre.umich.edu/nppc

We may also update the NPPC information available through gopher (gopher.snre.umich.edu) and anonymous FTP (ftp.snre.umich.edu). Please contact us if you have comments about our online resources or suggestions for publicizing our educational materials through the Internet. Thank you!

Pollution Prevention in Corporate Strategy
NATIONAL POLLUTION PREVENTION CENTER FOR HIGHER EDUCATION

Note on the Trash Crisis

Prepared by Susan Svoboda, manager of the University of Michigan Corporate Environmental Management Program (CEMP). This document may be used by either students or faculty for background information.

As the volume of municipal solid waste (MSW) produced in this country continues to grow, communities are finding it increasingly difficult to dispose of the garbage and sludge produced by business and industry, institutions, and individuals. Differing definitions about what constitutes MSW leads to different estimates of volume. The EPA estimates that each American produces 4 pounds of trash per day; *BioCycle* magazine estimates 6.6 pounds per day. In general, estimates vary according to whether both pre-consumer and post-consumer waste are included or just post-consumer.

According to the EPA, approximately 73 percent of our trash was landfilled in 1988. Yet, over the past 10 years the number of operating landfills has decreased by 60 percent, with the majority of the closings occurring in New England. Today, the highest percentage of new closings are in the western states. The rate of landfill closings is a serious issue as past dumping practices, characterized by unsanitary conditions, methane explosions, and releases of hazardous substances into groundwater and the atmosphere, have made it increasingly difficult to site new landfills.

New EPA regulations,which require controls such as groundwater monitoring, may force many small landfills to close. The opening of several large facilities may offset the loss of the small sites, making capacity a more meaningful measure. It typically requires at least five years to permit and develop new landfill facilities. According to a 1988 EPA study, eight states had less than five years of remaining capacity, and 15 states had five to ten years of capacity.[1] This capacity constraint, coupled with cleanup costs, has caused an increase in "tipping fees" (charges to use landfills). For example, in Wisconsin it is estimated that a sixfold increase in the state's tipping fees may be necessary to cover pollution problems at licensed landfills over the next 30 years.[2] Further, the incentive to minimize tipping fees has caused the waste-hauling industry to grow rapidly as waste is transported to regions with higher capacities and correspondingly lower fees.

As of 1991, 20 states had enacted some type of waste reduction plan; 22 have enacted some requirements that local government provide some sort of recycling program. In addition, 29 states have enacted more than 100 disposal bans, prohibiting certain bulky or toxic items from landfills or incinerators.[3]

A growing recycling infrastructure and improved incineration methods, combined with constrained landfill capacity, are changing the way waste is disposed of in the United States. By 1995, the EPA estimates that 53 percent of waste will be landfilled, 23 percent incinerated, 19 percent recycled, and 5 percent composted.

Landfills

Municipal solid waste (MSW) comprises 90 percent of the materials that are landfilled. The remaining 10 percent consists of construction debris, sewage sludge, incinerator ash, medical waste, etc. In 1976, the Resource Conservation and Recovery Act (RCRA) was enacted, thereby prohibiting uncontrolled dumping and assuring that operating landfills were sanitary. EPA regulations forbid open burning and require all landfills to have a clay or a synthetic liner as well as alternate layers of plastic or dirt between layers of trash. Only 25 percent of operating landfills had groundwater monitoring equipment prior to 1986.[4] Now, mandatory leachate systems use pipes to collect and treat water that seeps through a landfill to the liner.

State-of-the-art regional landfills with multiple liners and environmental controls are estimated to cost

$400,000 per acre. The expected lifetime of a landfill is ten years. Once a landfill is full, it is allowed to settle for a few years before it may be used for a park, athletic field, or golf course.

Landfills must be carefully managed in order to reduce their inherent drawbacks. For example, each day's deposit of trash must be covered so that litter and ash are not scattered by the wind. In addition, organic wastes that are landfilled partially decompose under certain conditions to produce carbon dioxide, methane, ammonia, water, and other chemicals, which, unless recovered, may be released into the atmosphere. Further, during decomposition, liquids may percolate through the landfill and carry chemicals into the soil and groundwater. Finally, until alternative means of disposal are determined, landfills contain many common items such as glass, plastics, and metals that will never biodegrade.

Landfill disposal costs in the United States are estimated to be $40–60 per ton and rising.

