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Final Project Report
Waste Reduction Technology Transfer Case Studies

prepared by the:

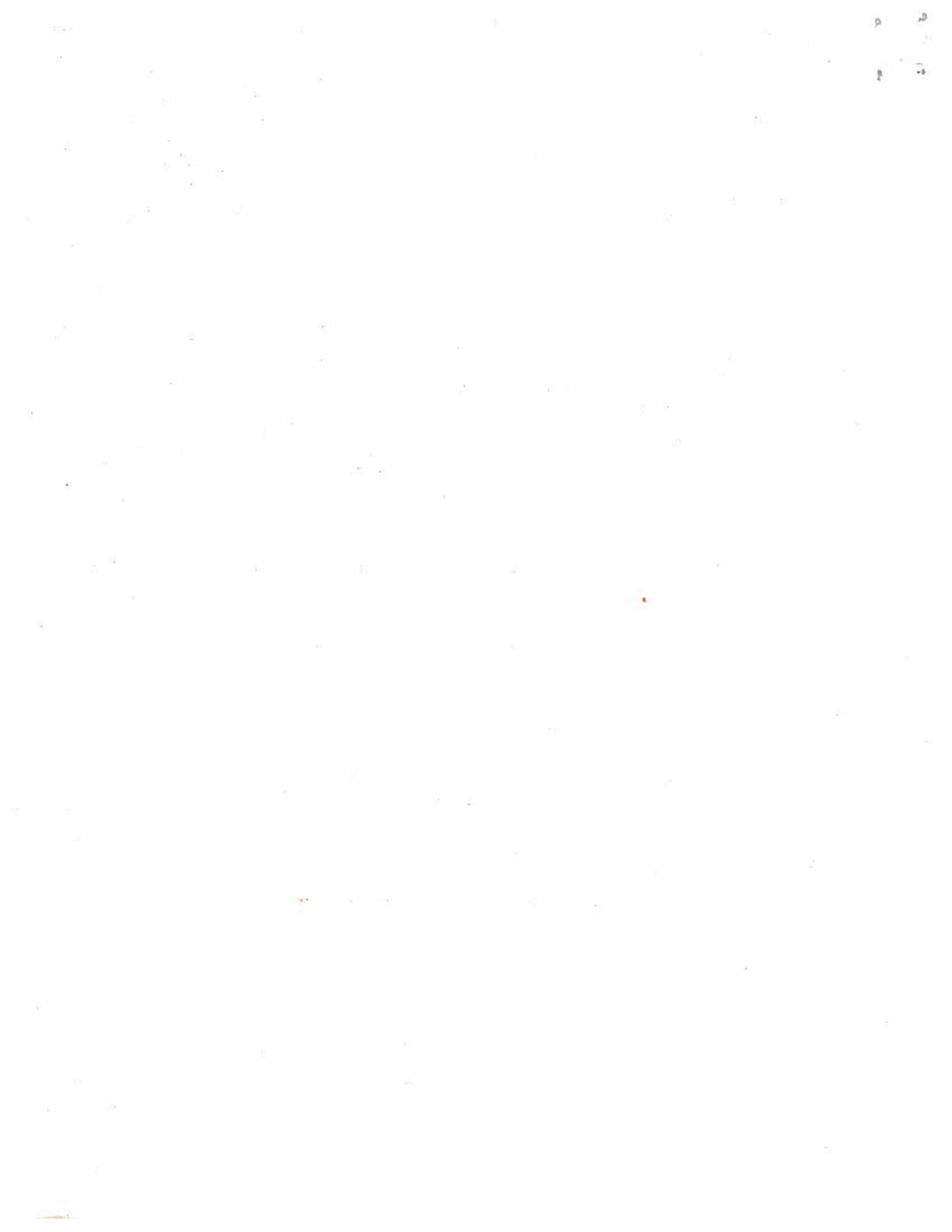
**Solid Waste Research Group
School of Natural Resources
University of Michigan
Ann Arbor, Michigan 48109
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**Office of Waste Reduction Services
State of Michigan Departments of Commerce and Natural Resources
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PREFACE

FUNDING

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ACKNOWLEDGEMENTS

Solid Waste Research Group, School of Natural Resources, University of Michigan

The Solid Waste Research Group selected the case study firms, conducted the on-site data collection and analysis, documented the waste reduction activities, evaluated the potential impacts of these activities on the waste stream if they are adopted by other firms throughout Michigan, and prepared the case study reports. The following members of the Solid Waste Research Group participated in this project:

Jonathan Bulkley, Project Director, Professor of Civil Engineering and Natural Resources
Gregory Keoleian, Principal Investigator, Research Fellow in Natural Resources
Raymond DeYoung, Participating Investigator, Research Scientist
Andy Duncan, Research Assistant
Elise McLaughlin, Research Assistant
Dan Menerey, Research Assistant
Martha Monroe, Research Assistant
Thomas Swenson, Research Assistant

State of Michigan Departments of Commerce and Natural Resources

The Office of Waste Reduction Services of the State of Michigan Departments of Commerce and Natural Resources provided assistance in the selection of case study firms and in reviewing the final report. Ms. Myra Grant served as project manager and administered the grant for the Resource Recovery Section, Waste Management Division, State of Michigan Department of Natural Resources.

The information presented in this report is the sole responsibility of the Solid Waste Research Group, School of Natural Resources, University of Michigan.

Case Study Firms

The case study firms were selected according to the following criteria: a priority of source reduction over recycling and other waste management strategies; transferability of the documented waste reduction practices to other firms; information availability and accessibility; the potential amount of solid waste reduction achieved if other firms adopt the model waste reduction practices; and a diversity of businesses in terms of their SIC Code, size, organizational structure, and geographic location.

The five firms studied are the following:

1. Hudson's department stores in Michigan; retail department stores
2. Gretchen's House III in Ann Arbor; child day care facility
3. McPherson Hospital in Howell; cafeteria and patient food service
4. People's Food Cooperative's Packard store in Ann Arbor; grocery store
5. Steelcase in Grand Rapids; office furniture manufacturer

PROJECT PUBLICATIONS

The following documents are available through the Office of Waste Reduction Services:

Waste Reduction in The Department Store Sector, Case Study Report: Hudson's Department Stores

Waste Reduction in Child Day Care Services, Case Study Report: Gretchen's House III

Waste Reduction in the Hospital Sector, Case Study Report: McPherson Hospital

Waste Reduction in Food Retail, Case Study Report: People's Food Cooperative's Packard Store

Waste Reduction in the Furniture Manufacturing Sector, Case Study Report: Steelcase Inc.

Waste Reduction Fact Sheet: Hudson's Department Stores

Waste Reduction Fact Sheet: Gretchen's House III

Waste Reduction Fact Sheet: McPherson Hospital

Waste Reduction Fact Sheet: People's Food Cooperative's Packard Store

Waste Reduction Fact Sheet: Steelcase Inc.

Documents may be obtained from:

Office of Waste Reduction Services
Michigan Departments of Commerce and Natural Resources
PO Box 30004
Lansing, MI 48909
Phone: (517)-335-1178

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SUMMARY

The goal of this research is to effect the transfer of waste reduction activities from a firm that is successfully practicing waste reduction to other firms throughout the State of Michigan. The project was organized into two main phases: I. Selection of commercial/industrial sectors and firms for case study and II. Case study research. Phase I was accomplished as follows:

- *Criteria for selection* were established with an emphasis on source reduction practices and by assessing potential impact on Michigan's nonhazardous waste stream if the proposed waste reduction practice is adopted by other firms.
- *Search for candidate firms* was aided by trade groups and government agencies.
- *Final selection* necessitated a somewhat subjective review, because it was difficult to establish a precise matrix for ranking candidate firms.

The five firms chosen for a detailed case study were:

1. Hudson's department stores in Michigan; retail department stores
2. Gretchen's House III in Ann Arbor; child day-care facility
3. McPherson Hospital in Howell; cafeteria and patient food service
4. People's Food Cooperative's Packard store in Ann Arbor; grocery store
5. Steelcase in Grand Rapids; office furniture manufacturer

Phase II of the project was organized into three main tasks. The investigation of case study firms entailed a *process analysis* to determine material flows through each system, including waste generation, equipment, labor and energy needs; an *economic analysis* quantifying costs necessary for a comparative evaluation of systems before and after implementation of a waste reduction program; and an *organizational and motivational analysis* to determine which people and factors were critical in proposing and instituting successful waste reduction methods. Potential impact on sector waste generation and transferability of the documented waste reduction programs to other businesses in the state were then evaluated. Finally, a fact sheet and detailed case study report for each subject firm were prepared.

A brief summary of significant findings from the case studies is presented here. More detailed information can be obtained from individual case study reports.

- Source reduction methods at the five case study firms significantly decrease waste generation. Some source reduction programs investigated are in the early stages of development and other opportunities for source reduction remain unexploited.
- In most cases, the implementation of a source reduction program resulted in a cost savings to the firm. Wasteful practices contain many hidden costs, such as labor. The successful programs studied required small capital investments.
- Driving forces behind the implementation of waste reduction programs were based in some cases on either external factors or internal factors, and in other cases on a combination of both. External factors include costs, competition, and reaction to public environmental consciousness; internal motivations are based on corporate environmental ethic or individual commitment to improving the environment and conserving resources.
- Impact on the state's solid waste stream from the source reduction practices studied is potentially significant. The full range of waste reduction practices at the case study firms can be transferred to other firms within their sectors, and many practices are applicable with little modification to firms outside the sectors studied.

I. INTRODUCTION

Commercial/industrial businesses in the State of Michigan have a primary responsibility to reduce nonhazardous solid waste. The overall goal of the Michigan Solid Waste Policy is to promote source reduction, reuse, composting, recycling, and incineration with energy recovery while limiting the use of landfills.¹ Source reduction is given the highest priority among waste reduction strategies, because decreasing the amount of waste created or generated at the source is the most direct and efficient means of reducing solid waste.

Businesses have control over two types of wastes: internally generated waste and postconsumer waste which is associated with the products they manufacture or distribute. This latter category includes packaging waste, a major component of municipal solid waste.

Ideally, solid waste reduction strategies should achieve goals for pollution prevention. Comprehensive plans for waste reduction should be developed within a product life cycle framework. This framework tracks a product or service from cradle to grave. The life cycle stages include raw materials extraction, manufacturing, use, resource recovery, and disposal. A waste reduction plan should assess environmental impacts and health risks associated with the flow of materials and energy through each stage of the life cycle. In addition to nonhazardous solid waste generation, environmental impacts and health risks include: hazardous waste generation, industrial accidents, air and water pollution, ecological degradation, and occupational and consumer health risks. A systematic approach is recommended for waste reduction to avoid the shifting of environmental impacts between stages of the life cycle or shifting of pollutants between compartments of the environment. For example, a program to reduce nonhazardous solid waste that dramatically increases air pollution should not be implemented.

The *Michigan Solid Waste Policy* states that the state must take the lead in providing educational and technical assistance to realize an eight to 12 percent reduction in the waste stream by 2005. State government can meet this goal by assisting commercial and industrial enterprises with the identification and implementation of effective solid waste reduction programs. This project seeks to facilitate the transfer of waste reduction practices, techniques or technologies to other firms throughout Michigan through the documentation of successful commercial/industrial waste reduction programs. Five commercial and manufacturing firms whose sectors produce significant amounts of the total non-residential waste stream in Michigan were identified and analyzed. Efforts by the Michigan Department of Natural Resources and Department of Commerce, Waste Reduction Services, will likely be more effective if specific, detailed, and proven plans for waste reduction are offered to businesses. Availability of this information should hasten adoption of solid waste reduction practices by Michigan industry.

