PACKAGING WASTE

Spring 1988

Packaging Waste

An Analysis of H. 1172--
"An Act to Protect the Environment by Encouraging a Reduction and Recycling of Packaging in the Commonwealth"

Prepared for Representative Mark Roosevelt by Urban and Environmental Policy Department graduate students at Tufts University.

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Preface

As graduate students in the Department of Urban and Environmental Policy at Tufts University we are interested in researching laws that seek to minimize the impacts of human activities on the environment. One such law recently proposed by Massachusetts State Representative Mark Roosevelt (D-Suffolk) addresses the need for reducing the solid waste stream.

This report examines the potential impacts of House Bill 1172, "An Act to Protect the Environment by Encouraging a Reduction and Recycling of Packaging in the Commonwealth." The legislation is designed to:

- o reduce the volume of solid waste generated,
- o encourage the use of recyclable and reusable materials,
- o develop markets for recycled materials, and
- o generate revenues to promote recycling.

We first present an overview of the role of packaging in the current solid waste crisis and of trends in the packaging industry. The more original part of our research consists of three case studies that examine the potential effects of the bill. In each case we examine competing materials or products, and look at how the bill will affect their use. Specifically, we looked at the impacts of the bill on fast-food packaging, bags, and milk cartons. The report then provides a survey of current and potential markets for reclaimed material. The report concludes with an analysis of the bill's strengths and weaknesses and our recommendations as to how it should be modified.

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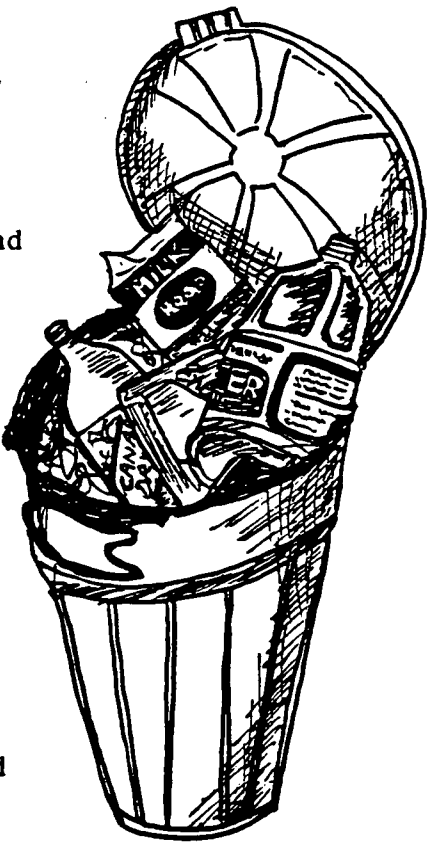
Executive Summary

The following report investigates the probable effects on the packaging industry of House Bill 1172, "An Act to Protect the Environment by Encouraging a Reduction and Recycling of Packaging in the Commonwealth," otherwise known as "The Packaging Reduction Act." The act seeks to reduce packaging waste by imposing fees of $.02 on every unit of packaging that is not made from recycled material, and $.01 on every unit that is not recyclable. The fees will be waived if the packaging is made from secondary materials and is recyclable. Any revenues collected will be used to promote recycling.

The report provides an overview of the problem of packaging waste, discusses the overall economic impact of the bill and summarizes market trends in packaging. Three case studies compare costs and potential use of recycled versus non-recycled packaging if H. 1172 were to be enacted. The report concludes with a survey of barriers to recycling and presents recommendations and conclusions.



The Solid Waste Crisis: Disposal

The report begins with a discussion of the solid waste crisis and of disposal options for the future. Massachusetts generates approximately 6.1 million tons of trash, about one ton per person per year. The costs of disposal in landfills and waste-to-energy plants is rising from a range of $5-20 five years ago to current levels of $65-100 per ton. The shortage of disposal capacity is a frightening problem; the Division of Solid Waste Management projects that three-quarters of landfills now operating in Massachusetts will be forced to close by 1990. The cost for building new landfills is estimated at $150,000 an acre, plus an extra $35,000 per acre for closing the landfill when it is full. If landfills were the state's only disposal option hundreds of millions of dollars would have to be spent to meet disposal needs for the next 20 years.

The costs of incineration are also high. Typical capital costs of an incinerator, burning 500,000 tons of trash per year, are at least $150 million. In addition, there are the costs of constructing and monitoring special landfills to dispose of the ash, and the ongoing expenses of operation and maintenance, including the need to control and monitor emissions. Externalities include the damage to human health and the environment resulting from air pollution and ash.

Feasible alternatives to landfilling and incineration are source reduction and recycling. A substantial portion of trash is recyclable. The largest percentage of total municipal solid waste is paper (600 pounds per person per year, or 30-40% of total weight of solid waste), some of which can be separated and recycled. The next largest percentage is durable goods and food. Here, the potential for recycling is minimal, although food can be composted. Glass is next at 140 pounds per person per year, then metal (50 pounds per person per year), which are both recyclable. The last category of municipal solid waste is plastic (75 pounds per person per year), which is technically difficult to recycle. At least 500 pounds of trash per person per year could be recycled, saving the Commonwealth $100 million per year in disposal costs if we assume an average of $65 per ton tipping fees.

Packaging in the Waste Stream: Benefits of H. 1172

Paperboard packaging comprises one-third of all paper in the waste stream. Glass and metal containers, after accounting for bottle bill returns, are estimated at fifty or sixty pounds per person per year each. At least thirty pounds per person per year of plastic remains in the waste stream after bottle bill plastics are returned for deposit. An unknown quantity of plastic is combined with other materials, particularly paper and glass, as "flexible packaging," making it hard to separate.

Packaging makers are moving towards an increased use of plastic. Plastic has a high volume to weight ratio, does not

degrade, and makes other materials difficult to recycle. The use of plastic containers, plastics for the microwave, plastic coatings, and plastics mixed with other materials is increasing. The use of both glass and steel is decreasing, while the use of paper is remaining stable. Aluminum is the only recyclable material whose use is increasing.

Coupled with the recently passed Solid Waste Act of 1987, the Packaging Reduction Act provides a clear incentive for both consumers and manufacturers to choose recycled and recyclable materials and products. The former will provide an inexpensive and plentiful supply of secondary materials, while the latter will provide economic incentives to use them. In order for the two bills to work effectively, facilities that provide recycled materials must be accessible to packaging manufacturers. The Packaging Reduction Act encourages manufacturers who can use reclaimed materials to locate in the state by creating a demand for their products. The growth of recycling in the state will more than offset the relatively minor effects of the bill on jobs in the state. Furthermore, the distribution of packaging related and general manufacturing jobs in Massachusetts, with a high proportion of paper-related industries, indicates that H. 1172 will benefit the Commonwealth's in terms of net job creation.

A cost-effectiveness analysis of the bill compares the amount collected in fees with the increment in recycling which can be expected from the bill, which will result in substantial avoided costs for the state. The fees will be used to conduct solid waste research and attract secondary materials users to the state. Revenues will decrease as manufacturers use more recycled materials and make recyclable products. A decrease in the waste stream will also reduce the environmental stresses caused by solid waste disposal.

Case Studies

The writers utilized a case study approach to investigate the potential effectiveness of H. 1172 at reducing non-recyclable packaging and removing recoverable materials from the waste stream.

Milk

The first case study investigates packaging used for milk containers. The three containers considered are: HDPE (high density polyethylene) jugs, paperboard cartons coated with polyethylene films, and glass bottles. The glass bottles can be easily recycled, the HDPE jugs are potentially recyclable, and it is unlikely that the paperboard/polyethylene cartons could ever be recycled.

The milk packaging industry must consider various attributes of milk in making packaging decisions. Milk is sensitive to light, air, and scent transmission, and has limited preserveability. Contamination is a crucial factor when determining packaging. Refillable bottles pose a greater risk of bacterial impurities than non-returnable bottles. The choice of packaging materials cannot be based exclusively on economic or environmental factors.

Data on alternative milk packaging in the U.S. and Europe show that glass is a more expensive package than either paper or plastic. Furthermore, the cost of manufacturing packages for one-time use is much less than for packages designed to be returned.

Any added costs for milk due to H. 1172 will be passed on to the consumer. The HDPE bottles are probably eligible for the $.01 recyclability credit; glass is eligible for the full $.03 credit. Because the cost of glass is much higher than for other milk packaging, the credit and fees will influence neither consumer nor manufacturers' choices.

Bags

The second case study investigates the potential effects of the Packaging Reduction Act on paper versus plastic bag use for consumer purchases in a chain of Massachusetts retail stores. Paper bags are more expensive than plastic bags, though the margin is so small that H. 1172 will have significant impacts on a retailer's decision about whether to purchase paper or plastic bags. With the $.03 fee imposed by H. 1172 added to plastic bags, and with paper bags being made from recycled paper, paper would enjoy a competitive advantage over plastic.

The owner of a small polyethylene bag manufacturing company was interviewed for this study. Because the proposed legislation would increase the plastic bags' selling prices from 50%-600%, the company would stand to lose a large share of their business. Being a relatively small company operating close to the margin, it would probably be forced to close.

There exist potential hindrances to recycled paper bags capturing a large share of the bag market. First, the cost of manufacturing bags from recycled paper is high. There are other technical problems with recycled paper manufacture: using 80% recycled paper in bags (the level necessary for a paper product to qualify as "recycled" and receive the $.02 credit) will produce a bag too weak to meet some users' needs. To give recycled paper bags increased market share at the expense of plastic bags, the bill's present definition of "recycled paper" may have to be relaxed.

Fast Food

The final case study explores the bills potential effect on the use of polystyrene (foam) hamburger box and the paperboard hamburger box--"clamshells"--which are used in two popular fast-food restaurants.

The McDonald's Corporation prefers polystyrene foam cl- -hells for most of its products because of foam's insulating character- ics. While McDonald's considers the container economically desirable, there are many environmental concerns pertaining to the clamshell's disposal. Foam products do not physically degrade in a landfill, and their incineration emits air pollutants. Though recycling foam is technically possible, food contamination and collection costs make it economically prohibitive.

The Burger King Corporation uses polyethylene-coated paperboard. They find paperboard to be economic, easy to market, and environmentally safe. The paperboard clamshell is safer to dispose of in a landfill because of its degradeability, but its incineration produces undesirable pollutants. Because food and grease that soak into a paperboard clamshell are impossible to clean, recycling of paperboard clamshells is not feasible.

Food and Drug Agency requirements discourage the use of secondary materials in food packaging because of their potential contamination. However, as long as the recycled material is not in contact with the food, recycled paper can, in part, be used to manufacture clamshells. Recycled polystyrene foam is not used in clamshells because of chemical contamination and because the quality of the product declines. If H. 1172 were enacted, then McDonald's would have to pay the full $.03 fee; if Burger King switched to recycled paper, it would have to pay a $.01 per unit fee.

Both corporations claim that any additional costs will get passed on to the consumer. At present, both McDonald's and Burger King do not consider switching to recycled paper to be in their economic interest. However, there would be substantial incentive to switch if this legislation were passed.

Recommendations

H. 1172 depends on expanding recycling markets in the state, but barriers to recycling will slow that process. Certain technical problems pertain to food contamination, separating materials, and the difficulties in recycling plastics. Additionally, interstate commerce regulations, taxes and subsidies favor the use of virgin materials. The report discusses needed policy changes at state and federal levels.

The report concludes that the bill will have a significant effect on some sectors of the packaging market. The analysis of the bill's "cost-effectiveness" concludes that the bill will pay for itself over an extended period of time, when trends in packaging and increasing disposal costs are taken into account. The report makes various recommendations about specific provisions in the bill: the eligibility requirements need to be more flexible, and the priorities for expenditure should emphasize education and public awareness more than technological development, at least in the initial stages. The alternative strategies of increasing the fees and banning certain materials outright are discussed. The report recommends that some revenue be devoted to remediation of economic dislocations caused by the bill. Finally, the bill is considered in the context of overall state policy towards recycling, and the potential for other decisions which will encourage source reduction is discussed.

Introduction

Any analysis of House Bill 1172, "An Act to Protect the Environment by Encouraging a Reduction and Recycling of Packaging in the Commonwealth", and the packaging industry in general begins naturally with reference to the Commonwealth's burgeoning solid waste crisis. Legislation designed to achieve "source reduction"--the elimination of potential solid waste at the producer level--is not unique to Massachusetts. H. 1172 represents a growing trend in states frustrated in their efforts to cost- effectively dispose of solid waste. Landfills are becoming prohibitively expensive as average tipping fees climb towards previously unimagined highs. Incinerators face steep political obstacles to their siting and when the costs of environmental safeguards are factored in, they show little promise of providing cost-effective solid waste management. States are running out of disposal options.

Both incinerators and landfills also pose serious threats to health and the environment, which we will briefly review. For all these reasons, more and more legislators across New England and the nation are recognizing that the best available option in solid waste management is source reduction. House Bill 1172 proposes to use the power of the market to achieve that goal.

The bill presently faces strong industry opposition. Some flaws in its design and administration must be corrected. However, by encouraging the reduction of excessive packaging waste and the creation of markets for the secondary materials the state will generate under the Solid Waste Act of 1987 (Chapter 584)--the Packaging Reduction Act positions itself as a signpost at the crossroads of solid waste management. The road we have taken till

now passes by the recycling option in favor of more incinerators and "secure" landfills. The road to recycling leads to the development of markets and jobs and views a portion of the present waste stream as a resource instead of refuse. This act is designed to reduce packaging materials that are "excessive" and those which cannot be recycled. If it is impractical to eliminate certain non-recyclable packaging materials, H. 1172 shifts the costs of their disposal from the public to those manufacturing the materials by levying a fee, which will be used to promote recycling research.

"An Act to Protect the Environment by Encouraging a Reduction and Recycling of Packaging in the Commonwealth" will not make the solid waste crisis in Massachusetts disappear. Rather, it will indicate to manufacturers, retailers, and the general public that the steep costs of disposal deserve consideration in manufacturing, marketing, and purchasing decisions.

Our analysis begins with a summary of House Bill 1172. We will then give some dimensions of the solid waste crisis in Massachusetts, both anecdotal and factual, including a brief survey of the environmental hazards associated with incineration. We will consider the ever-increasing amount of packaging materials in the solid waste stream, trends in the packaging industry, and how the industry might be affected by this legislation.

"I KNOW THERE'S COOKIES IN HERE SOMEWHERE!"

House Bill 1172--The Packaging Reduction Act

Many states are taking action against the rising flood of waste materials. The legislative approaches to reducing the amount of garbage are diverse. They include mandatory participation in recycling programs, surcharges (tipping fees that are used for a recycling program), point of sale product bans and deposits, and financial incentives that encourage recycling through grants and loans, tax credits, and procurement guidelines. The Massachusetts effort will depend on a combination of these strategies.

House Bill 1172 targets packaging because it accounts for one-third of the waste stream and uses materials that are difficult to recycle. By attaching a fee to certain packaging products the bill seeks to include the social cost of packaging--that is, environmental and disposal costs--in the price of the package. The objectives of the fee are to:

- o encourage the use of recyclable packaging;
- o encourage the production of goods using recycled materials;
- o discourage the use of excessive packaging;
- o create a funding source for recycling programs;
- o promote markets for recycled materials; and
- o support research into new recycling technologies.

Packaging is defined by the bill as enclosures used to protect, store, contain, transport, display, and sell products, including but not limited to containers. The bill proposes a 3 cent packaging disposal fee for each container. Multiple containers used to package a product are each assessed a separate fee. The fee applies to containers made in whole or in part of: aluminum, cloth, fiber, glass, metal, paper, paperboard, plastic, wood, or any combination thereof. The fee will be assessed to the seller of any container used for a product intended for retail sale within the Commonwealth.

All containers meeting the standards for recycled material

content will receive a credit of two cents per container. The bill defines "recycled materials" as any material otherwise destined for the municipal solid waste stream that a recycling service company collects, separates, or processes and returns to economic markets in the form of raw materials, feedstocks, or products. "In-house" or "pre-consumer" recycling by a packaging manufacturer is not included in this definition. The required percentages of recycled material content are as follows:

- o 50% for containers predominantly made of glass;
- o 80% for containers predominantly made of paper;
- o 40% for containers predominantly made of plastic;
- o 50% for containers predominantly made of aluminum or metal; and
- o 30% for all other types of containers.