Incineration

In 1988, the United States had 164 incinerators operating in 36 states with a design capacity of 70,000 tons per day. Vendors estimate that municipal incinerators typically operate at 85 percent capacity due to occasional shutdowns.[5] Incineration handles solid waste by burning combustible materials and melting noncombustibles. There are two processes for incineration: mass burning and refuse-derived fuel (RDF). Mass burning systems burn unseparated municipal waste on a moving grate that helps agitate the waste in order to mix it with air. RDF separates materials such as steel or glass, and shreds the remaining materials before burning to produce cleaner emissions.

Many mass-burn and RDF systems are designed to recover energy by transferring the thermal energy to water in a boiler. The steam that is produced can be used to produce electricity or distributed by pipeline to buildings and industry. Combustion "upsets" can cause temporary increases in emissions due to changes in MSW composition, or failures in plant power, instrumentation, or controls.

As MSW burns, flue gas is created that may contain carbon monoxide, dioxins, acid gases and metals. Older incinerators without computerized combustion or pollution controls have higher emissions than modern facilities. Today, scrubbers, filters, and continuous monitoring devices control emissions.

Incineration produces ash that includes minerals, metals, unburned organic carbon, and dirt, which constitutes 10–20 percent of the original material's volume. Fly ash consists of light particles that are blown off the grate and form in the flue gas. Fly ash typically contains volatile metals such as mercury, lead, and cadmium as well as dioxins and PCBs. Bottom ash consists of the uncombusted or partially uncombusted materials remaining on the grate after burning. Less volatile metals such as aluminum, iron, and tin as well as hydrocarbons are typical components of bottom ash. In some cases, this ash could be highly toxic, because the heat of the incinerator may increase the toxic properties of the materials burned.

Ash creates potential hazards, as it can be blown into the air during transport or contaminate groundwater after disposal. The main method for controlling blowing ash is to collect it, spray it with water, and combined it with bottom ash to produce a sludge. The EPA estimates that 36 percent of ash is disposed in landfills containing only ash, 17 percent is disposed with MSW, and the rest is undetermined.[6] Research is being conducted to determine how to stabilize the ash chemically before transport and disposal.

Although incineration has been performed successfully in Europe and Japan for decades, in the 1970s domestic incinerators were plagued by problems due to inadequate technology and less stringent safeguards.

Building incinerators is risky business. Not only is siting difficult because of community opposition, but laws that affect construction and operating costs can vary greatly between a project's start and finish. However, incinerator construction, maintenance, and operating costs are somewhat offset by the sale of energy produced in the process.

Plastics release four times more energy during incineration than average MSW as they "borrow" energy from the petroleum that is released during burning.[7] However, plastics that are incinerated can also be a valuable source of income to recycling programs that pay as much as $300 per ton for separated post-consumer plastics. Incineration is currently more expensive than landfilling — $90–110 per ton — making it an economical choice only for communities that would have to transport waste long distances before disposal.

Recycling

Recycled materials are either pre-consumer or post-consumer. "Pre-consumer" refers to both materials and by-products that have been recovered during the manufacturing process. "Post-consumer" materials are derived from products that have already fulfilled their original purpose and were separated from MSW.

Recyclability refers to the actual rate at which materials are recycled in a given geographical area. Although some materials can be recycled into products similar to the original product ("closed-loop" recycling), the recycling process generally weakens or changes the composition of the original material. Therefore, most products are "open-loop"-recycled into materials that require less strength or different properties. In addition, the U.S. Food and Drug Administration does not allow packaging that has direct contact with food to be made from recycled plastics, which may have absorbed toxins from oil, pesticides, or other hazardous materials.

Although recycling holds potential for relieving some of the waste burden, the complexities of building an infrastructure to support the process are cumbersome. Materials are collected either by drop-off programs or curbside pickups. Drop-off programs may be centrally located or may require driving many miles. These facilities may or may not have on-site workers, but do generate revenue from the sale of collected materials. Many drop-off programs were started by the beverage industry as an alternative to bottle deposits, and are more common in the western United States. More than 2,700 curbside programs are currently operating in the United States, 45 percent of which are mandatory; these are primarily in the Northeast.[8] Curbside services typically operate similarly to garbage services, using trucks that consume fuel and contribute to air pollution.