The five case studies of commercial and industrial firms analyze process, economic, and organizational/motivational factors associated with waste reduction programs. The process analysis includes a description of the product and process changes resulting from waste reduction programs and the amount of reduction achieved. The economic analysis evaluates the costs and revenues produced by the documented waste reduction activity. Baseline economic data, including fixed and variable costs and revenues before the intervention, are compared with the post-intervention data. An organizational/behavioral section examines the decision making process including incentives and organizational support, company policy, and employee attitudes related to the initiation of a waste reduction program.

The detailed case studies can serve as organizational and operational guides to other businesses within the same commercial or industrial sector. Businesses outside the sector can also

¹ *Michigan Solid Waste Policy* Michigan Department of Natural Resources, 1988.

adopt the more generic waste reduction programs described in each report. Some of the waste reduction programs documented in the case studies can be implemented relatively easily, whereas others may require significant capital investment, employee training, or operational changes. Each case study attempts to identify key elements of the model waste reduction program that are necessary for its successful implementation.

PROJECT OBJECTIVES

The explicit goal of the research is to effect the transfer of waste reduction activities from a firm that is successfully practicing waste reduction to other firms throughout the State of Michigan. For this purpose, the following objectives are defined:

1. Identify commercial and industrial operations that are major sources of solid waste.
2. Research successful solid waste reduction practices and technologies that, if adopted industry wide, would significantly reduce the amount of material entering the waste management system.
3. Research five cases to document and demonstrate the effectiveness of solid waste reduction practices and technologies at selected firms so that source reduction technology can be transferred to other businesses interested in implementing and operating similar source reduction programs. This requires cost, process, and organizational analyses.
4. Prepare a two page summary document (Fact Sheet) and a comprehensive, detailed technical report (Case Study Report) for each of the five waste reduction cases researched. These documents will be distributed to industry personnel through appropriate trade associations and also through the office of Waste Reduction Services, Michigan Departments of Commerce and Natural Resources.

The five firms studied were the following:

1. Hudson's department stores in Michigan; retail department stores
2. Gretchen's House III in Ann Arbor; child day care facility
3. McPherson Hospital in Howell; cafeteria and patient food service
4. People's Food Cooperative's Packard store in Ann Arbor; grocery store
5. Steelcase in Grand Rapids; office furniture manufacturer

Project publications are available through the Office of Waste Reduction Services at the following address:

Office of Waste Reduction Services
Michigan Departments of Commerce and Natural Resources
P.O. Box 30004
Lansing, MI 48909

The final report provides a general description of the methodologies used in this project and summarizes and discusses significant findings from the five case studies.

II. METHODOLOGY

The project was organized into two main phases:

- Phase I. Selection of Commercial/Industrial Sectors and Firms for Case Study
- Phase II. Case Study Research

PHASE I. SELECTION OF COMMERCIAL/INDUSTRIAL SECTORS AND FIRMS FOR CASE STUDY

The major criterion used to select a waste reduction technique or technology for research was its potential for decreasing the size of the waste stream if it is implemented sectorwide. Factors that affect the transfer of waste reduction technology include size of the operation, number of employees, type of process, and organizational structure. To facilitate technology transfer, waste reduction programs were researched in firms that are characteristic of others in the sector. Inquiries to trade associations, solid waste management consultants, and individual firms were conducted to identify successful source reduction programs.

Signed publicity releases were obtained from each firm so that the research results can be disseminated throughout the commercial/industrial sector.

Task 1. Establish Criteria for Selection

The following criteria were used to select the five case study firms:

1. Potential impact on the nonhazardous waste stream if waste reduction practice is implemented by other firms statewide
 - a) amount of waste reduction achieved by model firm
 - b) number of firms within the state that can implement the technology
 - i. model firm representative of other firms within a sector
 - ii. transferability of waste reduction practice across sectors
 - c) major sector of the economy
 - i. employment
 - ii. number of establishments
 - iii. pollution abatement solid waste data
 - iv. value added, sales
2. Subject firm emphasizes preferred hierarchy of waste reduction practices
 - a) source reduction, including reuse
 - b) on-site composting and recycling
 - c) off-site composting and recycling
3. Product life cycle impact and risk assessment
 - a) Does this waste reduction program create or magnify additional risks and impacts in the life cycle of the product (raw materials extraction, manufacturing, use, resource recovery, disposal)?
 - b) Do cumulative product life cycle impacts and risks exceed alternative products/processes?

4) Information availability

- a) Data records
- b) Accessibility
- c) Signed Public Release

5) Subject firm demonstrates a variety of source reduction practices

- a) product design changes
 - i) product life extension (durability)
 - ii) eliminate or reduce packaging
 - iii) product composition
 - iv) product quality
- b) input material changes
 - i) material composition/quality
 - ii) material substitution
- c) process changes
 - i) process design
 - ii) process layout
 - iii) process control
- d) operational changes
 - i) management practices
 - ii) material handling improvements

Task 2. Search for Candidate Firms

A search was conducted to identify five model firms from different commercial/industrial sectors which have implemented successful waste reduction programs. The major commercial/industrial sectors are presented in Appendix A along with their two digit S.I.C. Codes. Several sources were contacted to generate a list of candidate firms. These included interviews with staff at the Office of Waste Reduction Services of the Michigan Departments of Natural Resources and Commerce, and at the Resource Recovery Section, Waste Management Division, Department of Natural Resources. A letter and survey were sent to approximately 60 major trade associations, environmental organizations, and waste management consultants requesting names of firms and contact persons. A copy of the letter and survey are included in Appendix B.

Economic data on the major sectors in Michigan was obtained from *County Business Patterns*, U.S. Bureau of Census. Solid waste generation data for commercial/industrial sectors are extremely limited. Solid waste data are compiled by two digit SIC code for Michigan in *Pollution Abatement Costs and Expenditures, Current Industrial Reports*, U.S. Bureau of Census. These economic and solid waste data do not necessarily indicate which sectors or firms present the greatest opportunities for waste reduction.

The candidate firms were contacted by telephone to obtain information on their waste reduction programs and to compile a general information profile on each business. In many cases, several persons were interviewed to collect the necessary information. Comprehensive descriptions of waste reduction activities were not recorded if the interviewer discovered that the business did not wish to participate in the project.

Task 3. Final Selection

After an initial search, candidate firms were ranked using the selection criteria. It was difficult to construct a precise scoring system for ranking candidates, so the research group relied on a more subjective review process to identify subject firms from among a number of possibilities. A letter identifying the waste reduction activities that were to be investigated and defining the scope of the project was then sent to the five case study firms as a means of seeking their formal approval. The letter emphasized that case study reports would be disseminated throughout the state, so classified or proprietary information should not be provided.

PHASE II. CASE STUDY RESEARCH

The work of Phase II was organized into three tasks.

Task 1. Investigation of Case Study Firm

An on-site visit of each firm was conducted to collect data necessary for process, economic and organizational/motivational analyses. A basic description of business activities, structure and organization was part of the on-site investigation.

A variety of waste reduction activities may have been implemented by the firm under investigation. For each case study, successful source reduction activity was analyzed in detail and the other activities were described in less depth.

Source reduction can be accomplished through changes in design (product composition, product life extension, reduction in product packaging); material input changes (material quality, material substitution); process changes (process design, equipment, layout, process control); operational changes (management practices, material handling improvements); and reuse. An evaluation of recycling and composting is included in each analysis where appropriate, although source reduction is the primary focus of this project.

Case studies focus on waste reduction achieved by specific firms. A comprehensive analysis would treat the entire life cycle of a product including raw material procurement, manufacturing, use, resource recovery, and disposal. The overall goal of a waste reduction activity should be to reduce cumulative life cycle risks and environmental impacts. Approaching waste reduction from this broader framework prevents the shifting of impacts between segments of the life cycle and can lead to more optimal resource management.

Process Analysis

Each case study's process analysis was conducted for two cases: the case before implementation of the waste reduction activity and the case after implementation of the waste reduction activity. Operational analyses were performed in such detail that source reduction technology could be transferred efficiently and accurately to other firms. A process methodology which outlines the scope of the process analysis and the specific methods used for data collection and analysis is provided with each case study report.

The first step of the process analysis was to define the system boundaries and thus develop a basis for comparative analysis. System boundaries were limited to the business under investigation. Other segments in the life cycle of the product or service under study were outside the scope of the analysis. For example, in a comparison of disposable and cloth diapers, the solid waste generated in diaper manufacture was not evaluated.

The three main components of the process investigation were:

- inputs to the process
- operational aspects of the process itself
- outputs, both useful products and waste products

Inputs include all the raw materials, energy, labor, and other factors that are combined to produce a good or provide a service. Time and motion studies were conducted to determine the labor requirements for each waste reduction activity. Generally, single measurements were taken to provide an estimate of the labor requirements for operational steps associated with the waste reduction activity.

For most case studies, generalized process flow charts of the analyzed waste reduction activity were prepared. These diagrams trace the flow of materials through each operational step for both the before and after waste reduction cases. Material flows and transformations which are not affected by the waste reduction change were not analyzed in depth. Equipment, operating conditions, and other specifications are included in the process description. Equipment specifications and utility requirements were generally obtained from the manufacturer. In the case of the food retail study, a comparison of inventory and shelf space area requirements for bulk and prepacked goods was made through direct measurements. Problems associated with the implementation of the waste reduction activities were discussed as part of the process analysis.

Characterization of material streams required quantification of weights and flow rates. In some cases, data were available from company records or from waste disposal companies servicing the case study firm. Other waste reduction programs were implemented without measurement of the waste streams. For these latter cases, materials were weighed to determine the amount of waste reduction achieved. For small packaging materials, analytical balances were used to obtain greater accuracy.

Economic Analysis

The net cost associated with the implementation and operation of a source reduction strategy was evaluated in each case study firm. The analyses account for fixed and operating costs required to implement each documented waste reduction activity. Businesses wishing to implement waste reduction programs may find that their cost analyses differ from the case study examples due to variations in economies of scale, wages, and disposal costs. Cost will likely be a major component of determining how willing other businesses may be to adopt the documented waste reduction technologies.

The cost analysis was performed from the perspective of the business. External life cycle costs were not quantified, because they were outside the scope of this study. In many cases, however, external costs were identified and discussed. Costs or revenues that are unaffected by the waste reduction processes were not evaluated to simplify the analysis. The analysis consisted of an evaluation of baseline costs and revenues contrasted with after-intervention costs, revenues, and savings. The inputs, outputs, and operational steps of the process analysis were used as a guide to identify items for the cost analysis.

Organizational/Motivational Analysis

Transforming new ideas into standard operating procedure requires overcoming informational and motivational barriers. To assist businesses interested in developing and adopting waste reduction programs, the research group collected information that described the history of the waste reduction innovation. The following organizational and motivational questions were asked to identify the source of the innovation and the process for its implementation:

- Who originated the waste reduction innovation?
- What groups (e.g., engineering, process management) were instrumental in getting the idea on the decision-making agenda? Which group within the company acted as the most effective advocate of an idea throughout its evaluation (e.g., top management, production managers, workers)?
- What factors were critical in gaining acceptance (e.g., payback period, effect on product quality, total costs)? What obstacles had to be overcome for the successful implementation of the program?
- How much time did this project take from conception to implementation?
- Is there a company policy that supports waste reduction? Is there a program to involve employees in waste reduction planning?

A comprehensive set of questions used to interview employees and management about organizational and motivational aspects of waste reduction is provided in Appendix C. A survey was distributed among a random sample of employees at all levels of each case study firm to evaluate their attitudes regarding waste reduction. A copy of the survey is in Appendix D.