These numbers are not final. More research is needed to determine what should be the minimum percentages of recycled material content.

All containers deemed recyclable will receive a credit of one cent per container. The following factors will be considered to assess the "recyclability" of a container:

- o the ability to prepare and process the container for recycling when such container consists of more than one material;
- o the economic feasibility of recycling, reclaiming, or reusing the container;
- o the homogeneity of the material comprising the container;
- o the technological ability to recycle or reuse the container;
- o containers that constitute excessive packaging;
- o the recycling rate in the Commonwealth of the predominant material type used in the manufacture of the container;
- o other factors deemed suitable and consistent with the purpose of the bill.

Containers eligible to receive both credits will receive a full exemption from the fee. Other containers that will receive exemption from the 3 cent fee are containers used to package food or food products sold for human consumption. The food exemption

will not include containers used to package wine or other alcoholic beverages, and food and non-alcoholic beverages packaged in containers when sold in or by cafes, bars, hotel dining rooms, social clubs, vending machines, and other such establishments and eating places that sell prepared food at retail on a "take-out" or "to-go" basis.

Three years after the effective date of the bill, the food exemption will cease operation. The following are exempted from the bill:

- o containers sold or furnished for retail sale for which a refundable deposit of at least five cents per container is required. This exemption includes, but is not limited to, refundable beverage containers governed by sections 321-327 of Chapter 94 of the General Laws, and refundable milk bottles.
- o containers used to package medications or prescriptions of registered physicians;
- o containers holding two gallons or more in volume;
- o containers not intended for retail sale within the Commonwealth or actually sold in retail but not for final use and consumption within the Commonwealth.

Revenues generated by H. 1172 will not go into the general revenues of the state, but will instead be set aside for the recycling program. The revenues will fund:

- o the fee assessment program and other recycling programs,
- o public education on the importance of recycling,
- o research and development at state universities on methods to reduce waste,
- o community grants for education and for businesses involved in recycling, and
- o competitive business loans for research, development, and implementation of recycling technologies.

The decisions made determining what packages are eligible for the credits and where the monies from the revenues will be earmarked are to be determined by a packaging board created within

the Department of Environmental Quality Engineering (DEQE). The board will also have responsibility for establishing and implementing a recycling logo, which will identify recycled and/or recyclable packages. Within the DEQE, the board will be part of the Division of Solid Waste Management.

Solid Waste in New England: One Family's Perspective*

The Linnane family from the Wollaston section of Quincy participated in a Boston Globe study in the summer of 1987 that monitored their contribution to the solid waste stream. For one week the family kept track of every item they threw into their trash cans.

Both Mike and Maureen were surprised by the amount of garbage their family generated. As Mike said, "You don't realize how much it is, you just put three barrels out every week and it's gone."

Yet, it is not really gone--it is simply a small portion of the 16,000 tons of solid waste produced daily in Massachusetts--16,000 tons of trash that Massachusetts is becoming increasingly harder and harder pressed to dispose of as time passes and the state's landfills reach their capacities and close. The pressing question is, then, what are we to do with all the trash we generate?

Mike Linnane, who grew up in Quincy, said that he has always been aware of the trash problem, especially since Quincy has had controversy surrounding their two town dumping grounds, which are now both closed. He feels that his family is conservative in what they throw away. They try to recycle as much as they can. Yet they are frustrated by the lack of formal recycling programs in their town or in state.

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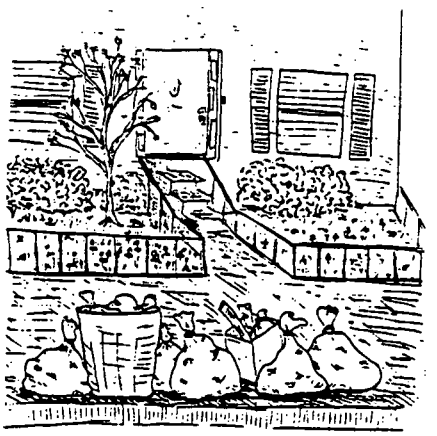
*Reprinted from the New England Environmental Network News 7(4), Fall 1987.

He was particularly surprised by how little of what his family uses is biodegradable. He feels that there is "no way that we can cut back on the trash we generate," but that he would happily recycle if adequate programs existed. In fact, he would prefer recycling to the state's proposed "mass-burn" facilities, which will convert trash to energy, as recycling is more conservation oriented.

Though he is not sure how well recycling would be received in Quincy, he recounted that as a youth "almost everybody in his neighborhood" separated food waste from the rest of the waste stream for a livestock company that used it as pig fodder and collected it once a week in the winter and twice a week in the summer.

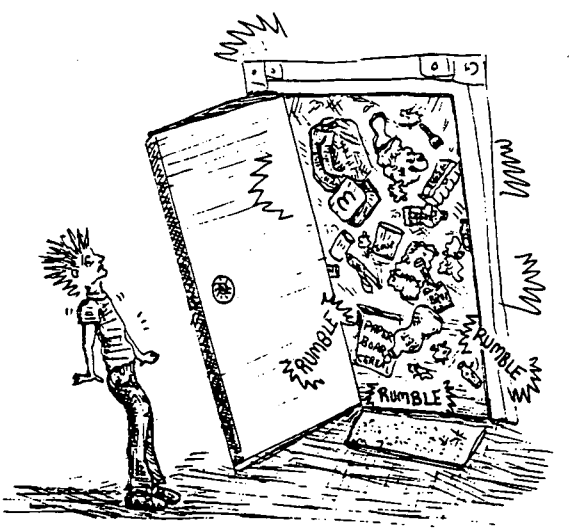
Maureen Linnane was also surprised at how much trash the family generated. Did she think that most people would recycle once they were made aware of the problem? "I think most people would," she replied. "Soon there will be no place to put it." The study also made her aware that much of Quincy's trash ends up in landfills halfway across the state, and that much of the state's trash ends up out of state, going to New Jersey and South Carolina. She said that we "can't keep doing that."

Both Mike and Maureen said their friends and neighbors expressed interest in the study. Many of them were also surprised at the amount of trash a family generates. The Linnanes thought the study was a good idea, and they hope it will bring the issue to more people's attention.



Packaging Waste

Like Mike and Maureen Linnane, we are all participants in the solid waste crisis; we all know our weekly trash contribution is going "somewhere." The solid waste crisis in Massachusetts can be understood in terms of facts and figures, although the quantities of trash that these numbers represent are hard to visualize and the impact of the crisis on each and every citizen of the Commonwealth will be more dramatic than we can easily imagine right now. Most of us don't worry about the trash that we throw away; we just put it on the curb or take it to the landfill and it disappears. This section of the report will sketch out one aspect of the crisis, its costs in dollar terms, and its dimension in physical units, tons, millions of tons in fact.



Frank is horrified to discover that a month of trash has returned.

The Facts and Figures on Solid Waste

This section will demonstrate that strategies other than landfilling and burning deserve consideration on economic grounds. But let us remember that there are measures other than dollars, other kinds of costs, and other dimensions of risk. Our report will discuss the environmental hazards associated with traditional disposal methods--the threat to groundwater from landfills and the risk from toxic chemicals released into the air by incineration. The costs of trying to avoid these dangers can be estimated in terms of simple numbers, and the state agencies dealing with solid waste have certainly done this. But at a certain point we also have to ask can we put a dollar value on our health, on the air we breathe and the water we drink? Do we really want to end up thinking of our homes as little decontamination zones, drinking filtered water and breathing electrostatically cleaned air, avoiding strenuous activity outside because we are uncertain about the air quality? In other words, what is the intangible cost of an environment polluted by our attempts to deal with the astonishing amount of trash we now generate? Such costs are difficult to include in cost benefit analysis and other such calculations.

We should think about the resources that went into creating all the solid waste that we throw away--every edition of the Boston Globe consumes thousands of trees and acres of forest. Ten percent of the Globe is recycled paper--why only ten percent? Plastic, which in the short period since 1950 has become an almost universal material in our environment, is made from oil. Politicians are constantly reminding us of the dangers of depending on foreign sources for the supply of this raw material. Other common materials like glass and aluminum consume huge amounts of energy in their production. That means more oil or coal consumed, more smoke, more acid rain, leading to a whole litany of environmental complaints. Even something so prosaic as yard waste--leaves and grass clippings--is really a valuable resource to build soil. So as our report reviews the costs of trash, how much of it there is,

where it comes from and where it goes, remember also that there are many intangible costs, in terms of our national security, our health, the protection of the environment and of resources for the future.

The State's Waste. The Department of Environmental Quality Engineering estimates that we in Massachusetts generate approximately 6.1 million tons of solid waste per year.[1] This works out to about one ton per person per year. About 45% of this waste is residential,[2] which translates to about two and a half pounds per person per day thrown away in or around the home. Municipal solid waste as discussed in this report also includes commercial waste, but not industrial or construction debris; we used a figure of 1700 pounds per person annually.

New landfill space is costing $150-250,000 an acre.

Until recently, nobody has worried too much about this amount of trash, but the expense of burning it or landfilling it has risen so much over the last few years, that the average citizen has become concerned. A look ahead shows that there is reason for alarm. The cost of disposal at landfills, transfer stations, and waste-to-energy facilities has risen from a range of $5-20 a ton as little as five years ago to a range of $65-100 a ton now, and some communities are paying over $100 a ton.[3] That does not include the cost of collection which might range from $25 to $35 per ton. Estimates of the cost Boston will face to dispose of its trash when its current contract comes up for renewal go as high as $150 per ton.[4]

To understand this increase, there are two related factors that should be noted. The first is that regulation of landfills began to seriously impact municipalities about four or five years ago. Many landfills were found to be inadequate, and forced to close. The second related factor is a desperate shortage of landfill space; the companies that haul solid waste have profited greatly from the diminishing supply and rising demand. The Division of Solid Waste Management (DSWM) projects that three-quarters of the state's

landfills now operating will be forced to close by 1990.[5] The in-state landfill capacity will be reduced from 3.4 million tons per year to 1.8 million tons per year. Table 1 shows DSWM's trashflow projection for the year 1990.

A 1.5 million ton per year waste handling capacity shortfall is projected by 1990.

How much will it cost--landfills? This leaves a considerable shortfall in disposal capacity, even if Massachusetts does not increase the amount of solid waste generated. If Rhode Island, New Hampshire, and Maine refuse to accept any more of our solid waste, we will have to develop an additional 1.5 million tons of disposal capacity in state. That's going to be expensive. The minimum cost of building a new landfill is estimated by the Department of Environmental Quality Engineering (DEQE) at about $150,000 an acre.[6] A recently completed landfill expansion in Springfield, on which the contractor reportedly lost money, came in at $250,000 an acre.[7] To the cost of creating new landfill capacity must be added the cost of closing the landfill when it is full, at an average cost of $35,000 an acre,[8] as well as the costs of long-term monitoring to guard against groundwater contamination.

What do these figures mean in terms of disposal costs? One option is to build more landfills. A 55-acre landfill, which would accept 240 tons of waste per day for the next 20 years, could be expected to cost about $16 million, according to a landfill model

Table 1. Projected Solid Waste Management Shortfall by 1990

Current Disposal Modes	Amount in millions of tons per year
projected landfill capacity	1.8
projected incineration capacity	2.8
total projected disposal capacity through traditional means	4.6
present generation of solid waste	6.1
projected need for alternatives	1.5

Source: Massachusetts Division Solid Waste Management

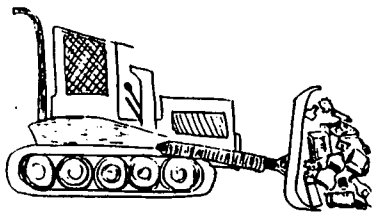
generated by consultant Anderson Nichols.[9] To deal with the 1.5 million tons of solid waste, Massachusetts would have to build thirty such landfills, at a total cost of close to $500 million dollars. Even this estimate represents the most optimistic and least likely scenario.

The solid waste legislation recently enacted (the Solid Waste Act of 1987), provides a combination of loans and grants totaling $90 million for construction of solid waste facilities, but this amount would cover less than 20% of the $500 million capital expenditure needed if it were applied to landfill construction alone. At present therefore, Massachusetts faces a considerable shortfall in terms of disposal capacity. To reduce the total amount and to change the character of solid waste, measures other than landfilling and incineration are necessary. Otherwise we will be facing a tremendous expense, much larger than what has been budgeted so far.

What do these numbers mean for the cities and towns? If municipalities committed the necessary funds to the construction of new landfills and continued to own and operate these facilities on a regional basis, it is possible to imagine that the present costs of disposal would remain constant or even go down. In the example given above the annualized cost of the construction of such a landfill would work out to about $25 per ton of capacity. Assuming in the neighborhood of $30-40 per ton to monitor and operate this landfill, we arrive at what seems (today, not 5 years ago!) like a reasonable figure for trash disposal. But the state has not planned to meet the projected demand by creating new landfill capacity, and it is hard to imagine the already hard-pressed cities and towns of the Commonwealth coming up with half a billion dollars for this purpose. Of course, the traditional answer is to rely on the private sector. What has this achieved for us to date?

Adequate new landfills for the next 20 years would cost the Commonwealth of Massachusetts half a billion dollars.

In order to estimate what will happen to the cost of solid



waste disposal over the coming years, it is necessary to consider the market forces at work. The dramatic increases in commercial rates over the last five years (averaging close to 400% statewide) are due to the ability of commercial haulers to control the market and profit enormously from the shortage of landfill space. Any reasonable person can anticipate that local communities will resist the construction of new landfills, and that despite the best efforts of the state to monitor their construction and operation they will eventually contaminate groundwater, creating even more expensive problems. This is why we believe it is imperative to consider alternatives.

The Costs of Incineration. Incineration is a technology that was widely hailed in the late 1970s as the solution to two problems: the shortage of energy and the excess of trash. Those who design and run incinerators claim a 95% volume and 75% weight reduction of garbage.[10] They cite pollution control devices such as baghouses and electrostatic precipitators that achieve a 90% removal of hydrochloric acid gas emissions and a 60% removal of sulfuric acid gas emissions.[11] We will discuss the potential environmental problems associated with refuse-to-energy facilities below, but in the context of this analysis we should note that incinerators are expensive. The capital costs for a facility burning 500,000 tons of trash per year can exceed $150 million.[12] Perhaps a third of this solid waste would remain as ash, to be disposed of in special landfills that cost as much as half a million dollars per acre to build.[13]

The economics might seem reassuring at first glance, but a careful look at today's market will disabuse us of the hope that there are any easy solutions. The amortized cost of a waste-to-energy plant works out to about $20 per ton of capacity over a twenty-year lifetime, but in addition to this are the costs of operating the plant and of landfilling the ash. When the current contracts for waste-to-energy facilities expire, estimated tipping

fees are expected to rise above the current $60-70 range.

Again market forces and the increase in environmental safeguards have worked to dramatically increase costs. For instance, part of the new state legislation is devoted to the regulation of potential problems with the emission of dioxins and other toxic substances from these facilities. The Environmental Protection Agency (EPA) decision to classify incinerator ash as non-hazardous waste has been controversial, and revised state policy on the disposal of the ash will significantly increase costs, adding as much as 20-30 dollars per ton of ash. Such concerns make it equally likely that communities will resist the construction of new facilities. Finally, even though three such facilities are presently permitted or under construction, this increase of 1.2 million tons/year capacity, as we have seen, will leave approximately 1.5 million tons of solid waste with no place to go except out of state.

Incinerators emit a wide range of pollutants, including acid gases, toxic metals, polynuclear aromatic hydrocarbons, and dioxins.

Other Costs of Incineration. Because of their supposed safety in operation and ability to greatly reduce the volume of garbage, incinerators are championed as a panacea for our solid waste problems. Yet, incineration presents significant risks for human health, town finances, and political futures. These risks have been researched and discussed by numerous health officials, scientists, and citizen advocates. It is to the discussion of their research that this report now turns.