Sorting materials is a critical step in the recycling process, because contamination can jeopardize an entire batch of materials. The process starts by previewing the materials to remove any oversized or explosive items. In many cases, materials are carried along conveyor belts for manual separation; however, some materials such as broken glass are dangerous to remove and may be done mechanically. Plastics are particularly hard to separate due to their visually similar physical properties. The industry is searching for ways to automate this process. One practice currently being used to separate plastics is to float the materials, since containers of differing materials have differing densities.

Once materials have been sorted, they are usually ground or chopped, washed and dried, and sometimes remelted for purification and to achieve similar color and consistency throughout the melt.

The recycling industry faces several economic barriers. Manual separation is an expensive process, but contamination makes an entire batch worthless, and the recycler must pay the cost of disposal. Large differences in the weight-to-volume ratio may reduce incentives to recycle as hauling fees are based on the number of trucks used, but recycling allowances are based on weight. Options such as increasing monetary incentives for recycling or taxing products that use virgin materials may realign economic incentives. Finally, there does not yet exist a consistent supply of inputs or a consistent demand for recycled products to stabilize prices. Many materials are currently recycled to avoid disposal rather than to earn revenue from actual material value.

Composting

Composting is the biological decomposition of organic material by microorganisms such as bacteria and fungi. It has been used for years to improve soil quality but is gaining popularity because it diverts waste from landfills and incinerators. With proper temperature and moisture controls, composting can quickly reduce the original volume of some materials by 50 percent. Biodegradable organic materials such as leaves, grass, food wastes, and paper can be composted.

Composting occurs either in static piles or vessels. In-vessel systems often co-compost sewage sludge with organic municipal waste. This process increases moisture and speeds decomposition but increases odors. Once the compost is complete, the material is "cured" for several months to assure stabilization. It is then pulverized, crumbled, or pelletized to specification.

Composting faces similar challenges to those of recycling, in that organic materials must be separated from non-biodegradable materials (e.g., glass or metal). Compost products are used by landscapers, farmers, golf courses, etc. Most composting is done for local markets, as the weight of compost makes transportation expensive. Composting does not appear to be a profitable venture for municipalities, since the cost of collection offsets revenue from the sale of compost. However, it may offer a "break-even" method for disposal of organic solid waste.

There are currently approximately 1,400 composting programs in 44 states. Most programs start with autumn leaf harvests and expand to include grass clippings. Thirteen municipal facilities are operating, 10 are under construction, and 82 more are in planning stages.[9] In addition, some companies are experimenting with composting for their biodegradable products (e.g., Proctor & Gamble and its disposable diapers).

END NOTES:

1 U. S. Congress, Office of Technology Assessment. *Facing America's Trash*, p. 271.

2 Ibid., p. 335.

3 J. Walter Thompson. *JWT Greenwatch*, no. 4 (Spring 1991).

4 *EPA Report to Congress: Solid Waste Disposal in the United States.* Volume II, October 1988.

5 U. S. Congress, p. 221.

6 Ibid., p. 219

7 J. Stilwell, C. Contz, P. Kopf, and M. Montrone. *Packaging for the Environment*. New York: American Management Association, 1991.

8 J. Walter Thompson, p. 12.

9 Ibid., p. 16.

Published by:
The National Pollution Prevention Center for Higher Education
University of Michigan, Dana Building
430 East University Ave.
Ann Arbor, MI 48109-1115
• Phone: 313-764-1412
• Fax: 313-936-2195
• E-mail: nppc@umich.edu

The mission of the NPPC is to promote sustainable development by educating students, faculty, and professionals about pollution prevention; create educational materials; provide tools and strategies for addressing relevant environmental problems; and establish a national network of pollution prevention educators. In addition to developing educational materials and conducting research, the NPPC also offers an internship program, professional education & training, and conferences.

Your Input is Welcome!
We are very interested in your feedback on these materials. Please take a moment to offer your comments and communicate them to us. Also contact us if you wish to receive a documents list, order any of our materials, collaborate on or review NPPC resources, or be listed in our *Directory of Pollution Prevention in Higher Education*.

We're Going Online!
The NPPC provides information on its programs and educational materials through the Internet's World Wide Web; our URL is: http://www.snre.umich.edu/nppc

We may also update the NPPC information available through gopher (gopher.snre.umich.edu) and anonymous FTP (ftp.snre.umich.edu). Please contact us if you have comments about our online resources or suggestions for publicizing our educational materials through the Internet. Thank you!