Task 2. Potential Impact on Sector Waste and Transferability

The potential impact of a waste reduction program on Michigan's waste stream can be estimated by quantifying the waste reduction achieved by each case study firm then extrapolating these results based on several assumptions. Perhaps most critically, each waste reduction program is assumed to be implemented throughout an entire sector in which no other business is already practicing similar reduction methods. To further facilitate estimations of statewide impact, the operational and waste stream characteristics of the case study firms are assumed to be representative of the sector. Extrapolations were based on either the number and size of establishments in a sector or sales data from case study firms and appropriate sectors. These extrapolations assume that waste generation and waste reduction are proportional to sales or size.

Factors affecting transfer of the model waste reduction programs to other firms and the successful implementation of these programs were discussed for each case study. Such factors may include: the degree to which the success of a program depends on the initiative of individuals or a specific form of business organization, the number and size of operations to which a modified version of the model waste reduction program could be applied, the degree to which other firms use similar inputs and processes, and the initial investments that might be required to implement a reduction program.

Task 3. Case Study Documentation

Preparation of Fact Sheets

A two page Fact Sheet was written for each case study. It contains the following essential information: a general description of the enterprise, a general description of the waste reduction process, equipment and personnel requirements of the reduction program, a brief cost analysis, and the amount of reduction achieved.

The Fact Sheets provide information on effective waste reduction techniques and address key factors associated with successful implementation of various reduction strategies, thus encouraging firms within the same commercial/industrial sectors to adopt similar waste reduction technologies

and programs. The set of five case study Fact Sheets can also be used to promote waste reduction among firms outside the sector being analyzed.

Preparation of Case Study Reports

The Case Study Report contains more comprehensive information regarding the actual implementation of each source reduction program analyzed. It includes process details, an itemized cost analysis, and organizational and personnel requirements.

Without revealing proprietary information, it documents operational, organizational, and motivational factors in sufficient detail to eliminate or reduce uncertainties associated with implementation of a new process, technique, or technology. However, it is not intended as a comprehensive guide that identifies all possible waste reduction opportunities for each sector studied.

III. SIGNIFICANT FINDINGS

SELECTION PROCESS

Trade associations and government agencies provided assistance in compiling a list of candidate firms. Waste reduction consultants and environmental organizations were also contacted during the initial search phase, but neither proved willing or able to assist the study. Details of successful waste reduction programs implemented under private contract were considered proprietary, and environmental organizations did not respond to requests for information. Thus, the full range of innovative, aggressive waste reduction programs may not have been available for study.

Once a set of possible companies is selected, and some preliminary contact identifies successful practices, management approval should be obtained at an early stage. Significant time should not be invested in preliminary contacts before final approval has been obtained from managers who are authorized to grant broad access to the investigative team.

To facilitate their decision, managers should be given a sufficiently detailed outline of how the study is to be conducted and what it entails. A case study requires some time commitment from various employees for data collection and review. Firms must be willing to allow several on-site visits and also provide access to key personnel for follow-up interviews.

A company's willingness to share information frequently proved critical to their participation in the study. Several companies described innovative waste reduction practices and seemed eager to publicize their success but nevertheless declined to be involved in the project when apprised of the case study's detailed nature. Successful waste reduction measures are sometimes based on process or procedural changes that have ramifications beyond the waste reduction field. Innovations that could allow competitors to cut costs or increase the quality of goods and services may be withheld from public discussion, preventing a detailed study of the company's most effective waste management practices.

Other firms were removed from consideration when problems arose concerning the proposed economic analysis of their waste reduction methods. Either cost data were not available and could not easily be gathered by the research group, or the economic details of waste reduction were considered proprietary and therefore unavailable for public disclosure.

Finally, the type of waste reduction activities at candidate firms played an important role in the selection process. Businesses that have well-established recycling programs, but practice limited or nonexistent source reduction, were rejected in favor of companies with a primary focus on source reduction.

Visits were arranged at some firms surviving the initial selection process to obtain more detailed information. Final selection was then made from a pool of cooperative firms with the best source reduction programs.

Most firms were acutely aware of the publicity benefits inherent in being selected for a detailed case study of waste reduction. Additional benefits may also accrue to participating firms. As part of the study, each company receives an independent process and cost analysis of a specific waste reduction activity. Although the cost analysis is restricted to the information necessary for a comparative evaluation, participating firms still obtain a useful outside analysis of their methods.

Summary

- Trade groups and government agencies provided the best overview of candidate firms.
- Initial contact should establish which firms have the most successful source reduction practices, and only the best examples should be further investigated.
- Upper level management approval is critical at an early stage in the selection process. Access to data and a commitment of time must be fully authorized before the study proceeds.
- Many firms with successful waste reduction programs decline to publicly divulge details they consider proprietary and are thus unwilling to be the subject of a detailed case study.
- The benefits of participation should be stressed to candidate firms. Companies selected for the study receive free publicity and can also obtain an independent assessment of their waste reduction practices.

COMMERCIAL/INDUSTRIAL WASTE GENERATION

Many companies have not conducted waste stream assessments of their operations and do not have a precise understanding of their waste production. Some data on waste generation are available from *Current Industrial Reports, Pollution Abatement Costs and Expenditures*, U.S. Department of Commerce, Bureau of the Census. This broad overview is compiled from incomplete industry provided data, but it does provide some information on general trends. A far more detailed waste stream assessment of various economic sectors would assist in waste reduction planning and implementation. Ignorance of the magnitude and details of waste generation frequently makes accurate planning impossible.

WASTE REDUCTION ACHIEVED BY CASE STUDY FIRMS

Packard People's Food Co-op

Sales of bulk vs. prepackaged olive oil and shampoo were analyzed at the Packard People's Food Cooperative in Ann Arbor. Sale of bulk olive oil at the Packard PFC reduced waste generation by .35 lb for every pound of olive oil sold.

Waste generated by one pound prepack oil:	0.52 lb
Waste generated by one pound bulk oil:	0.17 lb
Net reduction in solid waste:	0.35 lb

Bulk shampoo sales do not lower waste generation as dramatically; only about 0.06 pounds per pound of product. Nevertheless, lightweight plastic shampoo bottles occupy disproportional volume in landfills.

Estimates of results achieved by the Packard co-op's full range of other waste reduction methods were made by extrapolating data gathered during a two week period in July 1990 to a full year, using sales figures. Waste generation was assumed to be proportional to sales. The two week study period demonstrated typical sales.

Waste reduction totals an estimated 43 tons annually at the Packard People's Food Co-op. Approximately 23 tons of waste are diverted from landfills by source reduction, which includes packaging reduction and reuse, and surplus food donations. This figure does not include any source reduction resulting from bulk sales. The remaining 20 tons are diverted by composting and recycling. The following figure graphically represents the Packard PFC's overall waste management practices.

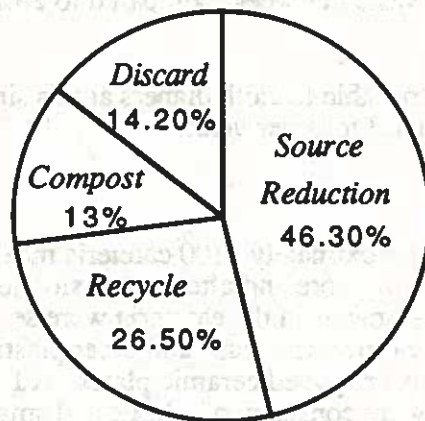


Figure 1. Results of Waste Reduction Methods at Packard People's Food Co-op

Figure 1 clearly illustrates the importance of source reduction in Packard's waste management program. Composting also makes a significant contribution to waste reduction, accounting for nearly as much total weight as all material discarded by the co-op.

Gretchen's House III

Estimates of waste reduction at Gretchen's House III are based on twelve infants using diapers during a five day week. Before the conversion to cloth diapers provided by a diaper service, an average of 210 disposable diapers were used each week for 12 infants. After the conversion, 60 disposable diapers are used each week for the final diaper change of the day. If parents use cloth diapers at home, infants are sent home in cloth diapers and returned in cloth diapers the next day; however, very few of the children are diapered in cloth at home. For 12 infants an average of 160 cloth diapers are used each week. Ten (10) of these diapers are used for purposes other than diapering, such as burp clothes and diaper changing pads. One cloth diaper is used per change, the same rate as disposables.

Gretchen's House III purchased 36 waterproof outer wraps for use with cloth diapers. Outer wraps prevent leakage and are essential for an effective cloth diapering system. Wraps are laundered at the day care center.

The conversion from disposable to reusable diapers resulted in a reduction of 53 pounds of solid waste per week. If cotton diapers were used exclusively, the diaper-related solid waste generation rate would decrease an additional 19 pounds per week. Solid waste generated by the disposable system includes disposable diapers, fecal matter and urine, and garbage bags used for disposal of the diapers.

Solid waste produced at the day care center by cloth diaper use consists entirely of plastic refuse bags provided by the diaper service to collect soiled diapers and wraps. A single bag is used each day to collect the wraps and one bag is used each week to return soiled diapers to the diaper service. The diaper service is currently investigating opportunities to recycle these bags. Only .32 lb of solid waste is produced each week by using cloth diapers.

The average diaper washed by the diaper service can be reused 125 times.² Old diapers are sold to paint shops, car wash stations, auto body shops, janitorial companies, and furniture manufacturers for use as rags. Cloth diapers enter the waste stream only after they are further degraded by these secondary uses (This occurs outside Gretchen's House III and was not included in estimates of total waste produced at the day care center by cloth diaper use). Discarded cloth diapers generate 0.21 pounds of waste per week, compared to 25.77 pounds of disposable diaper material, not including the feces.

- The conversion from disposable to cloth diapers at this single day care center results in a solid waste reduction of 1.3 tons per year.

McPherson Hospital

McPherson Hospital serves approximately 3100 cafeteria meals and 900 patient meals per week. Both figures remain constant before and after conversion to reusable dishware. Before the introduction of washable dishes, all meals in the cafeteria were served on disposable dishware, primarily expanded polystyrene. Some paper cups and other plastic implements, such as cup lids and straws, were also used. Patients received ceramic plates. All other dishware for patient meals was disposable. Disposable dishware consisted of a large and small bowl, a large and small plate, and two types of cups.

When the hospital food service provider began using washable dishes, ceramic items replaced comparable disposable dishware, with two exceptions. Paper disposable cups are currently used rather than washable glasses, although ceramic cups have replaced expanded polystyrene cups for dispensing hot drinks. A small ceramic bowl replaced the clear polystyrene cup previously used for serving puddings and other foods. This replacement was accomplished without requiring extra dish use. The following table shows how waste production at the hospital was affected by the conversion to washable dishware

² from tests conducted by Diapers Unlimited in Kalamazoo, Michigan

Table 1. Waste Production per 1,000 Meals

Item Being Measured	Disposable	Reusable	Difference
	Case	Case	
Dishware Disposal Weight	33.5 lb	0.25 lb	33.3 lb
Packaging Weight	9.5 lb	0.00 lb	9.5 lb
Total Disposal Weight	43.0 lb	0.25 lb	42.8 lb

As this table demonstrates, disposable expanded polystyrene dishware added 33.5 pounds to the hospital's waste stream for every 1,000 meals served. Even though McPherson has no access to a corrugated cardboard recycling program, packaging comprises only 22% of total discards from disposable dishware use.

Ceramic dishes are much heavier than polystyrene equivalents, yet because just 5% of total inventory breaks annually, ceramic dish use adds only .25 pound to the kitchen waste stream for every 1,000 meals served. McPherson hospital reduced waste production by 42.8 pounds per 1,000 meals after converting to washable dishes in its food service operation.