Health threats to humans from incinerators arise in two forms: through the air, and through the ash formed when the solid waste is burned. Incinerators emit a wide range of pollutants, including acid gases, toxic metals, polynuclear aromatic hydrocarbons (PAHs), and dioxins. Some of the metals, PAHs, and dioxins are known or suspected carcinogens.[14] Some of these chemicals are also suspected of contributing to birth defects and genetic mutations.[15] Among the metals emitted are cadmium, mercury, arsenic, and lead, the last of which causes neurological and blood disorders,[16] and to the

elimination of which federal and state governments are presently committing significant resources. One insidious characteristic of some toxic pollutants is their ability to bioaccumulate in the food chain, ending up in much higher concentrations in humans than were originally emitted by the incinerator. Bioaccumulation is the process whereby toxins enter the food chain at a low level and become concentrated as they move up the chain.* When people consume a food product in which a pollutant has bioaccumulated, they ingest concentrations of the toxic chemical that are much higher than those emitted by the incinerator. The more humans eat of such a product, the more concentrated the toxin becomes in human fatty tissues. Dioxin is one chemical that has been noted to bioaccumulate in this fashion.

Pollutants emitted from incinerators can bioaccumulate, ending up in humans in much higher concentrations than those released into the air.

This process of bioaccumulation has been well documented. Sweden suspected its garbage incinerators when mothers living nearby were found to have high levels of dioxin in their milk.[17] The New York Public Interest Research Group (NYPIRG) noted that "dioxins and other trace-level toxic pollutants believed to have been emitted by European garbage incinerators have been identified in mother's milk, commercial dairy products, fish, soil, and dust."[18] This discovery caused several European countries to halt construction of incinerators "as evidence builds of the toxic side effects of that technology."[19]

The second area of concern about toxic chemicals from incinerators is the ash residue generated by the burning of garbage. Incineration is attractive as a solid waste management strategy

*Consider a toxic chemical, emitted by an incinerator, which settles in a field of grass. The chemical enters the grass and remains as the plant soaks up water and minerals from the earth. A cow, grazing in the field, eats the contaminated grass. Its digestive process releases the chemical into its body. Often toxic chemicals become embedded in the fatty tissues of animals where they remain because the animals' body chemistry has no mechanism for disposing of the chemical. The cow, unaware that it is poisoning itself, continues to eat in the field, and with time, accumulates a large quantity of the toxic chemical in its fatty tissue. When it comes time for slaughter, and the cow is butchered into steak, hamburg, etc., the chemical remains.

because it reduces garbage to as little as one-tenth to one-third its original volume, leaving only the burned remains in the form of ash. Two types of ash are produced by incinerators, bottom ash and fly or top ash. Though fly ash comprises only about 10% of the total volume of ash generated, it accounts for most of the residual toxicity following incineration.

Both fly and bottom ash, because they are the concentrated remains of the raw solid waste that entered the incinerator, concentrate all the toxic metals and chemicals contained by the trash. According to both the Environmental Defense Fund (EDF) and EPA, fly ash almost always fails toxicity tests; bottom and combined (bottom and top) ash also often fail the test.[20]

Incinerating garbage initiates various chemical reactions in the solid waste mix that produce additional hazardous substances. According to Richard Denison, a staff scientist with EDF:[21]

> some significant chemistry goes on during incineration. Because trash has a high chlorine content (from paper and plastics), most metals in fly ash are metal chlorides. Bottom ash contains mostly metal oxides. Because metal chlorides are water soluble, many metals are more leachable than they were in the original trash.

This solubility spells trouble for the safety of groundwater beneath the landfills in which ash is stored. The more soluble a compound is, the more likely it is to leach into the ground.

In addition, the heavy metals found in the fly ash are suspected as acting as catalysts for dioxin formation, which is considered to be one of the most toxic chemicals known. Denison adds that, though the "levels of dioxins and furans in ash vary significantly, concentrations 'well above' 1 part per billion--the limit set by EPA regulations for land-disposal of dioxin-containing waste, and the maximum level in soils recommended by the Center for Disease Control--have been observed."[22]

"dioxins and other trace-level toxic pollutants believed to have been emitted by European garbage incinerators have been identified in mother's milk..."

Though incinerator ash usually meets the technical definition of "hazardous waste," a loophole in federal law allows the states and municipalities to apply less stringent regulations to its disposal. Though results from EPA studies show that ash from 9 of 11 garbage incinerators failed EPA's test for toxicity,[23] and though half the ash from New York State's waste-to-energy incinerators exceeded federal limits for hazardous waste,[24] incinerator ash is managed as a "special waste" under the federal Resource Conservation and Recovery Act (RCRA). To date, California is the only state to classify incinerator ash as toxic waste. If Massachusetts or the federal government were to follow this example, the costs of landfilling the ash would become prohibitive, and would have to be borne by those municipalities who have contracted with private waste-to-energy incinerator firms.

Incineration provides us with a quick fix to the solid waste crisis. Yet it is a quick fix that will continue to engender significant citizen opposition to the siting of incinerators and landfills for the ash. Accepting incineration implies the following trade-off: it allows us to extend the useful life of solid waste landfills by a factor of 2.5 to 10 times,[25] in exchange for greatly increasing the toxicity of the materials placed in them, and the release of toxic gases into the atmosphere.

The Better Alternatives. Source reduction and recycling are reasonable alternatives both in terms of cost and as a means of coping with the shortfalls detailed above. To understand the potential for recycling and its economic appeal we must look at the composition of municipal solid waste. Various studies have been done on what is in the municipal waste stream both nationally (most notably a series of studies by Franklin Associates under contract to the EPA), and statewide. Estimates from these studies vary according to the season and the type of community, but some important patterns can be noted. We generate more trash per capita than nationwide, perhaps 15% more.[26] Paper is by far the largest

constituent of the municipal solid waste stream (MSW) averaging between 30 and 40 percent of the total by weight.[27]

table 2 :Composition of U.S. Solid Waste From Material Flows Analysis

Material	1985 percent of total		national estimated pounds per capita yearly	
paper				
newspaper	7.3		116.8	
books and magazines	4.7		75.2	
office paper	3.4		54.4	
corrugated	9.8		156.8	
mixed paper	9.4		150.4	
total paper		34.6		553.6
ferrous containers				
beverages	0.3		4.8	
food cans	1.3		20.8	
non-food cans	0.4		6.4	
barrels	0.1		1.6	
total ferrous containers		2.1		33.6
aluminum				
beer and soft drink	0.6		9.6	
other cans	0.02		0.3	
foil	0.2		3.2	
aluminum containers total		0.8		13.1
glass containers				
beer and soft drink	4.4		70.4	
wine and liquor	1.5		24.0	
food and other	2.9		46.4	
total glass containers		8.8		140.8
plastic packaging		3.5		56.0
yard waste		17.6		281.6
food waste		15.4		246.4
durable goods		11.5		184.0
all else		5.7		91.2
total all materials		100		1600.0

source: Waste Composition Study, Ferrand & Scheinberg Assoc. for DEM 1985

Of total solid waste per capita we estimate that over 500 pounds is paper of which 120 pounds per year is newspaper and 60 pounds office paper. Both of these have good potential to be recycled, with the highest value assigned to clean uncontaminated "office white" and lesser values to newspaper. In 1986 about 22% of paper was recovered and recycled nationwide: about 30% of newspaper stock was recycled.[28] The recycling of other paper used in packaging is more problematic as we will see in the discussion on recycling technology. Of the ton or so of waste generated per capita per year in Massachusetts, about 250 pounds is paperboard packaging of various types, of which 160 pounds is corrugated (technically known as containerboard).

The second largest constituent of our trash is yard waste, which can be readily recycled.

The next largest constituent of solid waste is the most variable and also the most easily recycled, and that is yard waste: grass clippings, leaves, brush and the like. At some times of year this category can comprise up to 40 percent of a municipality's trash; it averages about 20 percent. The state is planning to encourage the composting of these resources through a series of pilot projects; the savings to be realized are immediate and dramatic since the only requirement is enough land area for piling the organic material, and the end product is high-quality topsoil. Durable goods and food waste comprise the next largest categories, totalling 15% and 12% respectively in one study. The potential for recycling there is uncertain, although food wastes can be composted with some effort. Next in proportion of Massachusetts solid waste is glass. About 130 pounds per person per year of glass is either recycled or discarded. Metal containers account for an additional 50-60 pounds, of which approximately 20 pounds are returned under the bottle bill deposit program. Finally, the sampling techniques and national averages give a figure of about 60-70 pounds total for plastic. So using a combination of local and national figures, we obtain a summary figure for the amount of solid waste which could easily be recycled (i.e. excluding plastic and composite materials, durable goods and not counting composting) of about 500 pounds per person

per year. This amount of solid waste would cost the citizens of the Commonwealth about 110 million dollars per year to get rid of at the commercial rate of 65 dollars a ton, and as we have seen costs for publicly owned landfills would probably be comparable. What are the costs involved in recycling this amount?

The regional recycling plan, being developed under the aegis of the Solid Waste Act of 1987, estimates a capital expenditure of $7 million for a materials recovery facility (MRF); this represents an annualized cost of $610,000 over the twenty year life of the facility. Twelve such facilities are planned, for a total cost of $7.3 million per year. The recycling program proposal estimates that collection costs would be even less than those for traditional garbage collection, since specialized equipment would be used and fewer round trips per truck per day would be required. Assuming that the materials recovery facilities will be self-sustaining in terms of operating cost, the saving for the state can be estimated as the difference between the avoided disposal costs for the recyclable solid waste and the annualized cost of the MRFs and collection equipment--over $100 million a year net saving. So the goal of recycling 25% of the Commonwealth's waste stream is an ambitious but certainly worthwhile target, even if program estimates for facility costs are grossly underestimated. This report concludes that recycling is a vital part of the state's strategy. In order to consider the important role that the Packaging Reduction Act will play in the overall effort to reduce solid waste and encourage recycling we turn now to an analysis of packaging in the wastestream.

Packaging in Particular

Little data is available on consumption of packaging by state; interstate commerce is the dominant feature of our national economy. Massachusetts depends on other regions to produce the iron in steel cans and the oil in plastic. As it turns out, we process very little paperboard and glass: essentially, as this section

on the economic effects of this legislation points out, we import packaging.

The best one can do with the Department of Commerce figures, which track production in various industries, is to develop averages for national per capita consumption, and check those back against the solid waste figures of Massachusetts. This approach was simplified in order to complete the policy analysis of the bill by using a single figure for the ratio of current total Massachusetts solid waste to national per capita figures; we assumed that the proportions of material use remained constant. We also looked at municipal solid waste composition studies as a check on the material-flows method. The broad categories of materials discussed above are useful up to a point, but again some guesswork is required to interpolate and estimate for products that are not covered by the Bureau of the Census and other federal agency surveys.[29]

As mentioned above, paper is the largest component of the waste stream; paper and paperboard packaging account for more than a third of this, or around 265 pounds per person per year. Containerboard, (used in making "cardboard boxes"), represents 80% by weight of the consumption of paperboard, about 170 pounds per capita per year. Food (38%) and paper (14%) account for over half

Table 3: Packaging as Percentage of U.S. MSW

packaging material	packaging average % of MSW	current MA lbs./capita per year
paper	15.6	265
ferrous	2.1	36
alum.	0.7	12
glass	8.9	151
plastic	3.7	63
other	1.6	27
total	32.6	554

source: previous tables, Franklin Assoc.

Table 4 :Consumption of Paperboard Packaging by Type, Weight and Units, 1985

	U.S. cons. 1000's of tons	rough est. no. units millions	U.S. yearly per capita units	lbs.	Mass. consumed millions of units
containerboard	19,700	17,900	125	165.5	439
meat	1,458			12.3	
canned goods	1,281			10.8	
beverages	847			7.1	
other foods	3,901			32.8	
paper	2,758			23.2	
stone clay glass	1,556			13.1	
rubber & plas	1,300			10.9	
other indus	6,600			55.5	
folding cartons	3,080	90,160	378	25.9	2,207
food and beverages	1,694			14.2	
nonfood					
non-durables	246			2.1	
durable goods	1,140			9.6	
sanitary food containers	1,467	37,250	157	12.3	914
milk and beverage	545			4.6	
liquid tight, round	57			0.5	
other food cont.	865			7.3	
fibre and composite cans	292	7,600	32	2.5	186
food, froz juice etc	173			1.5	
motor oil	89			0.7	
other	31			0.3	
rigid set-up boxes	590	5,900	25	5.0	145
total paperbd.	25,129	158,810	716	211.2	3,891

sources: Fibre Box Assoc.; Rauch guide; Current Industrial Reports and Annual Survey of Manufacturers, Dept of Commerce

of the end uses of corrugated boxes. The food preparation industry also consumes most of the output of folding cartons, which are the familiar boxes for cereal, teabags, etc.; Americans consume an astonishing 30 pounds of folding cartons yearly. Another big segment of the paperboard packaging industry is so-called "sanitary food containers," which hold liquid or oily foods; these are milk cartons, frozen food containers, butter cartons, etc. Although plastic has taken over a large part of the milk and beverage market, paper packaging still controls half of this market, contributing about 15 pounds a year. In general food-related uses account for about

40% of gross tonnage, and substantially more on a unit basis, perhaps 65% of the estimated 700 paperboard containers that are consumed per capita yearly. Ironically, paperboard seems to be benefiting from the shift to new food packaging technology.

Paperboard packaging accounts for 215 pounds of solid waste per capita per year.

We anticipate an increasing use of paperboard combined with plastic, either coated with polyethylene film or as a shell for plastic "microwavable" containers. Although the potential for using recycled material in paper packaging is good, and recycling already accounts for a significant part of raw material (over 20%), recycling the packaging itself is often not economical, due to clay coatings (which create sludge in the reprocessing of fiber) or combination with plastic films. In sum, national averages and trends in the consumption of paperboard packaging give a figure of about 215 pounds per capita per year of solid waste. Probably only the containerboard is easily recycled, although opinions vary as to the problems with recycling coated and laminated stock.

Per capita consumption of glass containers, as noted above, was about 90 pounds per year nationally in 1984. However, much of the consumption in Massachusetts is recycled through the bottle bill, leaving perhaps 50 pounds per person per year of wine and liquor bottles, food containers, drug and cosmetics bottles, and chemical containers. Many reports have described the decline of glass in the packaging marketplace since its peak in 1979--production continues to decline, although the glass industry has closed plants and is prepared to compete vigorously for its share. Food is still the largest category of end use by weight, closely followed by soft drinks and beer. The light weight and high recycling value of aluminum have continued to attract brewers to cans; shipments of glass beer bottles have been declining about 5% a year. Shipments of glass containers for food have been down as well, while remaining about steady in soft drinks. These three categories account for over 90% of the glass container market.

Table 5 : Comsumption of Glass Containers by Type of Use

	* 1984 U.S. *		* est. current Mass. *			
			units		pounds	
	millions of units	% units	per capita	millions	per capita	millions
food	12,570	31%	79	459	45	264
beer	13,070	32%	81	472	39	226
soft drinks	8,900	22%	55	321	29	171
other beverages	3,040	7%	19	110	10	59
drugs and cosmetics	2,870	7%	18	104	3	16
chemicals	410	1%	3	15	2	10
total	41,000	100%	174	1007	127.8	746.2

source: Rauch Guide and Current Industrial Reports, Dept. of Commerce

Although glass has lost a lot of ground to plastic and metal in these specific areas it is easy to exaggerate the rapidity of shifts in material use--the overall market shares of the various materials expressed in dollars have been surprisingly stable in the last seven years. This makes materials-flows projections of wastestream seem less risky, and a sudden decline in the 50 pounds per year figure is unlikely.

An estimated 50 pounds per person of metal cans remain in the waste stream after subtracting deposit returns under the bottle bill. Partly because of its light weight and the incentive to recycle containers covered by the deposit law, aluminum has almost totally taken over the beverage market. However, relatively few aluminum containers are used for food, so the major part of metal packaging in the Massachusetts waste stream is steel. Food and beverages account for all but 4% of the cans produced. In terms of units, aluminum can shipments have exceeded steel since 1981, but because of their greater weight steel cans average 2%-4% of the waste stream nationally on the basis of weight as opposed to less than 1% for aluminum cans. For Massachusetts the ratio is even higher.