- McPherson Hospital will produce 4.5 less tons of waste per year by using washable dishes.

Other source reduction practices at McPherson include: repair by volunteers of various linens, gowns, and bedding items; double-sided photocopying of office documents; use of tablets made at the hospital from paper printed on one side; and the conversion from disposable to cloth diapers in the obstetrics department. Cloth diaper use at McPherson will divert about 1 ton of material from state landfills annually.

McPherson also recycles computer paper, mixed paper and containers made from glass, steel, aluminum, and plastic. The hospital's recycling program will divert an additional 21 tons of material from landfills per year, if current rates are maintained.

Steelcase Inc.

An integral part of waste reduction at Steelcase is the Machine Improvements Program. It is a proactive program to improve production processes by reducing material waste, machine downtime, energy consumption, and operating costs. Since the inception of the Machine Improvements Program, over 100 projects have been successfully implemented. A detailed study of several machine improvements revealed the following waste reductions:

- IMA Edge Bander adjustments: 16.9 tons less waste per year
- Assembly Table improvements: 4.3 tons less waste per year
- High Performance Roll Form Machine adjustment: 45 tons less waste per year

IMA Edge Bander Machine

This machine bands the edges of tables and desk tops with a laminated plastic strip. A table top is first cut to width, then rotated and squared with a one eighth inch cut. Tops were occasionally not cut squarely because mechanical switches failed to sense the top as it was delivered. This occurred three or four times per day, and interfered with the plant's production schedule. To improve the reliability of the machine, photoeye sensors were installed to sense tops

as they entered the cutting unit. A blow-off fan was also installed to keep the photoeye sensors clear of dust. The IMA edge bander machine improvement reduced waste production by three 45 pound pieces of composite board per day. Projected to a 250 day annual production schedule, this improvement will reduce waste discards at Steelcase by 16.9 tons per year.

Assembly Table

Desks and tables are assembled here. Previously, various pieces occasionally fell out of position, unnoticed by assemblers until it was too late to readjust them. Poorly positioned pieces were cut off and reassembled. Eight supports now hold the pieces in position until the glue has dried. Before this improvement, eight 3.6 pound pieces of wood trim were scrapped per day over a 300 day annual production schedule. The new support system reduces waste generation by 4.3 tons per year.

High Performance Roll Form Machine

New computer hardware and software were installed on the High Speed Roll Form Line, allowing faster processing of motor commands and faster response to those commands. Accuracy of the Flying Cutoff on the new system tripled after the improvements. On the old system, the Feeder could only be tuned with difficulty, and adjustments were soon lost, forcing reduced production rates. Dramatically improved accuracy on the new system can be maintained by software tuning which does not deteriorate. Line speed can thus be increased, and is no longer a significant factor in accuracy. Improvements on the Flying Cutoff and Feeder reduce scrap from 2-5 parts at start up to 0-2 parts each start up. The only major cause of cutting errors now is variation in the steel feedstock. Improvements to the High Speed Roll Form Machine save 70,000 parts per year and reduce solid waste by 45 tons annually.

Other waste reduction practices at Steelcase were not fully quantified. Steelcase practices a variety of source reduction and recycling activities that significantly reduce the company's waste production.

- Uncartoned shipment of chairs reduces packaging requirements by 1200 tons per year.
- Binder bins shipped without cartons require 70 tons less packaging annually.
- Pallet reuse diverts 296 tons of material from landfills yearly.
- A newly instituted office paper recycling program for a portion of Steelcase's operations will reduce waste discards by 138 tons annually.
- A plan to recycle cardboard will reduce waste going to landfills by 3500 tons per year.

Steelcase also recycles, or is considering recycling, fabric, foam, oil, and steel waste generated at its facilities.

Due to the scope and size of Steelcase's operations, an estimate of total waste reduction achieved by the company was not attempted. The preceding waste reduction results are provided to give examples of how Steelcase diverts materials from landfills through various practices.

Hudson's

Hudson's uses packing material as protection when shipping items to customers and returning merchandise to vendors. Beginning in 1987, the Briarwood Mall store in Ann Arbor experimented with shredding its own office paper waste for packing. Paper shredders used for this pilot program wore out quickly, causing supply problems for the store, but when available shredded paper proved to be an effective packing material. While this trial was in progress, many stores continued to use expanded polystyrene "peanuts" as a packing material.

Early in 1990, all Michigan stores replaced plastic packing with paper. Several types of purchased material were tried before the 17 Hudson's stores in Michigan decided to shred their own office paper waste, which was being discarded at most locations, for use as packing. The shredding site is located in the Southland Mall store in Taylor. High grade office paper of the type that Hudson's shreds is recyclable in some areas, but shredding for reuse is a more desirable waste management practice even in those cases where paper can be recycled. Recycling requires additional energy inputs for gathering, remanufacturing, and distribution compared to direct reuse of the paper for packing. Manufacturing processes also produce waste and pollution, regardless of whether they use virgin or recycled materials.

Before converting to the use of packing material produced from internally generated office paper waste, Hudson's purchased approximately 33,000 pounds of paper packing annually. Hudson's expects to shred 20% of its annual purchase of 210,000 pounds of office paper, producing about 42,000 pounds of packing material.

Waste generation is dramatically reduced by the new system. All material now being shredded was previously discarded, and the only wastes generated by the new system are the plastic bags used for shipment and some shredding litter. Weight of the bags used to package purchased packing was not calculated. Paper packing use after conversion is projected to remain the same, adjusted for sales, with an estimated excess annual shred of 9,000 pounds available for sale to other retailers.

- Hudson's shredded packing program will reduce waste disposed in Michigan landfills by 21 tons per year.

Other source reduction methods vary at different Hudson's locations. Examples of some store's source reduction practices include:

- Substituting washable dishware for disposable dishware at meetings and staff gatherings
- Working with vendors to reduce the amount of packing material and packaging used for incoming shipments
- Replacing disposable batteries used for displays and staff equipment with rechargeable batteries
- Reducing office paper weight for some applications
- Double-sided photocopying of reports

Corrugated containers are recycled at each location and lightweight plastic bags from all stores are concentrated at the Southland Mall store for baling and recycling.

- The 17 Michigan Hudson's stores divert 700 tons of corrugated board from landfills each year. Plastic recycling reduces waste generation by another 8 tons annually.

ECONOMICS OF WASTE REDUCTION

Packard People's Food Co-op

A variety of costs incurred by the co-op after wholesale purchase of olive oil and shampoo were analyzed. Only those added costs necessary for a comparative evaluation were documented.

Total store costs analyzed in this study for bulk olive oil are \$3.10 per pound. The retail price of bulk olive oil is \$4.99 per pound, or \$1.89 per pound more than analyzed store costs. Prepackaged olive oil costs the store a total of \$3.40 per pound, and is sold for \$5.15 per pound, a difference of \$1.75 per pound.

Bulk shampoo costs Packard \$1.64 per pound, and is sold for \$2.65 per pound, a difference of \$1.01 per pound. Prepackaged shampoo costs \$2.35 per pound, and is sold for \$2.92, a difference of only \$.57 per pound.

The analyzed added costs of the two bulk products are less than or equal to the added costs of the corresponding prepackaged products. The total calculated cost of selling a pound of bulk oil is about \$.30 less than a pound of bottled oil. The total calculated cost of selling a pound of bulk shampoo is about \$.70 less than bottled shampoo. This allows the co-op to sell bulk products at a lower price and at a greater profit margin than equivalent, prepackaged items. The following figure demonstrates how the cost of selling prepackaged olive oil differs from the cost of selling bulk olive oil at the Packard People's Food Co-op.

Cost Per Pound of Bulk and Prepack Olive Oil

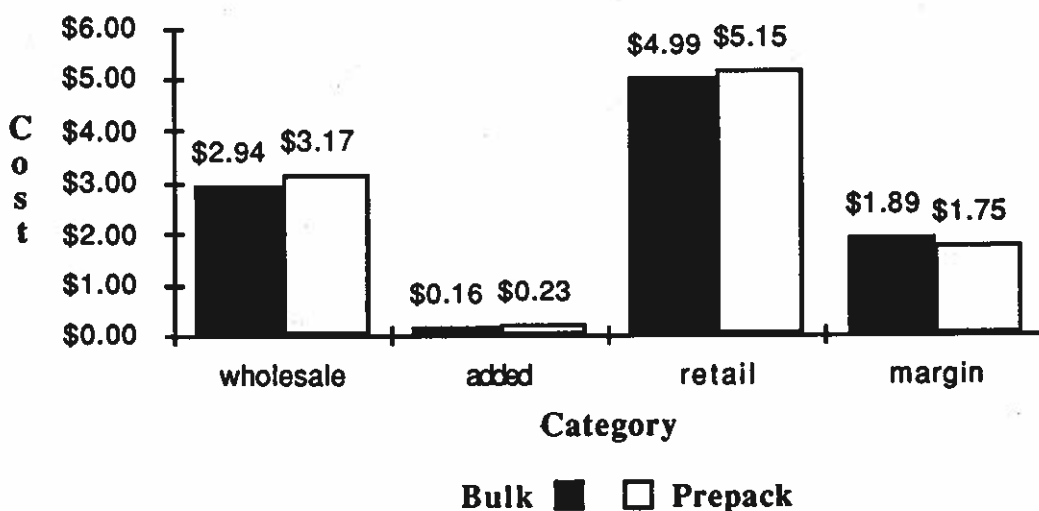


Figure 2. Costs of Selling Bulk and Prepack Olive Oil
(margin = retail - (wholesale + added). Not all added costs were analyzed, so actual margins are less than the above figure suggests.)

The lower wholesale cost of bulk merchandise is the main reason for the cost difference between bulk and prepack products in both the olive oil and shampoo cases. As the olive oil case demonstrates, lower added costs can also reduce store costs and allow Packard to sell bulk olive oil with a larger margin than prepackaged oil. Added costs were essentially the same in the shampoo case. The margins estimated in this graph are the result of subtracting wholesale and added costs from the retail price. Because all added costs are not quantified in this analysis, actual margins will be significantly less than these figures suggest.

Costs not included in the analysis (e.g., overhead costs, floor cleaning, and light bulbs) are a significant portion of total store costs. Nevertheless, it is assumed that they would be assigned equally to bulk and packaged product. Therefore, the results of a more comprehensive cost analyses would not be qualitatively different. In addition, labor for daily inventories is not evaluated here; prepackaged products are likely to require more frequent shelf inventories and thus be more costly to sell.

- Bulk items are less costly for Packard to sell than equivalent prepackaged goods.

Gretchen's House III

The conversion from disposable to cloth diapers resulted in a cost savings to the day care center of \$226 per year. The total cost per week for the disposable system was \$52.40. The cost for diapering after conversion to cloth was \$47.96 per week, which includes a cost of \$32.99 for cloth diapering and \$14.97 for the last change of the day into disposable diapers. The disposable system previously used at the day care center cost \$.25 per diaper, and the cloth system that replaced it costs \$.22 per diaper, which includes a disposable for the final change of the day.

The major cost for the single-use system is the disposable diapers. This cost accounts for 92% of the total cost per child. Other costs include refuse bags for diaper disposal, transportation costs for purchasing the diapers each month, and labor costs for purchasing and stocking the diapers.

Solid waste disposal is a significant environmental cost not included in the total costs incurred by the the day care center. Gretchen's House III owns a four cubic yard dumpster that is serviced weekly by the City of Ann Arbor. The conversion to cloth reduced waste discards by half, but the collection and disposal cost to the day care center remained unchanged. The City of Ann Arbor includes collection and disposal fees as part of property tax assessment; these fees are not calculated on a weight or volume basis.