Metal cans are still strong in such non-food uses as spray cans,

Table 6: Consumption of Metal Cans by Type of Use and Material

end use	* 1985 U.S. number of units billions	% of total units	* est. current units per capita	total millions	Mass. weight total M tons	* lbs. per capita
beverages (alum)	69.6	68.9%	409.3	2390.6	47.6	16.3
beer	36.9	36.5%	216.9	1266.4		
soft drinks	32.7	32.4%	192.5	1124.2		
food (94% steel)	27.3	27.0%	160.4	936.8	135.4	46.4
non-food (steel)	4.1	4.1%	24.4	142.3	11.7	4.0
aerosols	2.3	2.3%	13.7	79.8		
paint	0.9	0.9%	5.3	31.2		
other	0.9	0.9%	5.3	31.2		
	101.0	100.0%	594.1	3469.6	147.1	50.4

source: Rauch Guide; U.S. Census of Manufacturers, Dept. of Commerce

paint cans, and larger containers (such as the infamous 55-gallon metal drum), whereas plastic containers have made their biggest penetration into the industrial and commercial mid-size container markets, such as drywall compound buckets. Aluminum is eminently recyclable, and with proper processing (crushing, de-labeling, shredding) steel cans are also marketable. So 50 pounds of metal cans per capita per year means 10 million dollars of disposal costs, a sum certainly worth considering.

The category of plastic is the most difficult to estimate, since there is no single group of Standard Industrial Codes (SIC codes) that covers production of plastic materials, and the diversity of forms and products, including flexible films and sheets, extruded, molded, and other kinds of containers, makes analysis more complex. From a business perspective, plastic is the "hottest" segment of the packaging industry. Since the mid-1960s this material has captured over 10% of the packaging market. Total volume of plastic in tons has been increasing at 4% per year, which of course implies a much greater increase in volume since plastic is so light. Blow-molded plastic bottles are a particularly dynamic area; in 1985 they

Table 7 : Consumption of Plastic Bottles by Type of Use

	1984 U.S. no. units millions	% of total	est. current units millions	Mass. per capita
food and beverages				
carbonated beverages	2,963	17%	105	18
fluid milk	2,614	15%	93	15
other	2,440	14%	87	14
medicinal and health	2,614	15%	93	15
cosmetics and toiletries				
hair care	1,220	7%	43	7
other	1,307	8%	46	8
household chemicals				
detergents	1,394	8%	49	8
fabric softeners	497	3%	18	3
other	880	5%	31	5
automotive and marine	540	3%	19	3
industrial chemicals	436	3%	15	3
other	854	5%	30	5
totals	17,428	100%	619	103

source: Rauch Guide and Current Industrial Reports, Dept. of Commerce

accounted for 20 billion units nationwide, almost all of which are in consumer products, food, beverages, cosmetics, detergents and so on. A large proportion of these are collected and returned under the bottle bill, although over half of returns still end up in landfills.

Of the estimated 45 pounds of plastic packaging per capita in the waste stream, there are perhaps 12 pounds in the deposit cycle, leaving 33 pounds to be landfilled, or burned. Aside from the soft-drink bottle returns, virtually no plastic is recycled at present. The problem with plastic in the wastestream is its ubiquitous use with other materials such as paper, metal, and even glass (e.g. the styrofoam wrap of glass bottles). Not only is plastic difficult to recycle, it makes other materials difficult to recycle. Thus, considering plastics suggests that the logical next step in this survey of packaging in the wastestream is a look at the future of packaging, the trends and the technology.

Add up the numbers and we discover that an astonishing 360 pounds per capita per year in the wastestream is packaging material that could be recycled. Instead it is designed, produced, and sold merely to be thrown away. We can also do some hopeful figuring and conclude that the goal of recycling 25% of the wastestream would include about 200 pounds of this packaging, which is worth almost $40 million in avoided disposal costs to the citizens of the Commonwealth at the rate of $65 dollars a ton. What remains is mostly plastic and coated paper--the least likely to degrade, the most toxic to burn, and with the highest volume-to-weight ratio. Yet these materials seem to represent the future in packaging.

Trends in Packaging. An examination of packaging trends is important when considering the effectiveness of H. 1172, because they reflect the willingness of the packaging industry to respond to citizens' concerns about the impact of a product throughout its life-cycle. Current trends indicate that the packaging industry gives only secondary consideration, if any, to the social costs of packaging materials.

Ironically, the packaging industry studied the problem of disposal twenty years ago. In the late 1960s and early 1970s the World Packaging Organization sponsored a project to measure the "D-factor" (a rating on the ease of disposal and potential for recycling). This was done so that packaging manufacturers could develop better disposal characteristics for their goods.[30] Today's packaging products demonstrate that the project did not succeed. There was a "general apathy among many packagers who did not choose to recognize the environmental problems caused by packaging waste."[31]

The failure of the D-factor project reflects economic realities. Companies are reluctant to internalize (i.e., pay for) the costs of pollution and disposal (externalities) unless pressured by public interest groups or by legislative initiatives. Consistent with their

opposition to the D-factor proposal, most packaging industries are opposed to the incentives proposed by H. 1172. Given the reluctance of packaging manufacturers to alter their behavior of their own accord, legislation seems the only available method to get industry to change course.

Market Share. Trends in the packaging industry indicate that recyclable materials are losing ground to plastics, paper bottles, and composite cans. "Paper bottles" (aseptic packages), and composite cans are both impossible to recycle. Only the outer, paperboard part of the product can be made from recycled materials. Plastics in general are difficult to recycle, although some of the obstacles are slowly being overcome. Aluminum is the only recyclable material that is growing in use. Projections by the Interpack group of West Germany show the current trend in market shares of packaging containers* by material from 1981 to 1991, see Table 8.

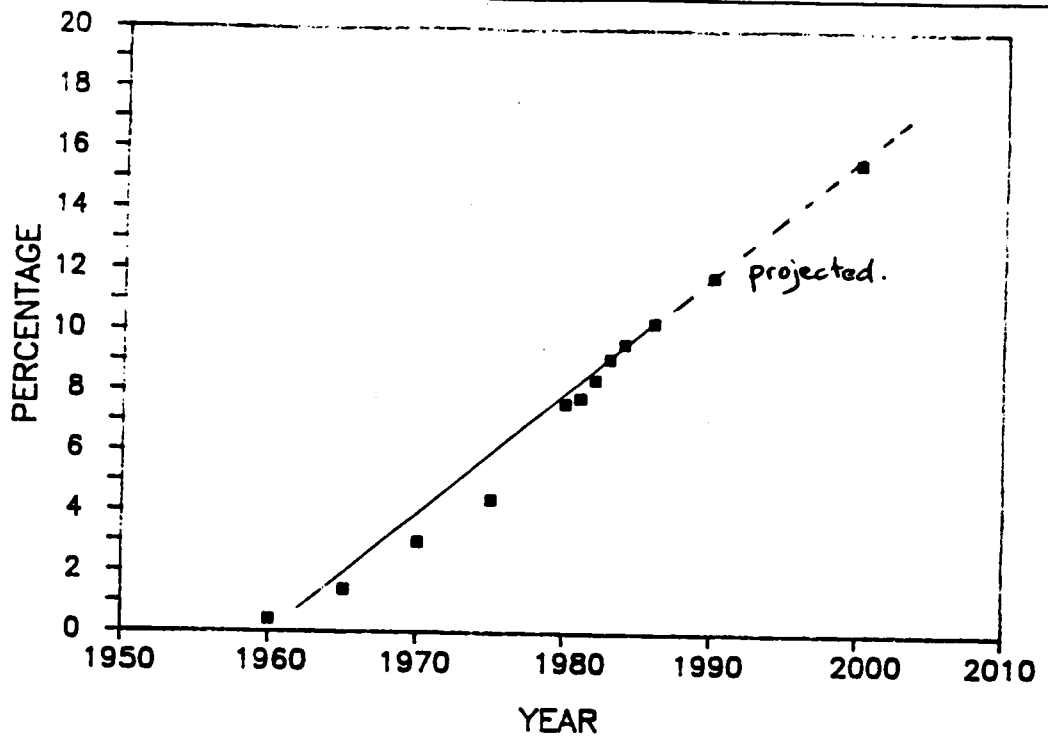
Table 8: Present and Projected Market Share of Packaging.

	Present Market Share (%)	Projected Market Share (%)	Rate of Change (%)
Paper Bottle	0.2	2.3	+ 2.1
Composite Can	4.0	4.3	+ 0.3
Plastics	13.1	26.5	+13.4
Steel	23.5	8.4	-15.1
Glass	28.9	19.5	- 9.4
Aluminum	30.3	39.0	+ 8.7

Source: "Market Study Ranks Materials 1981-1991," Packaging, August 1987.

*This projection is for containers, therefore it omits the role of blister packaging (see glossary), materials used in bags and fast-foods, and paperboard boxes.

Figure 1: Plastics as Percentage of Municipal Solid Waste



Source: Franklin Associates.

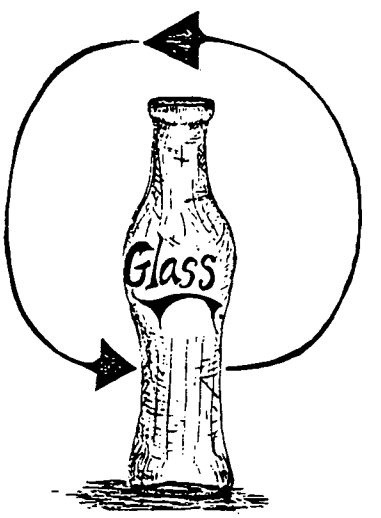
The bill's effect on glass usage in Massachusetts would be minimal because the decline in market share of glass containers is mainly attributable to breweries shifting to aluminum cans and away from glass bottles. From 1980-1985 shipments of glass containers dropped by 5.8 billion units, 5.0 billion of which were replaced by aluminum beer cans.[32] The bill will not affect this market because beer cans are covered by the bottle bill and are therefore exempt from the fee.

In fact, the bottle bill has encouraged retailers to sell soda only in plastic bottles and aluminum cans. The large-size glass soft drink containers are losing ground to lighter and larger PET bottles in bottle bill states, like Massachusetts, because PET bottles are easier to collect, store, and transport than is glass. This has led to a significant decrease in the soda bottle market share for glass in bottle bill states.

In the area of glass food packaging and juice containers, however, the bill could hamper plastics' entry into the glass market through PET bottles and jars, and multi-layer plastic squeeze bottles. The growing attractiveness of plastics is indicated by McCormick & Co.'s decision to switch its "entire line of spices under the McCormick and Schilling brands [from glass] to PET jars."[33] But this bill may make companies think twice before they switch from glass (which will always be eligible for the three cent credit) to plastic (which at best can only get the one cent credit).

The bill's effects on steel can use will be more substantial. Most of steel's decline in market share is due to competition from plastics and the fact that Americans are spending less time preparing meals, in favor of increased consumption of convenience foods.[34] More and more foods are available in table-ready plastic for cooking in either the oven or microwave, or both. This means that plastic packages are substituting for steel cans. Since plastics will be able to receive, at best, only a one cent credit under H.1172, the cost of prepared foods in plastic packaging will increase. If these are the types of products consumers demand, they will have to pay a higher price that reflects the cost of disposal.

Paper products in many cases will be exempt from the two cent fee but not the one cent fee because they cannot be recycled. An area of strong growth for paper products--aseptics juice and drink packages (the single-serving throwaway containers)--could be adversely affected by a three-cent fee. In this case, glass, which already has a strong hold on single service juice containers, will benefit.



Plastics will be hard hit by this bill because they cannot be reused in food packaging. This is where the bill will have its greatest effect on packaging trends. Melissa Larson of Packaging magazine captured the trend of plastics in packaging when she said that "1986 may well be remembered as the year that just about

everything came out in plastic."[35] As the packaging industry moves more towards plastics, the recycling of packages will become more difficult unless the industry begins to consider a package's recyclability during the manufacturing process. Two examples of industry's failure to create recyclable packages are the plastic soda can and the new microwavable/"ovenable" entrees. General Foods' latest product, now being test marketed, is a case in point. "Impromptu" entrees, which have a shelf-life of one year, are packaged in: crystallized PET trays, sealed with foil-based lidding material, and domed with opaque white plastic, the composition of which remains a "closely guarded secret."[36] "Impromptu," voted one of "This Year's Most Exciting Packages" by Packaging magazine, is certainly not going to win high marks for its recyclability or for its use of recycled products. An opaque plastic dome made from unknown polymers cannot be recycled. This package epitomizes the throw-away mentality: use once and put in the trash. It's fast, easy, and convenient, but consumers are paying for this lifestyle in skyrocketing disposal costs.

As the packaging industry moves more toward plastics, recycling will become more difficult unless the industry starts considering recyclability during the manufacturing process.

In all areas except aluminum, the trend is away from materials that are easily recycled towards plastic, which is difficult to recycle, and towards paper materials that are non-recyclable. Unlike other common packaging materials--tin-plated steel cans, aluminum cans, and glass containers--recycled plastic products cannot be used in food packaging because of contamination. The other three materials, because they are melted down at high temperatures, are reusable for food packaging.

This trend towards plastics is occurring in spite of growing consumer awareness and acceptance of the need to recycle. In a June 1987 survey by Packaging magazine, consumers responded favorably to recycling issues. To the question, "how important is recycling to you?," eighty-two percent answered "extremely important" or "somewhat important." To the question, "would you be willing to separate such items as glass, cans and paper from

household trash so that they could be collected separately?" again, eighty-two percent answered "yes," which was an increase of 5.8% from the previous year. To the question, "how often does the recyclability of a package affect your decision to buy one over another?" 41.3% answered "often" or "sometimes," up from 36.2% the previous year.[37]

One result of growing consumer awareness and increased state legislative actions to limit waste is research into and development of plastics recycling technology by the plastics industry. The current approach of the plastics industry is misguided. They propose building plants that can recycle a variety of commingled plastics, instead of making products from fewer resins that can be more easily sorted and recycled. The current industry approach of developing products that completely disregard recycling technology exacerbates the increasing trash problem.

In a June 1987 survey by Packaging magazine, consumers responded favorably to recycling issues.

The Importance of House Bill 1172

The increasing use of plastic is in response to a variety of factors. The designers of packaging view their creations as advertising placed where it can be most effective, right at the point of sale. They also claim that they are responding to consumer preferences. Packaging manufacturers, have doubtless done the sophisticated market research to assess these perceived demands for convenient, microwavable, light-weight, highly graphic packages. Much of what their researchers have discovered has been widely reported as "lifestyle" changes; two-income families have little time for food preparation and extra money to spend on convenience. (U.S. Department of Agriculture estimates that 11 cents of every food dollar is spent on packaging.)[38] As many observers of the American economy have noted, advertising "creates" demand as well as responding to consumer needs.

One factor in packaging use is the perceived need for novelty. In the 1950s and 1960s new packages were introduced about every

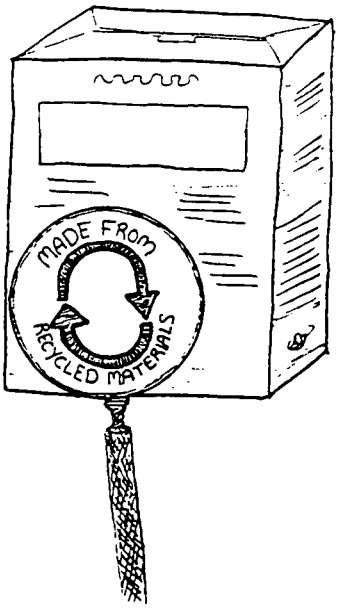
seven years; now they come out every two or three years.[39] Other factors in the development of new kinds of packaging materials include widely noted trends in the scale of distribution and sales. The "mega-store" requires a different kind of package to minimize labor, automate inventory and facilitate handling.

The U.S. Department of Agriculture estimates that 11 cents of every food dollar is spent on packaging.

Finally, through the development of new technologies packaging manufacturers have worked hard to improve the barrier and thermal properties of various plastics in what they commonly refer to as a "favorable" regulatory climate at the federal level. For example, recent changes in Food and Drug Administration regulations now allow the use of hydrogen peroxide as a contact sterilant, now permitting a greater variety of plastics to be used in packaging. Thus the emergence of such radically new techniques as aseptic plastic packaging, (enabling prepared foods to be stored at room temperature in sealed plastic containers), retortable plastics (which can be reheated at high temperatures), and other exotic technologies. What the manufacturers have not done, as noted above, is to consider the external costs associated with their choice of materials and design. There are examples of creative design using easily recycled materials, such as the award-winning glass "pineapple" introduced by Dole. But these are the exception rather than the rule.