Total costs per week would increase \$2.39 before the conversion and \$0.64 after the conversion if disposal costs to the city were included in the overall analysis. Increased costs in the cloth diaper case are comprised essentially (\$0.63) of the disposable diapers infants wear to the day care center. A disposal fee system based on weight or volume would make the cloth system even more favorable economically.

The cost of diapering a child in cloth consists of the diaper service cost and the cost for purchasing and cleaning outer wraps. The diaper service cost per diaper is \$0.125 or \$18.75 per week, which includes a \$4.00 service charge for delivery. The purchase price for each wrap was \$3.00, which translates into a weekly cost of \$2.12 per week (based on an average life of one year for three dozen wraps). The other costs associated with the cloth diaper system are related to washing the wraps and consist primarily of labor.

Figure 3 shows the allocation of costs for both diapering systems at Gretchen's House III.

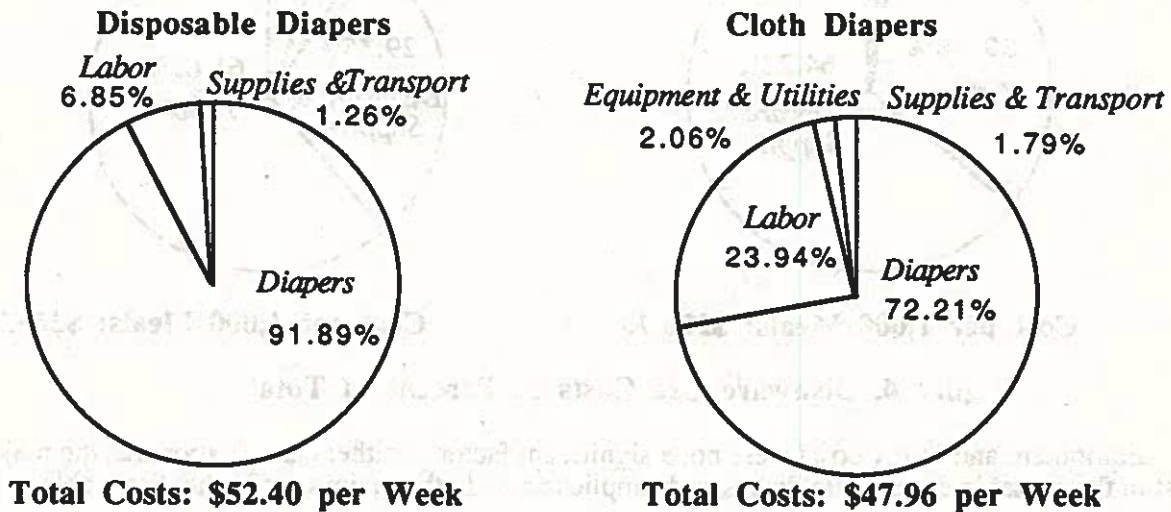


Figure 3. Weekly Costs For the Disposable and Cloth Diaper Cases

Diapers constituted the major costs in both cases. Labor comprised only 6.8% of total costs in the disposable case, but nearly 24% of total costs in the cloth diaper case. Supplies, equipment, transportation, and utilities do not contribute significant costs to either case.

- the conversion to cloth diapers saved Gretchen's House III \$4.44 per week, or 9.3% of total diapering costs.

McPherson Hospital

Two categories account for over sixty percent of total costs in both the disposable and reusable dishware cases:

- Labor costs nearly double when ceramic dishes are used.
- Dishware and supplies cost half as much when ceramic dishes are used.

Labor costs increased significantly after McPherson Hospital converted to washable dishes. When disposable dishes were used, fifty (50) thirty (30) gallon bags of trash were discarded from the kitchen daily. After the conversion to washable dishes, the kitchen discarded only two (2) thirty (30) gallon bags of trash daily. The labor required to transfer disposable dishes from collection carts and place them securely in bags, while significant, proved substantially less than the labor required for rinsing, washing, and handling ceramic dishes.

Ceramic dishes cost much less on a per use basis than disposable dishware. The savings realized from lower dishware costs essentially counterbalances increased labor costs, resulting in little overall difference between the disposable and reusable dishware cases.

The following figure shows how costs are allocated in each case.

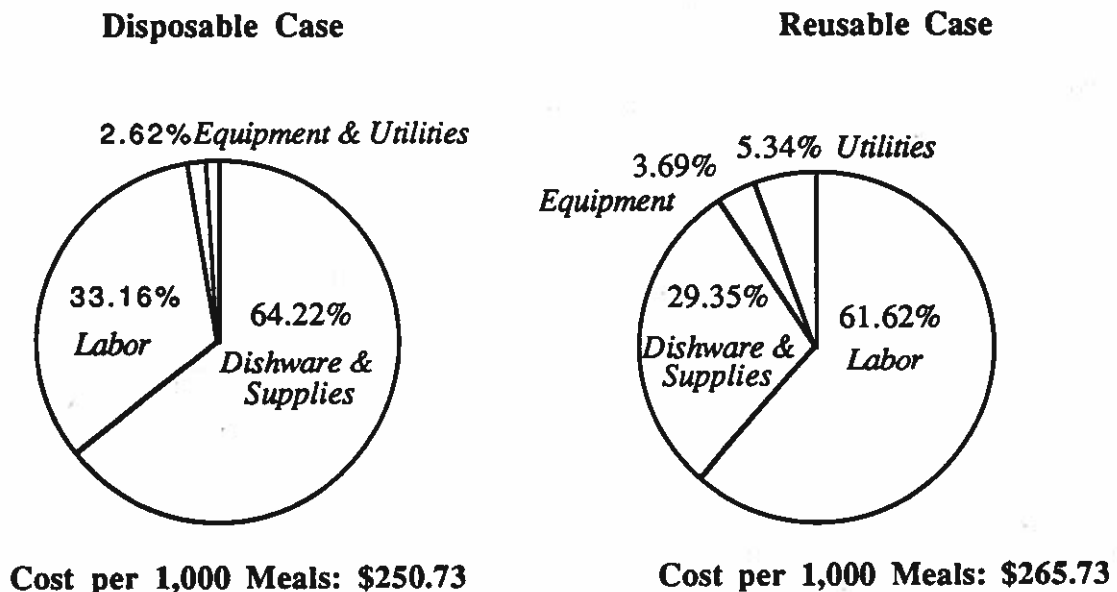


Figure 4. Dishware Use Costs as Percent of Total

Equipment and utility costs were not a significant factor in either case. Labor was the major cost in the reusable case, while dishes and supplies provide the major cost in the disposable case.

Changing costs in relatively minor categories could easily make reusable dishware less expensive to use than disposable equivalents. McPherson Hospital employs heated dispensing racks in its washing operation, a nonessential item, particularly for cafeteria meals. Purchase and use of these racks costs approximately \$7.70 per 1,000 meals. Offering drinks in washable glasses could have a much more powerful effect on comparative costs. Even if disposable cups are deemed essential, expanded polystyrene cups cost approximately half as much as paper equivalents. Use of EPS cups would reduce costs in the washable dishware case to approximately \$250 per 1,000 meals.

Further analysis reveals that costs in the disposable case are sensitive to changes in the price of dishware, but less sensitive to changes in disposal fees. Sixty four percent of total costs are allocated for dishware and related supplies; disposal fees account for only 1.6% of total costs. In the short run, increases in the cost of disposable dishware can thus be expected to have a much greater impact on the economics of disposable dishware use than increases in disposal fees.

Changes in labor costs would have the greatest impact on the cost of using washable dishes. An increase in labor costs, without an accompanying increase in the cost of disposable dishware or in the productivity of the workforce, could change the comparative economics of reusable dishware use. However, labor also constitutes 33% of total disposable dishware use costs, so any increase in labor costs would also affect the disposable case.

McPherson Hospital had a surplus of dishwashing capacity while using disposable dishes. No major equipment purchases were necessary when reusable dishes were substituted for disposable items. Purchasing a new dishwasher of the same brand and size of McPherson's would cost an additional \$7 per 1,000 meals, depreciated according to accepted accounting practices (i.e., yearly costs are purchase price divided by life expectancy of the product).

Reorganizing a kitchen to accommodate a rinsing and washing area may be just as costly as purchasing new equipment in those hospitals where no dishwashing is now done in the kitchen. Hospitals with dishwashers and rinsing equipment are likely to find the economic aspects of the conversion at McPherson more applicable.

- Reusable dishware costs McPherson Hospital slightly more to use than disposable dishware, but a modest alteration of procedures could make washable dish use cheaper.

Steelcase Inc.

The Machine Improvements Program analyzed in the detailed case study was instigated to provide Steelcase with a competitive edge through cost savings and increased production efficiency. Therefore, it is not surprising that waste reduction achieved through the methods analyzed in the study saved the company money. Modest capital investments and equally modest labor requirements for machine improvements tend to be one-time costs, while savings are realized over a several year period.

Waste disposal is a significant cost at Steelcase and provides additional motivation for waste reduction. Tipping fees are currently \$39.07 per ton. In several years, that price is expected to be around \$100 per ton. Hauling fees add another \$65 per ton to Steelcase's waste disposal costs. Labor is included in hauling costs, but no estimate of labor costs for gathering and handling waste before hauling was available. In fiscal 1990, total solid waste disposal costs (not including incineration) were \$678,000.

- The machine improvements documented in the detailed case study report lowered costs by \$45,420 per year.
- Shipping chairs uncartoned saves Steelcase \$890,000 per year, which includes avoided packaging and increased shipping efficiency savings.
- Selling pallets for reuse returns \$23,130 per year to the company in revenue and avoided costs.
- Paper recycling will save \$7,920 per year in avoided disposal costs.
- Recycling corrugated cardboard will save an additional \$218,000 per year from avoided tipping fees and sale of material.

Hudson's

Costs in the purchased packing case are confined to packing material and disposal fees for the office paper waste now collected for shredding. Disposal costs for the plastic packaging used for purchased packing are not calculated. In addition, no estimate of the cost of extra plastic trash bags used for waste collection in the before case is provided. Fewer bags are now needed because paper is separated and collected in corrugated boxes that will be recycled.

The labor cost required to gather and shred paper along with equipment and supply costs associated with the shredding system are significantly less than the cost of purchasing packing material from a vendor. The cost of discarding paper now recovered for shredding did not contribute significantly to the overall cost of the purchased system. Figure 5 compares monthly costs of the two packing material systems.

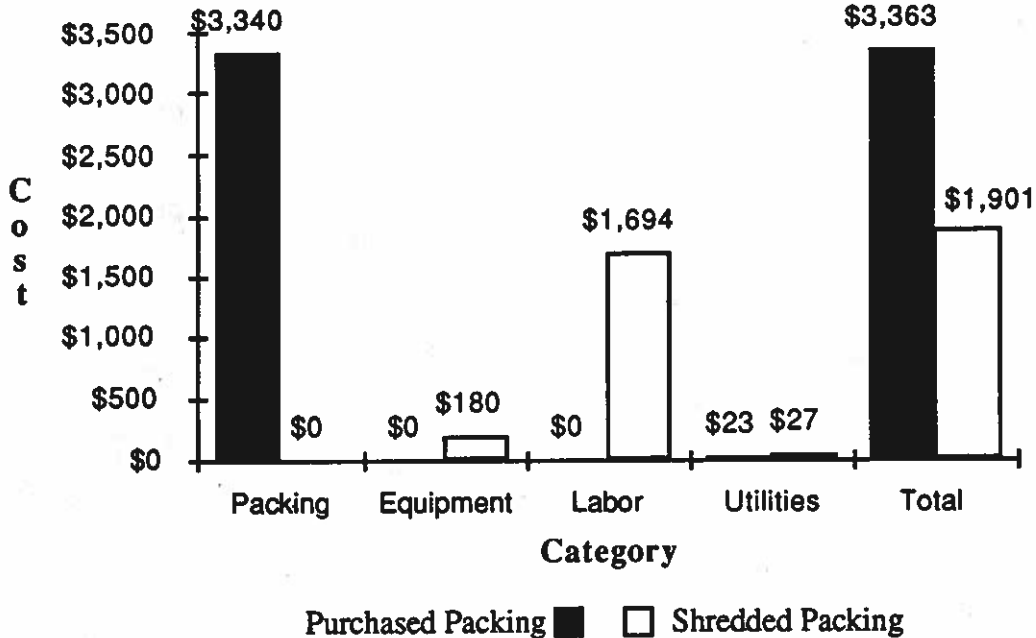


Figure 5. Monthly Cost Comparison Between The Two Packing Systems

Hudson's dramatically lowers packing costs by shredding paper rather than purchasing material from a vendor. As this graph demonstrates, Hudson's will save 43% of costs incurred in the old system by shredding its own paper.

Hudson's plans to shred approximately 27% more collected office paper than it had been purchasing. If this product can be sold at a price equivalent to the price Hudson's was recently paying for packing material, the shredding system could be much more economically advantageous than the above figures suggest. Purchased packing material costs Hudson's about \$1.21 per pound. An excess shred of 9,000 pounds would therefore produce as much as \$10,900 per year in additional revenue. When yearly savings are combined with revenues from sale of excess packing, the shredding program could yield as much as \$28,400 per year.

Summary

The waste reduction practices examined in the detailed case studies either saved firms money or were essentially cost neutral. Although results were similar, details of the cost analyses varied.

At the Packard People's Food Co-op, packaging and handling contribute significantly to the cost of selling prepackaged goods. Bulk sales allow some of these costs to be avoided or passed on to the customer in the form of added labor for purchasing. Additional time required to price bulk items at check out is outweighed by the labor inputs necessary to sell prepackaged goods.

Both Gretchen's House III and McPherson Hospital demonstrate how the added labor required in a reusable system is counterbalanced by the cost of disposable items. Alleged inconveniences and added costs attending a reusable system never materialized in either case.

The Steelcase study demonstrates how wasteful manufacturing requires more material input to produce the same output and also creates other costly inefficiencies. Labor required to gather and process waste is frequently substantial and is an often overlooked business cost. Systems and practices designed to be more efficient and less wasteful should naturally produce cost benefits.

At Hudson's, the cost of purchased packing material was substantially greater than equipment and labor needed to shred office paper for use as packing. The economic advantages of reusing internally generated material for an innovative purpose are clearly demonstrated by the Hudson's example.

Labor can be considered a hidden cost of many practices that produce excess waste. At McPherson Hospital, a significant portion of costs in the disposable system was allocated to gathering and handling waste, while at Steelcase waste handling costs, although not precisely quantified, contribute significantly to the final cost of waste disposal.

When overall societal costs of disposable systems or wasteful production methods are considered, the economic benefits of waste reduction are even more evident.

ORGANIZATIONAL AND MOTIVATIONAL FACTORS RELATING TO WASTE REDUCTION

Packard People's Food Co-op

The Packard People's Food Co-op's array of waste reduction activities is based on its philosophical commitment to environmentally friendly business practices and shaped by its small, democratically managed organization.

The following product guideline reflects the People's Food Co-op's philosophical orientation.

1. Top priority is given to natural foods, meaning products free of any artificial ingredients.

2. To further insure the quality of our foods, PFC looks for: whole foods, those with a minimum of processing and refining; organic foods, those grown in accordance with accepted standards; and best value, items of the highest quality at the best price.
3. Finally, preference is given to products that are: locally produced, produced and/or distributed by cooperatives, produced with the least human, animal, and environmental exploitation, have minimal and ecologically sound packaging.

Several significant elements facilitate waste reduction at the Packard People's Food Co-op:

- A policy to purchase foods with minimal packaging
- Nearly universal staff commitment to reduce waste in the store operations
- A general willingness to consider new ideas and to implement innovations
- The entire staff openly exchanges opinions and discusses the merits of new ideas
- The staff is small (6) and committed the ideal of cooperative decision-making
- People's Food Co-op shoppers are knowledgeable and cooperative
- Staff is committed to consumer education

Gretchen's House III

Major impetus for the conversion to cloth diapers at Gretchen's House III came from a conviction that cloth diapers are environmentally superior to disposables. The idea to use cloth diapers originated with the owner, but staff also wished to help solve the problem of waste generation.

Gretchen's House encourages innovation, change, and improvement in its operation in several ways. First, the staff are considered professionals. They are given membership in the National Association for the Education of Young Children and invited to attend the annual state conference at no expense. Ten hours of observation at other centers or of professional development are required per year, and the staff are encouraged to bring suggestions back to their center.

Second, the administration of Gretchen's House cultivates an atmosphere of flexibility and openness that encourages staff to look for better ways of doing their work. Even though the owner reserves the right to make final decisions, staff members can also make suggestions for changes and complain about problems. There seems to be an ideal combination of upper-level direction-setting (e.g., We will begin to use organic, non-toxic cleansers.) and full staff involvement in implementation (e.g., Which cleansers, where should they be stored, how can this be accomplished?). Suggestions can be made verbally to the administration, or directly at the biweekly staff meeting. New ideas are regularly implemented on a trial basis. During orientation for new staff, directions are sometimes introduced with, "this is the way we do things now...it could change at any time!"

McPherson Hospital

A combination of internal and external factors were instrumental in instigating waste reduction efforts at McPherson Hospital. Key motivational and organizational factors can be summarized as follows:

- A landfill crisis in Howell motivated McPherson Hospital and the surrounding community to reduce waste.
- Food service is provided by Servicemaster, Inc., an outside contractor. A motivated staff and relatively independent manager were major factors in quick implementation of a reusable dishware program.

- Management at Servicemaster and in the hospital responded to staff suggestions. Staff initiated interest in many waste reduction programs and helped make them successful.
- McPherson Hospital's prominent role in the community made it amenable to outside suggestions for waste reduction.

Steelcase Inc.

Factors influencing waste reduction practices of Steelcase Inc. can be divided into four categories:

1. Societal awareness of the environment
2. Business costs associated with the environment
3. Company philosophy and policies
4. Steelcase's World Class Manufacturing program

The first two categories are not unique to Steelcase. They could be the basis for similar waste reduction activities in many other businesses. Factors in the third and fourth categories are more specific to Steelcase and are instrumental in establishing an organizational environment that encourages waste reduction.

Steelcase Inc. Philosophy

Steelcase management seeks good relations with its customers, employees, and the surrounding community. A large manufacturing company inevitably affects the environment, but Steelcase attempts to reduce the environmental impact of its operations as much as possible.

World Class Manufacturing

Steelcase's strategy for manufacturing improvement is named World Class Manufacturing. This program helps create an organizational and attitudinal framework in which solid waste reduction becomes an integral part of the company's management and production activities. Rather than assigning the development and implementation of solid waste reduction measures to a single manager or department, all employees are encouraged to participate in manufacturing improvements.

World Class Manufacturing (WCM) comprises five principles:

- Employee Involvement
- Elimination of Waste
- Product Group Focus
- Quality
- Throughput

Employee Involvement is the central principle of WCM. Steelcase's participative management program actively enlists employees in decision making. Teams of approximately ten people meet at least one hour per week to develop new ideas, make recommendations, and plan innovations. Each team adopts projects designed to make environmental responsibility an integral part of daily activities.

Waste Elimination includes all waste; labor, energy, and material. Every activity at Steelcase should ideally add value to products, if not, it is eliminated.

Product Group Focus links process and design operations to promote standardization and enhance manufacturability.

Throughput is the rate at which a customer's order is transformed into sales dollars. Improved throughput reduces lead time and maximizes manufacturing efficiency.

Hudson's

Cost was a significant factor in motivating Hudson's to replace purchased packing material with their own shredded office paper waste. However, Hudson's also wishes to stay ahead of local ordinances banning nonrecyclable packaging and has implemented a formal policy for encouraging waste reduction. Individual involvement in programs created by local committees, and supported by Central Headquarters, is one of the most important elements in Hudson's successful waste reduction efforts. A structure now exists for encouraging the whole organization to demonstrate a commitment to waste reduction, so program ideas generated by local Environmental Action Committees can be adopted and supported in an efficient manner.

Operations Managers of individual stores also serve as Environmental Coordinators, thus integrating environmental concerns into management policies. These coordinators meet monthly to discuss operational issues which include environmental policy matters. Strategies to reduce waste are discussed at the meetings and innovative ideas are exchanged. The paper shredding operation documented in the case study report is an example of how Hudson's formal organization for implementing environmentally responsible practices functions.

- An organizational structure that provides formal avenues for waste reduction implementation made a major contribution to the success of Hudson's program. Employee participation at all levels produced a greater commitment to waste reduction.
- Hudson's has an effective network for communicating ideas and information between individual stores. Multi-store operations can implement successful local programs much more quickly when such networks exist.

Summary

- An organization that encourages employee participation in planning and implementation may be essential for successful waste reduction programs. People directly involved with procedures that produce the majority of a firm's waste must be involved for waste reduction to be most effective. All the case study firms emphasize employee involvement whether it be through participative management, or other plans that give employees some control over their activities.
- External factors are important in motivating some firms to reduce waste. A landfill crisis in Howell provided primary instigation for McPherson Hospital's waste reduction practices. Steelcase's waste management programs are largely aimed at improving productivity and competitiveness by eliminating all types of inefficiencies. Hudson's packing shredding program was also motivated by cost reduction. Further impetus for waste reduction is provided by Hudson's desire to keep ahead of ordinances banning certain types of packaging and feedback from environmentally concerned customers.
- Internal motivations also appear to be important elements of successful waste reduction programs. The Packard People's Food Co-op and Gretchen's House III implemented waste reduction programs primarily as a result of internally generated factors. Concern for the environment is based on external parameters, but the major motivation for waste

reduction in both cases came from philosophical commitments. Economic considerations did not play an overwhelming role in either case, although it is interesting to note that waste reduction practices at Packard and Gretchen's House III reduced costs.

STATEWIDE IMPACT

Food Retail

The Packard People's Food Co-op practices a wide range of waste reduction measures. Bulk food sales are not included in estimates of Packard's annual waste reduction of 43 tons. If waste reduction achieved by Packard is extrapolated statewide, 420,000 tons could be diverted annually from the solid waste stream by the food retail sector. This extrapolation assumes waste production is proportional to sales.

Estimates of the Packard People's Food Co-op's proportion of state sales were derived from total retail food sales data for 1987³ and 1990.⁴ Total Michigan retail food sales for 1987 were divided by total U.S. retail food sales for 1987 to determine Michigan's percentage of total U.S. retail food sales (.0324). This figure was used to estimate retail food sales in Michigan for mid 1989 to mid 1990 from total U.S. data that was not apportioned among the states. Sales at Packard were provided for mid 1989 to mid 1990, allowing the Packard co-op's relative proportion of Michigan retail food sales to be estimated (Total Michigan sales are 9,925 times greater than sales at the People's Food Co-op's Packard store). This figure was finally multiplied by Packard's annual waste reduction totals to arrive at an estimate of possible statewide waste reduction.

- As much as 420,000 tons of waste can be diverted from state landfills if all stores in the retail food sector follow the Packard PFC's waste reduction methods.