As opposed to other legislative strategies banning styrofoam and polyethylene, House Bill 1172 will use economic incentives, to persuade rather than prohibit. An essential part of the bill's design is its relationship to the recently passed Solid Waste Act of 1987, which provides funds for a statewide implementation of regional recycling programs. If industrial users of virgin materials in packaging are assured of a consistent, long-term and high-quality supply of recycled materials, then they will be more likely to make the necessary investments in equipment to use that material. Even where there is no great investment required, the assurance of a stable supply is important if businesses are to enter into long-term

contracts and other financial arrangements.



With increased public awareness of the importance of using recycled material in packaging, companies will probably publicize their use of such material. There has been in recent years an emphasis on "natural" products, with fewer additives and preservatives. Many products now provide detailed explanations of any artificial-sounding ingredients. It is not hard to imagine an extension of this consciousness to include "natural packaging;" already some products advertise their use of recycled materials (such as the plastic garbage bag made from recycled plastic). The combination of an economic incentive and an available supply of recycled materials is critical to the success of H. 1172. This bill and the recycling program work together. One encourages the shift in consumer preferences by giving competitive advantage to the use of materials that can be recycled; the other provides a steady and cheap supply of recycled material, so that manufacturers will be further encouraged to switch rather than fight. One creates a demand and the other a supply. This symbiotic relationship is important since by itself H. 1172 raises some questions about the availability of recycled material. If manufacturers claim that they would gladly use recycled material if it were available, and if it is not, then this bill will be viewed as nothing more than a regressive tax. The recycling program outlined by the Solid Waste Act of 1987 removes that objection.

Effect of the Bill on Jobs in the Commonwealth

In order to evaluate the effect of the bill on the Massachusetts economy, we looked at employment statistics collected by the Massachusetts Division of Employment Security and the Bureau of Labor Statistics in the United States Department of Commerce for answers to certain basic questions about the impact of the bill. Do companies in Massachusetts use a lot of packaging? How many jobs are there in making packaging? If the effect of a bill were to reduce the overall use of packaging, how many jobs in the

Table 9 : Profile of Packaging Related Employment in Massachusetts
packaging and filling machine operators and tenders, hand packers

SIC	type of business	packaging jobs	total jobs	%pack. total	%type/ MA total
20	food and kindred products	4,320	24,400	17.7%	3.9%
21-29	other nondurables	N/A	1,500	N/A	0.2%
22	textile mills	450	20,200	2.2%	3.2%
23	apparel	760	35,360	2.1%	5.6%
24-25	lumber & furnishings	280	12,000	2.3%	1.9%
26	paper and allied products	870	25,610	3.4%	4.1%
27	printing publishing and allied	990	46,240	2.1%	7.3%
28	chemicals	1,350	16,900	8.0%	2.7%
30	rubber and misc. plastics	1,480	30,800	4.8%	4.9%
31	leather and leather products	280	16,500	1.7%	2.6%
32	glass cement clay pottery concrete	340	11,300	3.0%	1.8%
33	primary metals	170	12,800	1.3%	2.0%
34	fabricated metal products	1,075	45,800	2.3%	7.3%
35	machinery, except electric	420	101,200	0.4%	16.1%
36	electrical equipment and supplies	2,500	114,800	2.2%	18.2%
37	transportation equip. industries	N/A	35,000	N/A	5.6%
38	instrumentation	1,490	57,000	2.6%	9.1%
39	misc. industries	900	22,000	4.1%	3.5%
	TOTALS	17,675	629,410	2.8%	100.0%

source: Occupational Profile of Selected Manufacturing Industries, 1983
Division of Employment Security, Commonwealth of Massachussetts

manufacturing sector might be affected? If the effect were to cause a shift in the patterns of packaging use, from non-recyclable to recyclable materials, would there be a net loss of jobs? If recycling were implemented, would there be a substantial number of jobs created?

To answer the first question, we looked at absolute numbers of employment, to determine where impacts would be critical, and where in absolute terms they might not be too drastic. We should also note that dislocations, if any were to be caused by the bill, would be less noticed at a time when Massachusetts has the lowest unemployment rate of any industrialized state. The results of this research are not too surprising. Taking all manufacturing employment by Standard Industry Code, we found that the highest numbers of jobs were in two sectors- "machinery, except electric" and "electrical equipment and supplies." Together these account for 25% of the manufacturing employment in the state in 1983. "Instrumentation" and "paper and allied products" are the next highest, with 9% and 7% respectively. A glance at the table

summarizing these results shows that Massachusetts manufacturing employment is not in areas that use a lot of packaging. Of the fifty largest consumers of packaging materials in the U.S. only one, the Gillette Co. (#50 on the list) is headquartered in Massachusetts. As we discussed in sections describing packaging in the solid waste stream, by far the greatest use of packaging is in food production and consumer non-durables.

Of total packaging sales, over half are to food and beverage producers (Anhauser-Busch is the nation's largest consumer of packaging) and only 23% of packaging sales categorized by end-use are for industrial products. The categories of "food and kindred products" and "other non-durables" reported by the state include only 4% of the manufacturing sector jobs in Massachusetts. As you would expect from the forgoing discussion, these are the sectors with the highest proportion of jobs actually involved with hand or machine packaging. In food production, about 18% of the jobs are classified this way, a very high percentage. In contrast, less than 1% of the jobs in "machinery except electric" are involved with packaging, and about 2% of the jobs in "electrical equipment and supplies" are so classified. The industry group with the highest proportion of packaging jobs after food production is "chemicals," SIC #28, in which 8% of the jobs involve packaging. Less than 3% of the state's manufacturing sector jobs are in this category. Of the 629,500 jobs in this profile of employment, about 3% overall were directly involved with packaging, either hand or machine.

The benefit of a shift in patterns of packaging use towards paper products would be beneficial to the state relative to the rest of the U.S.

We do not wish to overwhelm the reader with tedious statistics: the conclusion is clear. Massachusetts does not have a lot of jobs in sectors that use a lot of packaging, or where a high proportion of the jobs directly involve packaging. Much of our industrial employment is in sectors where very few jobs are directly involved with packaging. Another simpler way to state this: the economic benefits of packaging are out-of-state. We have already seen that the costs are all too much in-state, in the form of high disposal

costs. Any measure to reduce packaging therefore, will be a net benefit to our economy.

The second aspect of this analysis looks at jobs that would be directly affected, i.e. jobs in packaging production rather than use. We calculated what we called the "job ratio" in various categories of production to determine where Massachusetts employment was strong, i.e. where more people are employed in certain sectors relative to the population than are typically employed nationwide. For 1985, we looked at 11 categories from paperboard food containers to plastic bags, and also at categories where the availability of recycled material could be expected to have a significant effect on employment. The job ratio is high in several paper-related industries where absolute numbers are also significant,

Table 10: Industries Likely to be Affected by the Bill in Massachusetts

SIC	industry	Massachussetts number of employees 1982	Massachussetts number of employees 1985	1985 U.S. number of employees	job ratio
2654	paperbd. food containers	800	531	24,084	0.87
2621	paper mills ex. bldg. paper	5,500	5,861	128,948	1.79
2631	paperbd. mills	500	583	53,146	0.43
2641	paper coating and glazing	5,200	4,892	44,471	4.33
2643	paper bags, except textile	420	382	15,981	0.94
2645	die-cut paper and board	600	864	19,110	1.78
2646	pressed and molded pulp	250-499	250-499	2,860	3.44-6.87
2651	folding paperbd. boxes	1,900	1,781	42,208	1.66
2652	setup paperbd. boxes	1,100	1000-2499	9,692	4.06-10.15
2653	corrugated boxes	3,300	3,466	99,641	1.37
2655	fiber cans and drums	500	470	13,934	1.33
3411	metal cans	250-499	250-499	46,539	0.21-0.42
3221	glass containers	250-499	250-499	43,375	0.23-0.45
2821	plastics mat. for packaging	554	443	11,502	1.32
3079	plastic film, containers etc.	3,198	3,130	61,280	2.01
2643	plastic bags	780	812	34,624	0.92
	total employees in recyclable-material packaging industries			19,800 to 21,238	
	total employees in plastics-packaging related industries			4,385	

source: Bureau of Labor Statistics, Dept. of Commerce

in SIC codes 2621 and 2641--"paper mills" and "paper coating and glazing"--where we have over 10,000 jobs statewide.

We have a moderate number of jobs in many other paper-related categories, few in metal and glass container production and about 3,200 in miscellaneous plastic products, which includes plastic containers but may also include a wide variety of other products. Another 1200 jobs are in packaging-specific plastics, such as bags. In general, the job ratio was high in all paper-related sectors except for paperboard mills, including corrugated boxes, folding and set-up boxes, die-cut paper and board and others. The total number of jobs in categories that might benefit from a competitive advantage for recyclable material and from an increased supply of usable recycled material was around 20,000. In contrast, the number of jobs in plastics related categories, including some non-packaging materials, was around 4300. This pattern of employment combined with the

Table II: Unit Consumption of Packaging

	U.S. per capita			Mass. consumption		
	1978	1985	% change	1978	1985	1985 non dep.
				* millions of units *		
paperboard containers	1,032	1,065	3%	5,920	6,109	6,109
metal cans	291	424	46%	1,669	2,403	114
beer cans	127	154	21%	728	1,503	
soft drink cans	114	137	20%	654	786	
grocery and merch. bags	174	185	6%	998	1,061	1,061
glass bottles	184	174	-5%	1,055	975	712
cigarette boxes	141	115	-18%	809	660	660
plastic bottles	54	76	41%	310	436	363
milk cartons	100	63	-37%	574	361	361
fibre-foil cans	30	32	7%	172	184	184
liquor & wine bottles	16	20	25%	92	115	115
aerosol cans	10	10	0%	57	57	57
tubes, metal & plastic	10	8	-20%	57	46	46
misc. plastic containers	28	40	43%	163	233	233
total units	1,970	2,149		11,302	12,279	9,654

source: Rauch guide; Census of Manufacturers, Dept. of Commerce; our own estimates assuming 20 units/lb resin for misc. plastic containers

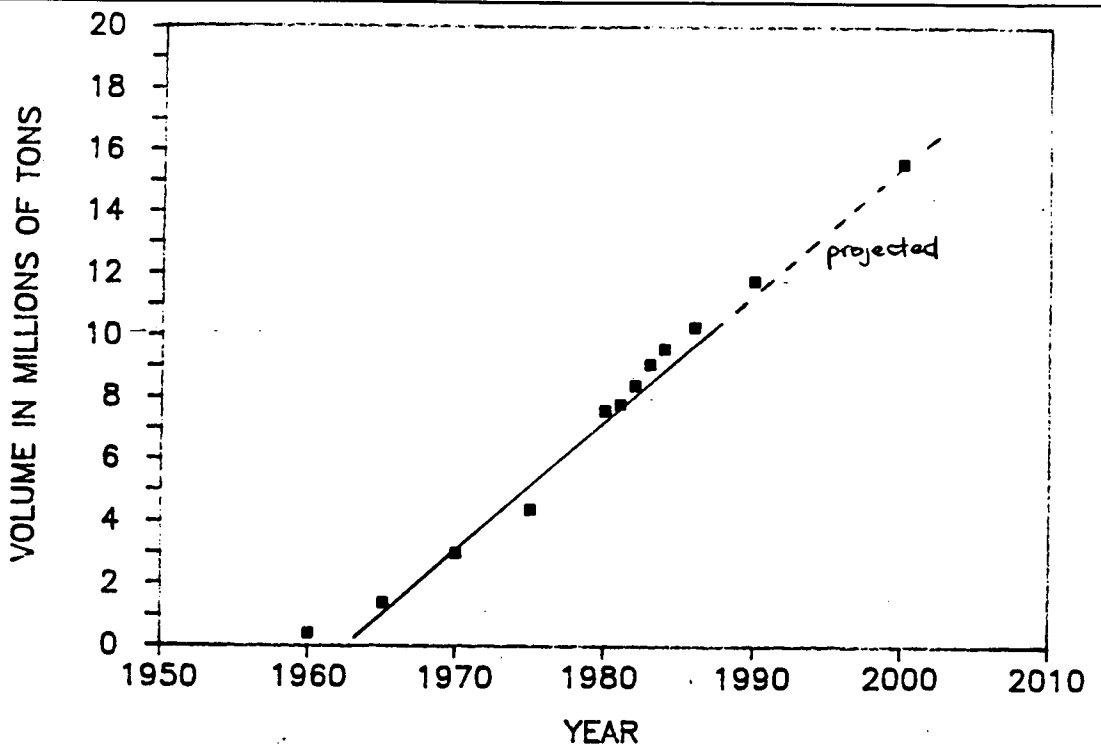
positive job-ratio indicates that the benefit of a shift in patterns of packaging use towards paper products would be beneficial to the state relative to the rest of the U.S.

Revenue Projections for the Bill

In order to estimate what the revenue from the bill might be under various scenarios we first had to develop baseline figures for the number of units of packaging consumed in the Commonwealth, and then estimate what proportion of the total might be recycled, and what proportion might be made from recycled material. Again using national averages for 1985, we were able to estimate unit consumption from industry trade group statistics and Department of Commerce surveys figures, since the adjustment for Massachusetts as a deposit-return state is fairly simple.

We consume on average about 700 paperboard packages, 425 metal cans, of which all but 133 are returnable, about 180 grocery and merchandise bags, 120 non-returnable glass bottles, 60 milk cartons (paper), another 60 non-returnable plastic bottles, and an assortment of other packages totaling a little over 1,600 non-returnable packages per person per year. If none of these were recycled or made from recyclable material then the fees set up by this legislation would total a very large sum, about 290 million dollars. Assuming that 50% of the paperboard containers could be recycled and made from recycled material, all the metal cans, 70% of the total number of grocery and merchandise bags, and all the liquor and wine bottles, we get about 41% of the number of units which would be recycled, reducing the projection for revenue to 170 million dollars. However, it is almost impossible to relate this figure directly to the cost-savings expected from further reductions in the waste stream. As we discussed earlier, the revenue is based on units of packaging and the savings are based on weight. Thus, containerboard accounts for the greatest part of the weight reduction, about 160 pounds, but a much lesser part of the revenue stream, with only an estimated 73 units per year.

Figure 2: Total Weight of Plastics in Municipal Solid Waste.

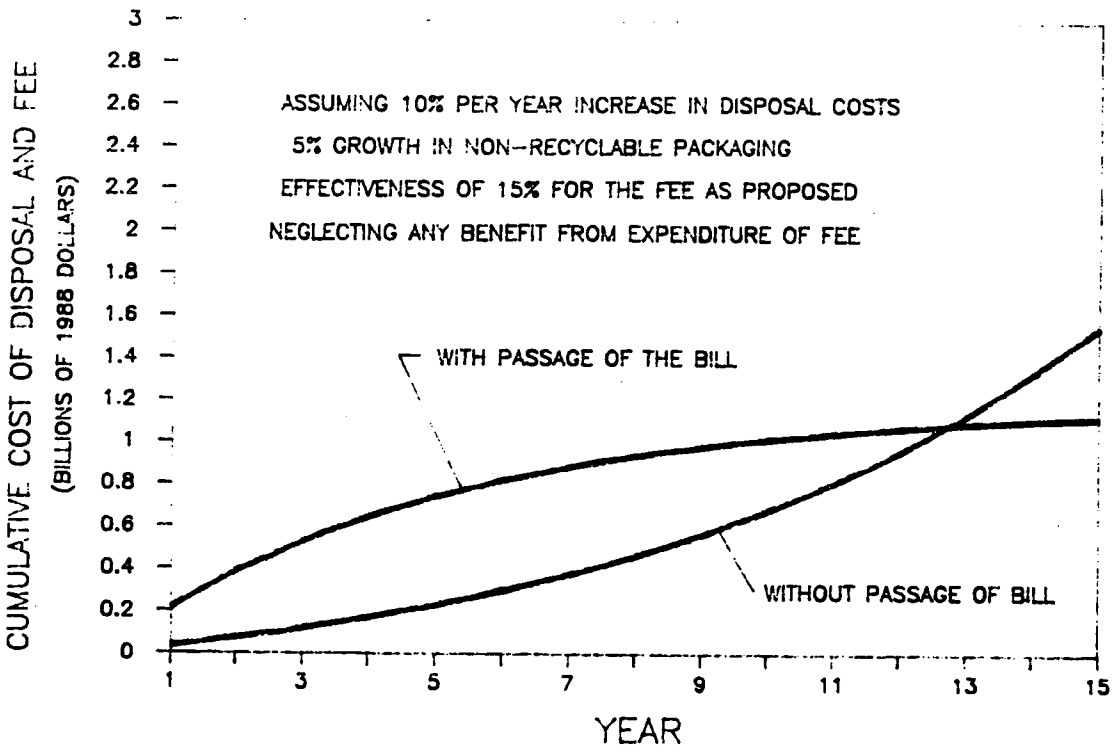


Source: Franklin Associates.

Cost Effectiveness Analysis

To get an idea of the cost-effectiveness of the bill, we need to consider the following analysis. The proportion of the waste stream that is packaging and that cannot be recycled at present is about 180 pounds per person per year, although as we have seen this figure is increasing. Assume that the cost of disposal will increase at a rate of 10% per year for the next ten years; that the proportion of packaging in the waste stream that cannot be recycled without this bill would increase at a rate of 5% per year; and finally that the bill will succeed in decreasing this amount at a rate of 15% per year. The analysis must then consider a stream of benefits equal to the avoided disposal cost, and compare that figure with the revenues collected, bearing in mind that total revenues will decline as the bill succeeds in reducing the amount of packaging that needs to be landfilled or burned.

Figure 3: Net Cost of Disposal With and Without Fee



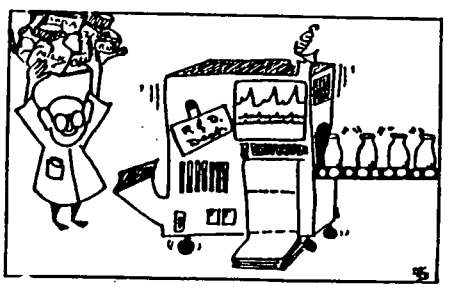
Source: Previous tables.

The results of this calculation are reported--using current dollars and a real discount rate of 6%--both in tabular form and graphically. The obvious conclusion is that the time frame becomes crucial in determining the "pay-back" period; neglecting any consideration of the benefits from the expenditure of the revenues collected under the bill i.e. the jobs created locally, the benefits from research and development, and also omitting consideration of the environmental benefits from the reduction in solid waste, we still find that the bill "pays for itself" in a period of 13 years. The assumptions are conservative--as the earlier discussion of trends and the various statistics provided earlier should make clear--but are still subject to a great deal of uncertainty. To further explore the issue of whether or not the bill would "succeed" a case-study approach is essential.

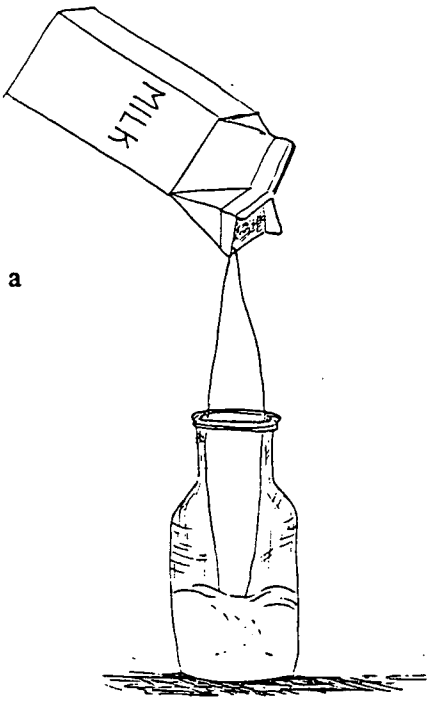
Why Cost-Effectiveness Is Not the Only Criterion

There are two important reasons why cost-effectiveness ought not to be the only criterion by which to judge a bill such as this. The first has to do with risk: we don't necessarily want to find out how high solid waste disposal costs can go before moving to change the patterns of production and consumption that caused them to go so high. It will take time for new patterns to emerge, for new markets to be created and for public education to work. Furthermore, there are benefits associated with encouraging recycling that are not easily quantified; these have to do with taking a long-term view of resource exploitation and environmental degradation. Every pound of plastic that we don't use (or develop the technology to recycle) is that much more oil that our children will be able to use, perhaps more productively and creatively than making some plastic film to wrap a leftover casserole once and then burning it a few days later. Every pound of aluminum that we recycle saves electricity. The environmental stresses associated with the production of these materials need to be considered as externalities, as well as the problems with disposal which have received most of the attention so far.

The other point about the cost-effectiveness of the bill is that the fee structure is designed to be self-extinguishing. If the bill and other measures worked to completely eliminate non-recyclable packaging, then the benefits would continue long after the costs. In other words, the benefits should be considered over the long term, whereas the fees collected should be viewed as a short term cost. This raises the question of whether the 3 cents is enough, in terms of effectively persuading manufacturers to change, and motivating consumers to insist on that change. This is the sort of question we left to the case studies to answer.



Milk Container Case Study



Methodology

The methodology used to collect information relied heavily on a literature review. Other methods used to collect information were interviews and personal correspondence.

Milk Industry

Background. Annual consumption of milk containers in Massachusetts is about 3 pounds per person.[40] An estimated 18 million pounds of high density polyethylene (HDPE) dairy bottles enter the waste stream annually; potentially they all could be diverted into recycling.[41]

Milk Packaging. In Massachusetts, milk is commonly packaged in four different types of containers. The size of the container frequently determines the packaging material. Gallon-sized containers are made from blow molded HDPE plastic. Half pint, quart, and half gallon-sized cartons are made from paperboard coated with polyethylene films (these are called Purepaks). Restaurants and cafes serve containers of dispenser milk in polyethylene. And, in some stores, milk is still sold in the traditional quart-sized glass bottle.

Half gallon, coated plastic or aluminum-lined, paperboard cartons are also observed in the market, but they are mainly used as juice containers. Juice containers are also made from half gallon containers of blow molded HDPE.

When analyzing the probable impact of H. 1172 on the milk industry it is important to note the scarcity of studies done on this topic and the reluctance of the milk industry to impart with production information. Because of this we relied heavily on studies conducted in other countries and on studies from the early 1980s for the analysis in this report. First and foremost, an understanding of the constraints on packaging in the milk industry is necessary.

According to Michael J. Hare, Associate Professor at the University of Toronto, Canada, the use of plastic coated cartons is rapidly gaining ground in the milk container market (see Table 12). Glass is no longer used to any appreciable extent. About 1.6 billion pounds of milk carton stock (sanitary paperboard) and 460 million pounds of high-density polyethylene are consumed to make milk cartons in the U.S., with half gallon and gallon sizes predominating. Most of the plastic is used for the gallon size, for which the plastic and the paperboard prices are approximately equal.[42]

Before further discussion on trends in packaging milk, it will be useful to understand the attributes of a good package. According to Hare, a good package properly protects the product or beverage, has

Table 12. Market Trends of Milk Containers, 1968, 1978, and 1983.

Market parameter	1968	1978	1983
Container:			
- Paperboard Carton	74	66	40-42
- Bulk pack carton bag	6	5	3
- Glass	12.5	2	1
- Non-returnable plastic	0.5	0.5	2
Size:			
- Half gallon	53	30	28
- Gallon	16	46	50

Source: Gaines, L.L., "Energy and Materials Use in the Production and Recycling of Consumer-Goods Packaging," Argonne National Laboratory, February, 1981.

positive marketing attributes, and is cost- effective. H. 1172 now calls for a fourth important attribute which Hare too has mentioned as necessary--that the package possess a positive waste management profile.

Hare cites the following attributes (which are not mutually exclusive) as possible waste management criteria for a package:

(1) possess reuse possibilities (glass milk containers qualify for this, the HDPE milk jugs are questionable, especially with regard to hygiene).
(2) be a good candidate for a household source-separation program (all rigid containers qualify).
(3) be a single material (both HDPE jugs and glass bottles qualify).
(4) be a good candidate for further research and development (both glass bottles and HDPE jugs qualify).
(5) be capable of being recycled under present technology (both glass bottles and HDPE jugs qualify).
(6) be a material for which there are real and regular recycling markets (glass bottles qualify as do HDPE jugs, but the recycling markets need further development).
(7) manufactured from a renewable resource (paper cartons qualify, however, the polyethylene coating complicates recycling potentiality. Glass bottles, although using non-renewable resources, are still considered as qualifying because of the abundant supply of raw materials (silica, limestone, soda ash). However, HDPE jugs and all the plastic used to coat the paperboard cartons are made from oil, which is not only a non-renewable resource but a resource we must import).
(8) face low institutional barriers (retailers prefer non-refillable containers over refillable bottles).
(9) be capable of being recycled into new beverage containers (glass bottles qualify).
(10) possess a low "void" factor in landfill (both glass bottles and HDPE jugs do <u>not</u> qualify).

Aside from the above mentioned waste-management criteria, other important criteria for determining the choice of milk packaging are the cost of production and operation, type of energy used in the production and operation, and consumer preference.

The specific characteristics of milk often affects the choice of packaging type. Milk presents different packaging problems from other beverages due to composition, limited preservability, sensitivity to light, and quality of easily absorbing scents and flavors.[43] Because of these characteristics, milk packaging must maintain hygiene, admit no scents and flavors, be opaque, and transmit no scents.

A returnable package for milk somewhat increases the chances of chemical contamination of the product because of 1) the possibility of coarse impurities in the packaging which are not removed during the cleaning (such as strongly smelling substances) and 2) a rough inside surface caused by the use of mordants, which makes good cleaning extremely difficult.

The risk of bacteriological impurities is also greater with refillable packaging than with non-returnable packaging. This is because the bacteriological count of returnable packaging before it is refilled depends on how the rinsing machine functions; filling bottles leads to more contamination than filling cartons.[44]

Light Transmission

Hank Middelveldt* reported that the influence of light may cause the milk to change its flavor and riboflavin (Vitamin B2) content. The resulting deficiency in taste is called 'oxidation taste.' Ultrahigh temperature milk (UTH milk), i.e. milk heated at 140 degree celsius for a few seconds, keeps for a long time but is particularly sensitive to light. UTH milk is only packaged in materials with low light transmission--packaging considered appropriate in the Netherlands for this type of milk is cardboard covered with an aluminum layer. For bacteriological reasons, it is almost impossible to use refillable bottles with this type of milk. Milk sterilized in the packaging can not be packed in cardboard.

*The Head of the Department of Liquid Milk and Liquid Milk Products, Commodity Board for Dairy Produce, in Netherlands.

Thus the choice of packaging materials can be determined neither exclusively by economic variables nor exclusively by environmental factors.

Cost

The unit cost of milk packaging used in Massachusetts, according to information collected from West Lynn Creamery (a dairy) and Bread and Circus (a retail store), depends on the material and the size of the container (see Table 13).

Because detailed domestic milk packaging cost studies are unavailable, this study relies on a literature review of a number of studies done in Europe. In an investigation conducted at Christian Michelson's Institute in Norway (CMI), Mikael Backman* examined the costs of three different types of milk containers: gable top cartons, returnable glass bottles, and returnable polycarbonate bottles.

Table 14 shows the total costs calculated for each respective package alternative. Within each alternative, that share of different

Table 13. Costs of Milk Containers

Container	Cost per Container (cents)
High Density Polyethylene	
- One gallon	10.5
- Half-gallon	6.0
Paperboard Container	
- Half-gallon, coated w/polyethylene	11.5
- Half-gallon, coated w/polyethylene and lined w/aluminum	14.0
Glass Bottle	
One Quart, w/75 cents deposit	72.0

Source: West Lynn Creamery and Bread and Circus.

*Mikael Backman is a university lecturer at the Transportation and Materials Handling Engineering Department of the Lund Institute of Technology.

package sizes has been selected which corresponds to the actual consumption in Norway. As is apparent from Table 14, carton packages are the cheapest alternative. Returnable polycarbonate bottles are 23 - 25% more expensive and returnable glass bottles are 52 - 53% more expensive, depending on the number of times the package is reused, than the carton container. If the waste stream alternative is assumed to be combustion with heat recovery, the difference will be a further few percent greater.[45]

Table 15 shows the costs calculated by the Danish Ministry of Environment for the different milk packaging alternatives. It is apparent from Table 14 that the costs for the one-way containers are lower than the costs for the returnable containers.

Comparing Tables 14 and 15, it can be seen that the difference in costs between one-way and multi-use alternatives in the two investigations are of different magnitudes. The explanation for this

Table 14. Total Costs (in Norwegian Ore) for Different Milk Package Alternatives According to CMI

	Throw-away Carton	Returnable Glass Bottle (cost/trip)		Returnable Poly-carbonate Bottle (cost/trip)	
		30 Trips	50 Trips	75 Trips	50 Trips
Package Manufacture	17.6	10.1	9.1	8.4	9.2
Filling	12.2	22.6	22.6	19.4	19.6
Distribution	16.0	26.4	26.4	20.8	20.8
Shop Costs	17.1	39.4	39.4	30.8	30.8
Consumer Costs	1.3	2.0	2.0	1.5	1.5
Refuse Handling	1.4	0.1	0.1	0.1	0.1
Total	65.6	100.6	99.6	81.0	82.0

Source: Backman, Mikael, "Milk Packaging and Its Costs: A Literature Study," Container Costs, Edited by J. Butlin and K. Lidgren, 1983.

Table 15. Total Costs (in Danish Ore/liter) for Different One Liter Milk Packages According to the Danish Ministry of the Environment.

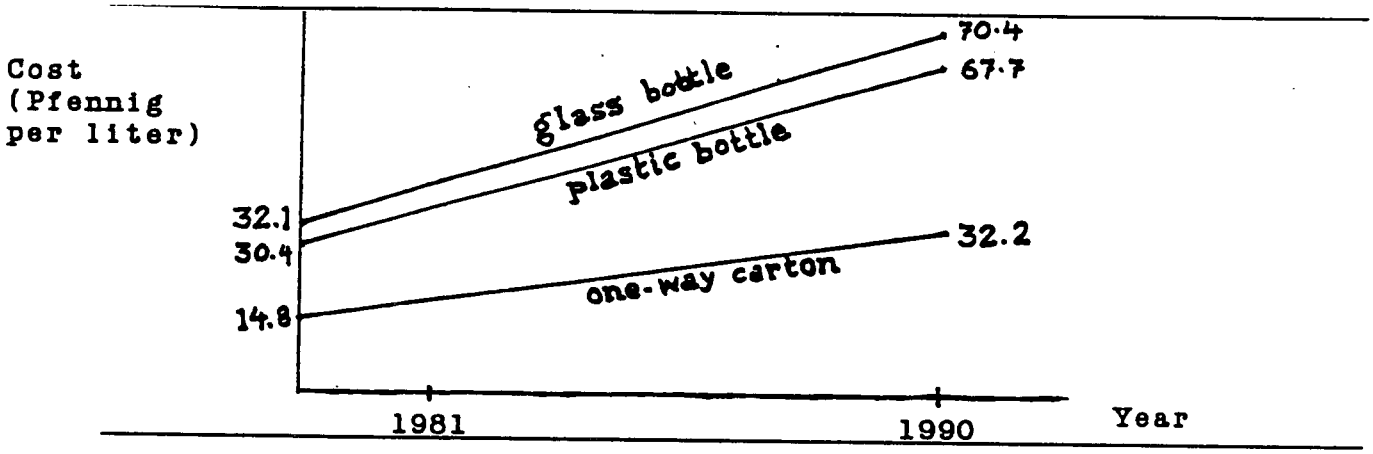
	Paper-board Carton	Plastic Pouch	Plastic Bottle cost/trip 80 trips	Glass Bottle cost/trip 30 trips
Package Manufacture	20.4	8.7	6.2	8.0
Filling	7.7	5.1	9.3	10.0
Distribution	16.4	16.4	19.6	22.8
Shop Costs	19.4	19.4	35.6	38.0
Consumer Costs	1.6	2.4	1.7	2.0
Refuse Handling	2.7	0.1	0.0	0.0
Total	68.2	52.1	72.4	80.8

Source: Gaines, L.L., "Energy and Materials Use in the Production and Recycling of Consumer-Goods Packaging," Argonne National Laboratory, February, 1981.

resides partly in the fact that the costs in Table 15 relate to one -liter packages whereas the Norwegian cost information relates to a mixture of different package sizes corresponding to the actual consumption in Norway. One explanation in the difference in package manufacture costs could be that the raw material, paper, is more expensive in Denmark than in Norway.[46]

In 1981, the Bundesanstalt fur Milchforschung in Kiel and the Roland Berger International Management Consultants in Munich each presented an examination relating to product, distribution and related trade costs for different [milk] package alternatives. Their cost analysis is considered to be more detailed and comprehensive than the others. In this investigation, Roland Berger also made a forecast over the development in processing costs up to 1990. The forecast, which is an extrapolation of the cost increases between 1970 and 1980, indicates that the cost difference between one-way and return systems will increase (Figure 4).