Child Day Care Services

The solid waste stream could be significantly reduced if there was a statewide conversion by all day care centers from disposable to cloth diapers. The greatest potential reduction would be achieved if all infants and adult incontinents in Michigan were diapered with reusable cloth. An estimated 0.68 billion disposable diapers are used annually in Michigan, which is equivalent to 41,000 tons of solid waste. (This is based on an annual total sales of 18 billion diapers nationally, assuming usage is directly proportional to population (1990 population projection under age five: Michigan/U.S. = 3.8%)⁵).

The potential for waste reduction in the day care service sector in Michigan can be estimated through an extrapolation of the waste reduction data for Gretchen's. For this analysis, it is assumed that Gretchen's House III is representative of the average day care center in Michigan (i.e., number of children per day, age distribution), and that other centers adopt the same diapering program implemented at Gretchen's House III. This method of approximation is very crude, but yields an order of magnitude estimate of the potential statewide impact. A statewide reduction of 880 tons of solid waste per year can be expected based on the above assumption.

³ *Census of Retail Trade*, Bureau of Census, U.S. Dept. of Commerce, 1987.

⁴ *Monthly Census of Retail Trade*, Bureau of Census, U.S. Dept. of Commerce, May 1990.

⁵ *Statistical Abstract of the United States, National Data Book*, U.S. Dept. of Commerce, Bureau of Census, ed. 110. 1990.

- Replacement of all disposable diapers used in Michigan by cloth diapers could lower annual solid waste production by as much as 41,000 tons.
- Conversion to cloth diapers by all day care centers could reduce solid waste disposed of in Michigan landfills by as much as 880 tons per year in Michigan.

Hospitals

McPherson Hospital will produce 4.5 fewer tons of solid waste per year after converting to reusable dishes. Assuming all hospitals in Michigan are now using disposable dishware, a conversion from disposable to washable dishes could reduce solid waste production by 880 tons per year in the state. This figure is based on McPherson representing an average case for all 196 hospitals in the state. If some hospitals are already serving meals on washable dishes, less waste reduction will be realized by a total conversion to reusable dishware.

Implementation of the full range of waste reduction methods now practiced at McPherson could have an even greater statewide impact. Assuming that recycling programs are available to all hospitals, but none are now being used, recycling in the hospital sector could divert 7,000 tons of material from Michigan's waste stream each year. This figure does not include corrugated cardboard, which is readily recyclable in many areas. In addition, some hospitals are already recycling various materials, so the actual impact of adoption of the McPherson model by the hospital sector cannot be precisely quantified.

- If all hospitals used washable dishware, waste could be reduced statewide by as much as 880 tons per year.
- Waste reduction could be much more significant if all food service providers converted to washable dishes.
- Adoption of McPherson's full range of waste reduction activities by other state hospitals could reduce waste generation by as much as 7,000 tons per year.

Furniture Manufacturers

No estimate of the impact of Steelcase's waste reduction programs on Michigan's waste stream was made because the scope of this project did not allow a full quantification of all reduction practices followed by the company. Even so, waste reduction achieved by the following programs are worthy of emphasis.

- Various machine improvements reduce waste by 66 tons per year.
- Uncartoned chairs reduce waste by 1200 tons annually.
- Uncartoned binder bins reduce waste by 70 tons per year.
- Pallet reuse diverts 296 tons of material from landfills every year.
- Corrugated cardboard recycling could divert 3500 tons of waste from landfills annually.
- Paper recycling reduces material discards by 138 tons per year.

None of the general waste reduction strategies practiced by Steelcase are confined to the furniture manufacturing sector. Reduction of the state's solid waste stream could be substantial if other manufacturers adopt Steelcase's strategies.

Department Stores

A rough estimate of Hudson's waste reduction programs on state solid waste generation can be made by using sales figures for Hudson's stores and comparing these to figures for the department store sector. Hudson's stores in the state generate sales of approximately \$990 million annually (derived from the 17 Michigan Hudson's containing 55% of all Dayton's and Hudson's retail floor space and assuming sales proportional to retail floor space). This represents about 12% of the \$8.4 billion annual sales in the Michigan's department store sector.

Assuming waste generation is proportional to sales in the department store sector and that all department stores in the state are now discarding at least 20% of their recoverable office paper waste, adoption of the Hudson's shredding program throughout the sector could divert as much as 175 tons of material from Michigan landfills annually.

If the preceding assumptions are applied to recycling, adoption of Hudson's recycling practices by all businesses in the department store sector could reduce waste disposed in Michigan landfills by as much as 5900 tons per year.

Statewide impact of the waste reduction methods practiced at Hudson's would be much greater if projected to the entire general retail sector. In addition, other retailers or manufacturers who require packing material for shipping could easily adopt the Hudson's system, substantially magnifying waste reduction in the state. Customers or vendors receiving shredded paper packing can also reuse or recycle this material, increasing the waste reducing impact of the Hudson's program even further.

- If all department stores shredded used office paper for packing, rather than discarding it, waste generation would be reduced in Michigan by as much as 175 tons per year.
- Adoption of Hudson's corrugated and plastic recycling practices by other department stores could reduce waste disposed of in state landfills by as much as 5900 tons annually.
- Waste could be reduced more dramatically if all manufacturers and general retailers used shredded office paper for packing. Recycling or reuse of paper packing by customers would further increase the waste reduction produced by shredding office paper for packing.

TRANSFERABILITY

Food Retail

Factors Enhancing Transfer of the Packard co-op's Waste Reduction Methods

- Bulk merchandise reduces solid waste generation, storage and shelf space, and total store costs.
- In many instances, converting to bulk sales requires little capital or equipment and can be effected with minor changes in retail operations.
- Through bulk buying, the consumer has control of quantity and is also likely to generate less postconsumer solid waste.
- Other waste reduction practices at Packard divert significant amounts of material from landfills and can be instituted without substantial cost or change in store operations.

Impediments to Transfer of the Packard co-op's Waste Reduction Measures

- Contamination is a greater risk in bulk sales.
- Some products are not well suited to bulk sales.
- Savings realized through bulk sales are, in part, derived from the transfer of labor to the customer. The additional time and effort required by customers to obtain their goods might impede acceptance.
- Organizational changes and employee training are necessary. A commitment to information and consumer education is essential.
- Adoption of Packard's recycling, composting, and food donation practices depends on the availability of local programs.

Child Day Care Services

Factors Enhancing Transferability of Gretchen's House III's Waste Reduction Methods

- Cloth diaper use significantly reduces waste generation.
- Cloth diapers cost less to use than disposables.
- Diaper changing times are the same for both cloth and disposable diapers.
- Diaper services are available in most areas of the state.
- Day care centers that are charged on a volume or weight basis for refuse collection and disposal have an economic incentive to reduce waste.
- Conversion from disposable to cloth diapers may be accomplished in several ways. Large institutions, such as hospitals, may find in-house laundering of cloth diapers to be more economical than a diaper service. In smaller institutions where a clothes washer is not available, arrangements could be made with a diaper service to include diaper wrap washing.
- When commercial provision and laundering of outer wraps is not available, the waterproof outer wraps required for an effective cloth diapering system are readily obtainable, cheap, and easy to use.
- Capital requirements for conversion to cloth diapers are minimal.

Impediments to Transferability of Gretchen's House III's Waste Reduction Methods

- Some areas of the state may not have access to a diaper service.
- Diaper services may not handle outer wraps. Some day care centers interested in using cloth diapers must therefore launder outer wraps in-house. This requires a washing machine, which may necessitate some investment.

Hospitals

Factors Enhancing Transferability of McPherson's Waste Reduction Methods

- Process changes required to replace disposable dishware with reusable dishes are minor, particularly when dishwashing equipment already exists.
- Significant waste reduction can be achieved by using washable rather than disposable dishes.
- Washable dishware use costs approximately the same as disposable dishware use.
- Motivation for waste reduction is high in many communities and companies.
- Other waste reduction practices at McPherson, including recycling and source reduction, require no special technology or organizational effort.

Impediments to Transferability of McPherson's Waste Reduction Methods

- Hospitals without dishwashers may find the process of converting from disposable to washable dishware more complicated and costly than the McPherson case.
- Substantial motivation may be missing in communities that do not feel pressured by landfill problems.
- Large organizations may find it more difficult to implement the full range of source reduction efforts made by McPherson. Differences in scale may require organizational efforts more complicated than those needed at McPherson.

Furniture Manufacturers

Factors Enhancing Transferability of Steelcase's Waste Reduction Methods

- Machine improvements at Steelcase significantly reduce waste generation.
- Reducing waste through machine improvements increases productivity, enhances competitiveness, and reduces costs.
- Many other waste reduction methods at Steelcase significantly reduce costs. Substantial motivation for waste reduction was provided by these cost savings, a factor that all manufacturers should share with Steelcase.
- None of the documented waste reduction methods are confined to furniture manufacturers. Other manufacturers can adopt similar methods to reduce waste generation, lower costs, and increase competitiveness.

Impediments to Transferability of Steelcase's Waste Reduction Methods

- Formal mechanisms, such as participative management that actively involves employees, are a key to the success of Steelcase's waste reduction programs. Companies lacking such an organizational structure may have less success with their waste reduction programs.

Department Stores

Factors Enhancing Transferability of Hudson's Waste Reduction Methods

- Waste paper is produced by all retailers and the Hudson's process for reusing this waste can easily be adopted by any retailer requiring packing materials for customer purchases.
- Significant waste reduction can be achieved by reusing office paper as a packing material.
- Shredding internally generated office paper to use as a packing material saves money, particularly in multi-store operations
- Other waste reduction practices at Hudson's can be readily adopted without significant additional cost. These include:
 - receiving goods in reusable packaging
 - asking vendors to reduce packing and packaging material
 - using washable rather than disposable cups and dishware
 - recycling corrugated cardboard and plastic, where feasible
 - recycling mixed paper waste and aluminum, glass, steel, and plastic containers

Impediments to Transferability of Hudson's Waste Reduction Methods

- Retail operations smaller than Hudson's may find shredding paper for packing material provides no cost advantage over purchased paper packing.
- Retailers without a formal organizational focus on waste reduction, or stores lacking staff participation, may have less success implementing a full range of reduction programs.
- Adoption of some waste reduction practices followed by Hudson's, such as recycling, is dependent on availability of local programs for small retailers.

IV. CONCLUSIONS

- A significant reduction of the waste stream could be achieved if the waste reduction practices outlined in this report were implemented statewide. Many opportunities for waste reduction have not yet been implemented by the case study firms. Other waste reduction programs are in the early stages of development.
- In most cases, the implementation of each waste reduction program resulted in a cost savings to the firm. Many programs were initiated with a relatively small capital investment. Wasteful practices contain many hidden costs, including labor.
- Reuse of internally generated material is an innovative and effective means of achieving substantial waste reduction. All of the case study firms emphasized reuse in their successful waste reduction programs.
- Driving forces behind the implementation of the waste reduction programs were based in some cases on either external factors or internal factors, and in other cases on a combination of both. External factors include costs, competition, and reaction to public environmental consciousness; internal motivations are based on corporate environmental ethic or individual commitment to improving the environment and conserving resources.

- In most cases, employee involvement and/or participatory management were important factors for the successful implementation of a waste reduction program.
- Businesses operating in multiple locations can adopt comprehensive waste reduction programs much more effectively when a network exists for communicating ideas between individual units. A formal organizational structure that provides avenues for employee participation and information sharing helps insure the success of waste reduction programs within local units and between divisions of the company as a whole.
- Impact on the state's solid waste stream from the waste reduction practices studied is potentially significant. If all documented reduction practices were implemented sectorwide, as much as 425,000 tons of material could be diverted from Michigan landfills each year.
- Most of the waste reduction practices at the case study firms can be transferred to other firms within their sectors, and many practices can be transferred to firms in a wide variety of sectors beyond those investigated.