Figure 4. Cost Development for Different Packaging Systems, 1981 - 1990



Source: Backman, Mikael, "Milk Packaging and Its Costs: A Literature Study," Container Costs, Edited by J. Butlin and K. Lidgren, 1983.

These studies prove that one-way packages are cheaper for containing milk products than the multi-use packages. But these studies ignore the disposal costs (negative externalities) of the paperboard and HDPE containers.

In purely general terms one should question investigations whose purpose is to make total-economic assessments when the capacity of the packages to satisfy a number of their basic functions are omitted from the economic consideration. The properties (or lack of properties) of a package always have a price and this is, naturally, also valid for properties which influence the labor market, environment, comfort, product protection, hygiene, wastage, etc.[47]

Recyclability

The three milk containers discussed all have varying degrees of recyclability and ability to use recycled materials. Glass containers can use recycled glass (cullet) and are recyclable. HDPE containers are recyclable but cannot be made from recycled HDPE due to hygiene factors. Paperboard cartons can be made from recycled paper/paperboard but are not recyclable because of the

plastic/aluminum lining.*

Energy

As shown in Table 16, paper is the only milk packaging material made from a renewable resource. Plastic and glass packaging all currently rely on non-renewable raw materials. The reserve of the main raw material for glass--silica sand--is not under pressure given the abundance of the resource.

Because the rate at which the industrial world consumes raw materials is growing rapidly[48] the World Commission on Environment and Development (1987) has stated the need to use both renewable and non-renewable resources in a sustainable manner.

Energy is consumed at various rates in the production and processing of packaging containers. To accurately determine the total energy consumed in the life of a package each energy input must be quantified. Such an exercise is complex.

In their report, Packaging in the New Zealand Environment, the

Table 16. Raw Materials Used to Produce the Three Types of Packaging Materials for Milk

Packaging Materials	Raw Materials	Renewability
Paper	Wood pulp	Renewable every 25-30 years
Glass	Silica sand	Non-renewable
	Limestone	Non-renewable
	Soda ash	Non-renewable
Plastic	Oil	Non-renewable

Source: Packaging in the New Zealand Environment: Issues and Options, Discussion Paper, Ministry for the Environment, November, 1987.

*More will be discussed on reuse and recycling later in this report.

Ministry for the Environment mentions three studies on the energy used in the life of a package: a 1978 study performed by the Organization for Economic Cooperation and Development (OECD) in Paris and two studies done by Tetrapak in Sweden in 1983 and 1986.[49]

According to this report, two conclusions with implications for the conservation of energy in packaging can usefully be drawn from these studies. First, the 1978 OECD study shows that refillable beverage containers are more energy efficient than their throw-away counterparts. Second, that the recycling of materials saves energy. This conclusion was drawn from data based on the recycling practices of several UK firms, notably glass and aluminum manufacturers.

The energy consumed annually in the United States to produce paper, glass, steel, aluminum, and plastic for consumer-goods packaging is 2.4 quad (1 quad = 1 quadrillion Btu.). A maximum of 1.5 quad could be saved if this packaging material were recycled, and about 0.6 quad could be recovered if it could be burned as part of Municipal Solid Waste (MSW). Paper and plastics compete in several markets including milk containers. In almost all cases, the plastic container requires less energy to produce and recycle. However, the major energy input to paper manufacture is wood, rather than oil and natural gas. For family-sized beverage bottles, a plastic bottle uses less energy to make and to recycle than a glass bottle. In addition, plastic bottles are combustible. However, glass bottles could be made with no oil or natural gas input, and they can be reused.[50] And, there is also no problem of toxic waste and air pollution associated with their combustion.

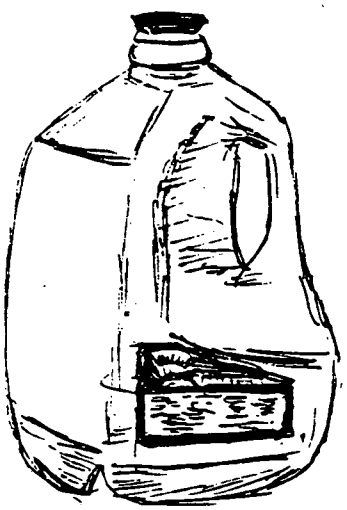
Glass can be recycled. However, recycling saves only about 25% of the energy used for manufacturing glass from virgin materials, because used glass must be remelted at nearly the same high temperature as raw materials for new glass (2700 degrees

Fahrenheit). Reusing glass, on the other hand, saves almost all of the energy needed to make new glass. The only energy cost that can be attributed to glass reuse is any additional energy to transport a refillable bottle compared to a new one. However, refillable bottles require more energy to make, because they are usually about 50% heavier (to minimize breakage) than the equivalent non-refillable bottle.

L. L. Gaines, of the Energy and Environmental Systems Division of Argonne National Laboratory in Illinois in work sponsored by the Assistant Secretary for Conservation and Solar Energy, Office of Industrial Programs (U.S. Department of Energy), reported that plastics are somewhat more energy intensive per pound than paper, with ratios of energy inputs of 1 - 1.3, depending on the specific material involved. However, paper products generally are heavier than equivalent plastic products. If the containers are burned, plastic has less energy foregone (energy input minus product heat of combustion) per container than the paper container. If packaging is recycled, the energy advantage of plastic over paper increases, because the energy required to recycle paper is relatively high (about 11,500 Btu/lb). Recycled paper and recycled plastic use about the same quantity of oil and natural gas; both use more of these fuels than virgin paper.[51]

The key to a successful recycling system is inexpensive collection of materials containing a small number of well-known components. According to L.L. Gaines, one promising candidate is plastic milk bottles, which could be returned to retail outlets, compacted, and perhaps sent back to their place of origin as a return (back-haul) cargo. Refillable milk bottles (glass, heavy-gauge polyethylene, or polycarbonate) consume the least energy per unit of product delivered. These bottles are economic if they make 20 or more trips, the number depending on the material. However, neither the consumer nor the dairy wants the added bother of dealing with returns.

The Food and Drug Administration (FDA) prohibits reusing plastic bottles for food applications. (However, recycled plastic can replace virgin plastic in other markets.) The marginal energy cost for reusing a glass bottle is low, because non-refillable bottles require transportation to a landfill and new bottles also need washing. Therefore, the marginal per trip cost of a refillable glass bottle equals the production energy divided by the number of uses. If a glass bottle is used three times, it requires less energy than a plastic one that is thrown away after one use.[52]



Thus, there is no simple answer as to which type of container is most favorable from an energy and materials standpoint. Each material has its advantages and disadvantages, and choosing one over another will depend on what criteria are deemed most important and whether combustion, recycling, and reuse are considered feasible as well as desirable.

Under the nation's first mandatory statewide recycling law, Rhode Island has launched two multi-material curbside pilots in the planned phase-in of a Providence area recycling region and materials recovery facility (MRF) expected to be on line in Fall, 1988. Both pilot programs including PET soft-drink bottles and HDPE dairy bottles began in October, 1987. Preliminary reports for the East Greenwich pilot area of 2025 households showed higher rates than for Charlotte, N.C. The data collected in this pilot project indicate that citizens will readily separate plastics in their homes if given the opportunity.[53]

West German curbside collections of co-mingled recyclables, including plastics, began about 10 years ago. Now, approximately 5 million people benefit from this service. Generally, participation and recovery rates are high, with many programs reporting at least 20% reduction of landfill wastes.[54]

In Ontario, Canada, with its "closed" retail system for beer (government regulations require that Ontario breweries sell their beer and consumers redeem their empties at Ontario brewers' retail outlets), consumers have historically redeemed their refillable bottles (which is still the dominant container) at about a 98% return rate (with a 10 cent deposit). The more recently permitted aluminum beer can is redeemed at about a 70% level with a 5 cent deposit.[55]

The Naperville Area Recycling Center (NARC) in the Naperville suburb of Chicago added HDPE dairy bottles to their voluntary multi-material curbside in spring, 1987. It serves 13,000 households with a population of 45,000. NARC targeted dairy bottles only but also receives miscellaneous HDPE containers such as juice and detergent bottles. They claim that space and equipment constraints at their processing sites currently prohibit increasing HDPE volume. In the first eight months, NARC collected 10 tons of HDPE, and sold them to Eaglebrook Plastics in Chicago. In eight months of collection, milk jug volumes have grown steadily to 1.5 tons per month now. NARC has declared the program a success and plans to actively solicit other HDPE containers when space and equipment allow.[56]

The Columbia County Recycling Program (CCRP) in Portage, Wisconsin serves a population totaling 27,000 and collects PET, HDPE milk jugs and other HDPE bottles through a bi-monthly, multi-material, post-consumer plastic curbside collection program. Last year they had to manually de-lid bottles, sort milk jugs from colored HDPE, and bale the bottles to earn six cents per pound. Now, they sell mixed HDPE bottles baled to several mid-west buyers at a contracted price of 15 cents per pound, three times the price of one year ago.

Most operators concur that plastic's resale value is improving and stress that the public is willing to set out plastics for recycling.[57]

Analysis

The proposed legislation, recognizing the difference between the milk packaging and the average item to be packaged, has considered a three year exemption period. This three year exemption period is accorded to containers in general that meet the criteria of "containers used to package food or food products sold for human consumption."

The important question is, "what happens when the three year exemption period expires?" The impression gathered from conversations with different milk packaging industry people* was that switching back to bottling milk in glass bottles would not only be too big a financial loss, but would also be unpopular among consumers. They implied that the extra fees imposed by the bill would be passed on. It is interesting to note here that their opinion on glass packaging being unpopular among consumers is contrary to findings of some studies. In the National Recyclers Multilogue Vol.2 No.1, Ray Chalmers in the special report "Consumer Survey Reveals Surprises" mentions that the consumer survey of food container preference showed that glass jars received a 4.3 on a scale of 1 to 5 for preserving flavor and taste, and 4.4 for convenience of resealing. Both these scores were the highest among the surveyed food containers which included squeeze bottle, metal can, carton with inner lining, and plastic jar.

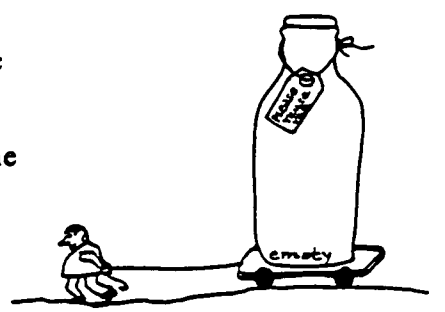
In examining the HDPE jugs, the plastic coated paper cartons, and the glass bottles used to package milk, the extra cost imposed by the bill does not seem to generate any competition between the HDPE jugs and the plastic coated paper cartons. It does not seem likely that one can have any significant advantage over the other as far as the bill's effect is concerned. Thus, it is quite likely that both types of packagers will pass on the extra cost. However, in terms of the 'recyclability' of the material, HDPE jugs might have

*They wished to remain anonymous.

an edge over the plastic coated cartons. Upon comparing these two types of milk packaging with glass bottles, glass bottles have an advantage over the other two as far as the three cents fee is concerned. However, the cost of glass bottles already being so much more higher than the other two types of packaging, the advantage from the fee imposed by the bill does not appear to be large enough to tilt the balance in favor of glass bottles.

Now, looking at all of this from a consumer's point of view, the extra three cents they might have to pay for milk in one type of packaging over the other does not appear to be large enough to influence their choice in terms of the overall cost of a packaged milk, especially, if their preference is for convenience. Convenience, here is assumed to be the difference in weight, reduced risk of breakage and resulting injury, and simply the luxury of being able to throw away the container after use as opposed to having to carry it back to the retail store. This, however, does not mean that the consumer preference is carved in stone. Consumer preference can be altered if the consumers could be made to fully understand the economic and the environmental costs associated with the disposal of the packaging and which, in some way or other, will be paid for out of their pockets.

Another aspect that needs consideration is the special characteristic of milk as opposed to other types of beverages. If the influence of light is to be given importance, milk packaged in the paper carton takes precedence over the others. Because of the liquid nature of milk, paper cartons must be waterproof. This is done either by waxing or by coating the paperboard with a plastic film. Both methods render the package non-recyclable. However, the paperboard carton could be made from recycled paper since the paper does not come in contact with the milk.



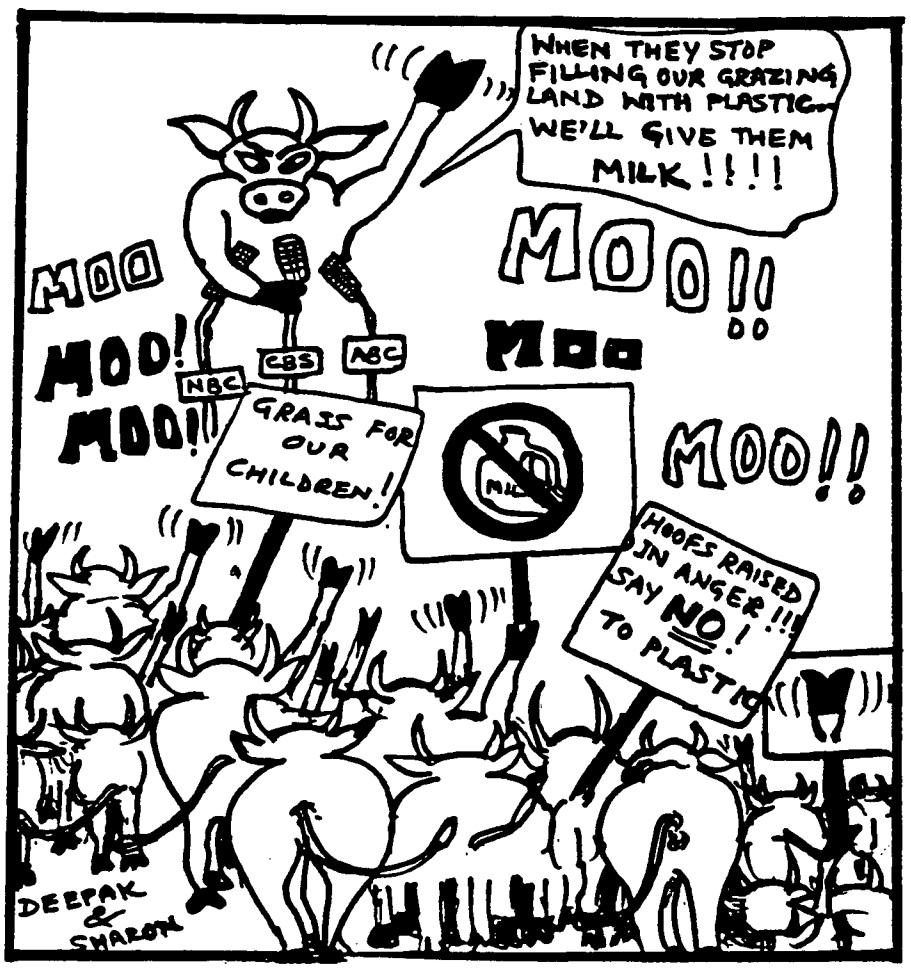
If hygiene is considered, a non-refillable package has an advantage over a reuseable one. The extra costs associated with

collecting, storing, transporting, and washing reuseable packaging need to be considered in the selection process.

If energy and the type of raw materials used to manufacture and process the packaging are considered, the choice of packaging will vary with the priority placed upon the energy type and the associated economic, political, and environmental contexts.

Thus, the different milk packaging materials offer no clear choice in deciding which is "best."