APPENDIX A

Major Commercial/Industrial Sectors and S.I.C. Codes

<i>Title</i>	<i>S.I.C. Code</i>
Agricultural Production-Crops	01
Agricultural Production-Livestock	02
Agricultural Services	07
Forestry and Forest Products	08
Fishing and Hunting	09
Metal Mining and Related Services	10
Coal Mining	12
Oil and Gas Production	13
Nonmetallic Minerals	14
Building Contractors	15
Heavy Construction	16
Special Trade Contractors	17
Food and Related Products	20
Tobacco Products	21
Textiles	22
Apparel and Other Textile Products	23
Lumber and Wood Products	24
Furniture and Fixtures	25
Paper and Related Products	26
Printing and Publishing	27
Chemicals and Related Products	28
Petroleum and Coal Products	29
Rubber and Miscellaneous Plastics	30
Leather and Leather Products	31
Stone, Clay and Glass Products	32
Primary Metal Industries	33
Fabricated Metal Products	34
Industrial Equipment and Machinery	35
Electronic and Electric Equipment	36
Transportation Equipment	37
Instruments and Related Products	38
Miscellaneous Manufacturing	39
Railroad Transportation	40
Local and Interurban Passenger Transit	41
Trucking and Warehousing	42
U.S. Postal Service	43
Water Transportation	44
Air Transportation	45
Pipelines, Except Gas	46
Transportation Services	47
Communications	48
Electric, Gas and Sanitary Services	49
Durable Wholesale Trade	50
Nondurable Wholesale Trade	51
Retail Building Materials and Garden Supplies	52
Retail General Merchandise Stores	53

Retail Food Stores	54
Retail Automotive Dealers and Service Stations	55
Retail Apparel Stores	56
Retail Furniture and Home Furnishings	57
Dining and Drinking Places	58
Miscellaneous Retail	59
Banks and Banking Services	60
Nondepository Financial Institutions	61
Security and Commodity Brokers	62
Insurance Carriers	63
Insurance Agents, Brokers and Services	64
Real Estate	65
Holding and Investment Offices	67
Hotels and Lodging Places	70
Personal Services	72
Business Services	73
Auto Repair Services and Parking	75
Miscellaneous Repair Services	76
Motion Pictures	78
Amusement and Recreation	79
Health services	80
Legal Services	81
Educational Services	82
Social Services	83
Museums, Botanical or Zoological Gardens	84
Membership Organizations	86
Engineering and Management Services	87
Private Households	88
Services, NEC	89
Executive, Legislative and General Government	91
Justice, Public Order and Safety	92
Public Finance Administration	93
Human Resources Administration	94
Environmental Quality and Housing	95
Economic Program Administration	96
National Security and International Affairs	97

APPENDIX B

Letter to Solicit Candidates For Case Study

5 June 1990

Dear Sir or Madame:

The Solid Waste Research Group at the School of Natural Resources, University of Michigan, is conducting a waste reduction research and demonstration project for the Michigan Department of Natural Resources, under the Quality of Life Bond, Solid Waste Alternatives Grants Program. Your participation in the initial phase of this project will be greatly appreciated.

The purpose of this project is to conduct case studies of successful waste reduction programs that have been implemented by commercial and industrial firms within Michigan. Five cases will be analyzed and documented so that the waste reduction processes, techniques, or technology can be effectively transferred to other firms in the state.

The first phase of the project is to select the firms for case study. We are requesting your assistance in providing names of commercial and/or industrial businesses that have implemented waste reduction programs (source reduction, reuse, recycling, and composting). We are interested in candidates from all sectors of the economy: agricultural, manufacturing, wholesale, retail, transportation, and service. The study is restricted to nonhazardous solid waste.

You will find enclosed a form to list businesses and a return envelope. In order to conduct the case study research this summer, we need the information as soon as possible. We will be contacting possible case studies during the month of June. If you have any questions regarding this project you may reach me by phone at (313) 764-1412.

Your contribution to this project will be greatly appreciated.

Sincerely,

Greg A. Keoleian, PhD
Research Fellow

enclosure

Waste Reduction Technology Transfer Project
Solid Waste Research Group
School of Natural Resources
University of Michigan
Ann Arbor, MI 48109
Contact: Dr. Greg Keoleian (313 764-1412)

Please list businesses that have implemented successful waste reduction programs. Waste reduction includes source reduction, reuse, recycling and composting practices. In the selection of case study firms, we will emphasize source reduction and on-site reuse, recycling and composting.

Some of the specific waste reduction practices that we will consider include: product design changes (product composition, product life extension, reduction in product packaging), input material changes (material quality, material substitution), process changes (process design, equipment, layout, process control), operational changes (management practices, material handling improvements).

We will use the following criteria to select the case studies: 1) potential impact on the nonhazardous waste stream if the waste reduction practice is used by other firms in the state; 2) ranking based on this waste reduction hierarchy: a) source reduction, b) reuse, c) composting, and d) recycling; and 3) transferability of the waste reduction practices.

1. **Name of business:**

Address:

Contact person(s) [title/responsibility and phone number]:

Brief description of waste reduction program:

2. **Name of business:**

Address:

Contact person(s) [title/responsibility and phone number]:

Brief description of waste reduction program:

APPENDIX C

Interview Questions for Organizational/Motivational Analysis

Where did the idea come from?

1. Does this company have a track record for innovation? How does the management encourage new ideas? How are decisions reached about implementing new ideas?

- How are innovators supported, and how are new ideas explored and implemented?
- Who leads the innovation?
- Is it the same person every time?
- Is it the same person throughout the project?
- Are other people encouraged to be leaders for other innovations?
- What would have happened if this implementation failed? Were there failures in the process of starting this project? Have there been other failures? Is support given regardless of initial unfavorable results?
- How confident of the innovation was the originator?

2. If there is no history of systematically supporting innovation:

- Where did the idea come from? Was it a business improvement suggestion? Was it prompted/supported/influenced by EPA/MDNR tapes and booklets on source reduction; by public pressure; by trade groups or competitors; by colleagues or clients; by cost of waste disposal; or from home/church/school influence?
- Was a Waste Audit Team formed? If such a team suggested the innovation, did it already have the support of management?

How was the idea sold?

1. Convincing others to adopt an idea is easier when an example of success in a similar venture can be combined with internal support and appropriate imagery.

- What provided the main support for this idea? Mandate from management, EPA/DNR, or consumers? Better business ethics? General environmental consciousness resulting from public opinion? A precedent in conservation of any sort?

2. Many factors are part of a decision to implement new ideas. Some are more important than others. What factors are considered?

- Threat of liability
- Doing the right thing
- Social pressure
- Employee pride
- Economic factors

What takes priority, and does this vary with different projects? If it varies, why?

How was the idea implemented?

1. Was one person a champion of this project? Is there an enthusiastic group who pursued this proposal? If so, where did they come from? How were they chosen or supported?

2. Were the employees trained for participation in the reduction effort, or simply told to comply with new procedures? Are they offered incentives, rewards, or bonuses?
3. How are participation and ownership encouraged in all necessary sectors of this company?
4. Did the company use outside help (consultant, manager)? An outsider might have suggested the project or been brought in to guide the process.

Questions to ask management:

- Please describe the development process of this waste reduction effort: concept, exploration, approval, implementation, and assessment.
- What is the corporate policy regarding waste minimization? (Obtain copy if available)
- Do you have goals for your waste reduction effort? (Obtain copy if available)
- Do you have a task force to assess your waste reduction possibilities? If so, who is on the list (complete with their titles)?
- Are employees involved in generating ideas for waste reduction? If so, is this level of employee involvement new for your company?
- What factors were important in the decision making process: economic feasibility, technical feasibility, social feasibility, novelty, ethics, etc.?
- What barriers to this innovation needed to be overcome? How?
- How much time did this project take from conception to implementation?
- How were decisions made at each plateau? (This factor is an integral part of the time needed to implement the decision, i.e. consensus style companies put in their time before the final decision is made, then are ready to implement)
- If you were to do this again, what would you change?
- How are the benefits of the waste reduction effort distributed?

Questions for the Waste Reduction Team or Main Innovator:

- Why you?
- Would you do it again?
- Have you championed waste reduction plans that failed?
- What would have happened if this program failed?
- Where did this idea come from?
- Did you follow any model or example?
- What support do you feel you have from above? Below?
- Could there be a next time, or was this a unique event?
- What would you do differently next time?
- Have you been asked to share your expertise with others?

Questions to ask the implementors at the bottom of the ladder:

- Does this program require a new way of thinking or new behavior?
- Have you noticed any changes beside this specific waste reduction? Has company attitude changed?
- Have you seen other ways to reduce waste since this innovation was introduced?
- How do you feel about implementing the next waste reduction effort?
- Is this more of a problem than other changes? Is it an improvement? If it is bothersome, is it worthwhile?
- Do you know that your efforts are making a difference? Can you see the changes your efforts make? If not, do you get reports or some type of feedback from those who can see the change?

APPENDIX D

Waste Reduction Attitudes Survey

THE UNIVERSITY OF MICHIGAN

School of Natural Resources

Contact: Dr. Greg Keoleian (313 764-1412)

The University of Michigan's Solid Waste Research Group will highlight your company in one of 5 case studies of Michigan businesses which have implemented successful waste reduction practices. We would like to understand the perceptions and attitudes of the staff throughout the facility, and have selected you to complete this short survey. Your responses will be kept anonymous. Please return this page to us, with any comments, in the attached envelope.

Job Title _____ Years employed here _____ Firm _____

1. The following questions are about the solid waste reduction efforts currently underway in your company. For each of the statements below, please circle the number which best fits your opinion:

- | | |
|---------------------|--------------------|
| 1 = certainly false | 4 = probably true |
| 2 = probably false | 5 = certainly true |
| 3 = not sure | |

- 1 2 3 4 5 This company strongly supports waste reduction.
1 2 3 4 5 A company policy on waste reduction is necessary to encourage new practices in this area.
1 2 3 4 5 This company is innovative -- a real leader in our field.
1 2 3 4 5 I am encouraged by my supervisor to develop ideas that would improve the way we do business.
1 2 3 4 5 Even "off-the-wall" ideas are considered by the management.
1 2 3 4 5 Many proposals are tested on a small scale before they are rejected or accepted.
1 2 3 4 5 Waste Reduction is one way to stay competitive.
1 2 3 4 5 Successful implementation of a waste reduction policy requires extensive employee training and motivation.
1 2 3 4 5 This company ought to be more environmentally sensitive.
1 2 3 4 5 The public should know about our waste reduction.
1 2 3 4 5 The success of any waste reduction practice rests on one person's shoulders.

2. The decision to implement a waste reduction practice may be influenced by many things. How important are the following when your company decides to proceed with an idea of this type?

- | | |
|--------------------------|-------------------------|
| 1 = not at all important | 4 = fairly important |
| 2 = slightly important | 5 = extremely important |
| 3 = somewhat important | |

- 1 2 3 4 5 Cost-of-transition to a new method
1 2 3 4 5 Technical feasibility
1 2 3 4 5 Worker acceptance
1 2 3 4 5 Cost of waste disposal
1 2 3 4 5 Community concern over solid waste
1 2 3 4 5 Our history with other conservation efforts
1 2 3 4 5 Corporate ethic
1 2 3 4 5 Common sense
1 2 3 4 5 The competition
1 2 3 4 5 Customer satisfaction
1 2 3 4 5 Marketing and P.R. possibilities

Please add other comments about your impressions of waste reduction at this institution on the back of the page. Thank you for your time.