The bill, as proposed, will probably not succeed in significantly changing the present trend in milk packaging. The two major factors that could influence the present trend in milk packaging are 1) major breakthroughs in plastics research and 2) heightened consumer awareness about the environmental and economical costs associated with different packaging materials.



Case Study: Paper vs. Plastic Bags

This study is designed to investigate the economics of the decision-making process at the retail and manufacturing level of H. 1172 in regard to:

- o whether a retailer will purchase paper or plastic bags,
- o the advantages of each,
- o the decisions a manufacturer and retailer will make in regard to the imposed fee,
- o the volume of present waste that could be recycled, and
- o background information on paper and plastics recycling.

Methodology

Information for this study was gathered exclusively through personal interviews.

Retail Level

Background. The retailer represents a chain that owns close to 100 stores throughout the northeast region. For purposes of this report we will refer to only its 72 stores in Massachusetts. I spoke with the person whose responsibilities include purchasing expense items for in-house use. That person, and the chain in general, wish to not be named in this report.[58]

Pertinent facts about this retail chain include: (1) bags and trash collection are its two highest line-item budget expenses, (2) it made the switch from paper to plastic bags approximately 1.5 years ago, and (3) any costs imposed by H. 1172 would be passed on to the consumers.

Costs. This chain used paper bags to package their customer's purchases up until one and one-half years ago. They now use

plastics. Bags are an expensive budget item for this chain .25% of sales is budgeted to bags; .33% of sales was their actual cost for 1987. They, their distributor, and manufacturers constantly negotiate to get the best possible price. Table 17 shows the effect of fluctuating plastic bag prices; the price paid at the store for less-dense one-sixth plastic bags with logo is less for December than the approximate price quoted by headquarters for the same bag in March (The one-sixth, or tee-shirt bag, is the common grocery sack).

This retail chain made the switch from paper to plastic for one reason: plastic bag prices were lower. Its analysis of the paper bag industry predicted that prices would rise by 11-13% for 1987. That predicted rise triggered the switch. Economically it was a good move for the chain because paper bag prices actually rose by 40-50% in 1987.

Because plastic bag prices fluctuate every 2-3 months, the chain continues to negotiate for the best deal on a regular basis.

Table 17. Costs Paid by the Retailer for Paper and Plastic Bags, (in cents per bag).

	Price as quoted by headquarters	Price at Retail store
High-Resolution one-sixth[1] plastic bag with logo	approx. 5 ¢	------
Less-dense one-sixth plastic bag with logo	3-4 ¢	2.75 ¢
One-sixth kraft bag with logo (paper)	>8 ¢	------
One-ninth plastic bag with logo	-----	2.25 ¢

[1] The one-sixth bag is the size of the standard grocery sack based on a price of $27.47 for a case of 1000 bags. The retail chain no longer purchases one-sixth paper bags based on a price of $22.50 for a case of 1000 bags.

Volume of Bags Used. In Massachusetts, this firm distributes approximately 1.75 million paper bags and 7.4 million plastic bags annually.* Potentially all of the paper bags could be recycled, though none of the plastic bags can be for reasons that will be discussed in section II of this case study.

Impact of Legislation. As already mentioned, the retail firm's decisions on what type of bag to purchase is based almost entirely on price, and are among its most expensive single budget items. It receives no return on its purchases, save the marginal benefits of logo advertising (which can and is done on paper bags; it just looks better on plastic). If H. 1172 made recycled paper bags more competitive than plastic, then the firm would go back to using paper bags.

The buyer stated that the proposed legislation would have a "dramatic impact" if it were adopted, and she indicated that any additional costs would be passed on to the consumer. The firm adamantly opposes this legislation.

Manufacturer

Background. The Ace-Lon Corporation of Malden, Massachusetts, is a medium-sized manufacturer of polyethylene bags. It employs 30-35 people and produces bags ranging in size from very small 6 in. by 6 in. plastic bags, up to the ubiquitous 30-gallon garbage bag. Paul Gentile, President of the company, provided information about the firm.[59] He has been in the plastics manufacturing business for 40 years.

Ace-Lon, along with several other small manufacturers, supplies the Greater Boston plastic bag market. Mr. Gentile estimates that Ace-Lon enjoys approximately a 4-5% market share of the

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*These figures are based on total chain-wide paper and plastic bag use from May to September and extrapolated to include the entire year for those stores only in Massachusetts.

Commonwealth's plastic bag market. He does not know the volume of plastic bags being imported into Massachusetts making this figure a rough approximation at best. Ace-Lon sells 10 million bags per month, and realizes a 4-5% annual profit for its efforts.

Selling Prices. Actual prices fluctuate depending on oil and resin prices and the general state of the economy, so the following prices are approximations. Ace-Lon's selling prices for bags vary from O.5-1 ¢ for its smallest bag, 1.5 ¢ for a plastic bread bag (2 ¢ if printed), to 4.5 ¢ for a printed one-sixth bag.

Recycling. Only minimal, pre-consumer recycling occurs at Ace-Lon, which is typical of the polyethylene bag manufacturing industry. They recycle test runs and misprinted labels. These "set-up" runs are reground into pellets and blown into colored garbage bags. The bags are darkly colored to mask the psychedelic effect printed, reground plastic would produce. Polyethylene as it is presently found in the solid waste stream cannot be re-manufactured into first-quality, clear plastic bags for food or display purposes. Mr. Gentile indicated that given current U.S. technology, the production of first quality polyethylene bags from recycled materials is not feasible.

Rick Thorneberg, Information Director for the Flexible Packaging Industry Association, in Washington, D.C., indicated that plastics recycling is in its infancy, much as paper, glass, and metal recycling were years ago.[60] There is currently a market for recycled plastics, especially PET (polyethylene terephthalate) soda bottles and polyethylene garbage bags. There is also a demand for composites of various poly films, called "commingled plastics," which give plastics a second, and perhaps additional lives. One use mentioned by Mr. Thorneberg for commingled plastics is "plastic lumber"--a hard plastic wood substitute.

Impact of Legislation. Mr. Gentile expressed strong opposition to this legislation. That attitude can safely be assumed to represent that of the plastics manufacturing industry as a whole. Under H. 1172, plastic bags would not qualify for the 2 ¢ rebate, and would only qualify under certain circumstances for the 1 ¢ rebate. In either case, this legislation represents forces that could generate large potential shifts in the retail bag market away from plastics and back toward paper.

Because Ace-Lon is operating at only a 4-5% profit margin, there are few places where they could further cut costs. Mr. Gentile indicated that the only option he would have in the face of such legislation would be to pass the costs imposed by the fee on to his buyers. Therefore, the fee imposed by the legislation would function as a 50-600% increase in its selling prices per bag, dramatically altering their competitive position in the bag market. If the legislation made paper bags more economically attractive than plastic bags to retailers, Ace-Lon would lose a large share of their business, and would experience the legislation as an effective ban on plastic bags. This legislation, in combination with the Solid Waste Act of 1987 would probably force Ace-Lon out of business. As previously mentioned, Ace-Lon employs 30-35 people.

When asked whether he thought the proposed legislation would force technology to develop recyclable plastics, Gentile replied, "you can't make it rain when the sun's shining." He believes that the government cannot and should not mandate sudden change. Rather, he expressed that change is a gradual process and implied that it must come at its own pace.

Plastics Trade Association

Background. Flexible packaging comprises the world of plastic films, aluminum foil, paper, and especially combinations of the above. The word "flexible" indicates that the different components of the packaging can be molded to the users' preference as each of the

above materials has unique properties that contribute to the whole. Information for this section came from Rick Thorneberg of the Flexible Packaging Industry Association.

Recycling. The Association noted that, though virgin materials manufacturing has a cost advantage over secondary materials manufacturing in plastics, in the short-run producers of plastics may be unable to meet their market demand. Mr. Thorneberg stated that in 1987 worldwide plastics manufacturers operated at 110% of capacity. This resulted in increased costs (which are continuing to climb), due to resin prices rising in the face of the increased demand and short supply. Under the circumstances the Flexible Packaging Industry Association considers this an opportune time for enterprising secondary materials plastics manufacturers to enter the market. Still, this process is inherently risky, and may only be profitable in the short-term because manufacturing plastics from other than virgin materials is still not competitive.

Impact of Legislation. In general, the Association views this legislation as a ban on plastics packaging because of the cost relationship between manufacturing plastics from virgin vs. secondary materials. They claim that using virgin resins to produce plastics is much cheaper than recycled materials for two reasons. First, there are great costs involved in collecting and transporting discarded plastics whose designed use has been realized and which have been abandoned to the solid waste stream. Of course, recycling programs would eliminate this objection. Second, though the Association stated that "technology is advancing daily" for using recycled materials, the manufacturing process is still less expensive when operating with virgin, rather than secondary materials.

The Association's position is to "recycle where appropriate," and burn or landfill the rest. Beyond that, if our society is to avidly recycle plastics for secondary manufacture, the Association suggests that government invest in technologies that will make recyclable

plastics available so that entrepreneurs can more easily enter the market. It also prescribes that government provide incentives for curbside plastic recycling in order to generate a cheap market supply.

Paper Trade Association

We spoke with David Carlton, Manager of the Kraft Paper Division of the American Paper Institute.[61] Mr. Carlton expressed several concerns about the logistics and administration of H. 1172. First, he stated that it is impossible to visually distinguish a kraft bag that included recycled materials from one that was made wholly from virgin materials. It cannot be done by inspection. This point is important because of the way bag converters (those who turn the kraft paper into bags) seek paper from manufacturers. Mr. Carlton paints a picture of a highly competitive and rapidly shifting market with most of the manufacturers and mills located in the South. Converters constantly seek out the lowest prices for paper. One reason recycled paper is not presently used in kraft paper bags is because it is not competitive with virgin paper. Mills are not designed to use recycled materials because of the price differences involved. If recycled paper were cheaper than virgin materials, then more of the secondary materials would be used to manufacture bags.

However, even if recycled paper were more financially attractive to the mills, there is the question of how much recycled paper can be worked into a paper bag that, in the case of grocery sacks, are designed to hold up to 25 pounds of groceries. Because paper fibers become shorter and weaker as they are recycled, only a certain percentage of a bag designed for strength can be made from recycled paper. As it presently reads, H. 1172 calls for paper products to be comprised of 80% recycled paper to qualify as a "recycled material." That amount would probably be unworkable in a grocery sack. For retail stores, where customers purchase fewer items at one time than they do at a grocery store, the sacks do not

have to be as strong, though 80% recycled paper may still be too high a percentage.

When the intent of H. 1172 was described to Mr. Carlton and the definition of what would qualify as a "recycled material" (i.e. 80% by weight), he exclaimed that the paper bag industry would be hurt by this. Because of the higher costs for using secondary versus virgin materials, legislation mandating a certain percentage use of recycled paper would hurt paper's competitive position against plastic bags. He would rather have the economic system work unhindered than have a law mandating recycled content.

The questions that remain are: can a recycled paper bag be made as strong as a virgin paper bag, and, will recycled materials manufacturers locate where they can make use of secondary raw materials? Presently there are no mills in Massachusetts making paper bags from recycled materials. Mr. Carlton recommend that the legislation create a phase-in period during which the shift from virgin to recycled materials would occur gradually. This would encourage new mills to locate in Massachusetts, and existing mills to adopt recycling technologies.

Yet, even with phase-in periods, and a competitive advantage, paper bags still may suffer a financial disadvantage in relation to plastic. Mr. Carlton indicated that the raw materials of plastic bags, resin, and of paper bags, wood pulp, comprise greatly different percentages of the bags' wholesale cost. He stated that resin is approximately one-third the cost of a plastic bag while pulp accounts for 60% of a paper bag's cost. This indicates that plastic bag manufacturers may be able to remain competitive with paper should H. 1172 be enacted into law.

Recycler[62]

Patrick Scanlon, Director of Environmental Resources of North Shore Recycled Fibers, runs an operation that daily processes 700

tons of recycled paper in three Massachusetts mills. Their major product is paperboard, which is the fate of 70% of recycled paper. They use no virgin materials in their manufacturing process. The paperboard they produce is then sent to a converter who turns it into boxes for such uses as shipping and food packaging.

Mr. Scanlon is a strong supporter of H. 1172--he regards it as a necessary complement to the recently enacted Solid Waste Act of 1987. He envisions H. 1172 creating the markets for secondary materials that will consume the mountains of recycled paper the Massachusetts Solid Waste Act will generate.

Presently, North Shore generates their raw material from two sources: from paper brokers, and by organizing town- and region-wide recycling efforts. This will change as communities across the state adopt the state's recycling program, which will channel paper out of local recycling and away from brokers and toward the state material recovery facilities (MRFs) mandated by the Solid Waste Act.

Because of the glut in the market created by the collection and processing of solid waste at the MRFs, the price of recycled paper would drop precipitously and force the brokers and small recyclers out of business. Literally mountains of recycled paper would grow across the state, their mining dependent on the markets, both domestic and foreign, currently extant and yet to be developed. As already mentioned, market development is the crucial role Mr. Scanlon foresees for H. 1172.

According to Scanlon, the domestic demand for recycled paper is at a plateau, and is currently being met. Paper generated by the solid waste legislation would far outpace current demand and would result in a gross surplus of recycled paper. He is concerned that if adequate markets are not created, then the state may end up processing solid waste twice (pick-up and materials recovery) before

landfilling instead of once as municipalities currently do (pick-up only) because of the excess supply which cannot be used.

Though the state may come to rely on the healthy export market in recycled paper (one out of every four tons of export material leaving the port of New York is recycled paper), that is not necessarily a stable market in the long-run, according to Scanlon. He reasons that the strongest market for recycled paper is in East Asia and California is currently considering legislation that would mandate state-wide recycling. Should that legislation pass, the west coast could come to dominate the recycled paper export market because of their closer proximity to East Asia.

Massachusetts is counting on recycled paper mills and converters coming to the state to utilize the great supply of relatively inexpensive recycled paper the solid waste legislation will generate. However, Scanlon warns that there is currently no developed domestic market that can utilize the paper that will be generated. Even if mills do move into the state, two to three years could pass before one is ready to operate. By that time, a considerable mound of paper could have been wasted.

Scanlon's greatest fear concerning the Solid Waste Act of 1987 is that it could fail. Because there is strong opposition in certain industries to recycling, a failure of this nature could doom future efforts to establish a healthy recycling economy.

For these reasons, Mr. Scanlon is optimistic about the possible effects of H. 1172. It could be the driving force that would create the markets to use the supply of paper.

North Shore Recycled Fibers, and its three in-state mills employ approximately 400 people. Its employment would increase should this legislation pass and markets for recycled paper expand.

Author's Analysis

Looking back to subsection C, "Volume of Bags Used," by the retail chain, and extrapolating the bag use figures from the approximately 70 Massachusetts stores of this one chain to the additional 1700 variety, drug, and proprietary stores in the Commonwealth that distribute bags for over-the-counter purchases,[63] we see an approximate state-wide use of 41.4 million potentially recyclable paper bags, and 175 million plastic bags, which must be either landfilled or burned. These figures do not include those bags used by department stores, miscellaneous general merchandising stores, liquor stores, used merchandise stores, miscellaneous shopping goods stores, candy, nut, and confectionery stores, dairy stores, retail bakeries, and miscellaneous food stores, all of which use paper and plastic bags. As of 1985 there were 6,355 stores in the Commonwealth that came under the above categories.[64] Nor do the above numbers for bag use include the 1,428 grocery stores in Massachusetts,[65] which can safely be assumed to comprise a significant percentage of paper and plastic bag use in the state. If all the above categories of retail stores were included in the estimate of bags used annually in the Commonwealth, the above numbers would easily triple.

An estimate of 20 variously-sized paper bags per pound yields figures of 1035-5410 tons of high-quality kraft paper removed annually from the Commonwealth's waste stream and available for recycling (if we estimate bag usage from all the other above sources, and assume that they will all be paper, the annual tonnage removed from the solid waste stream just from bags jumps to over 16,000 tons). Though this represents only a small fraction of the solid waste stream, if all the bags were paper, recycled, and made from recyclable materials, they represent not only a tangible number of new jobs in recycling, but also a savings to the Commonwealth through a reduction in tipping fees. If only paper bags were used and if 100% were recycled, this would translate into annual savings of over $0.5-$1.5 million, assuming average tipping fees of

$100/ton. By the same token, if there were no longer a market for plastic bags, then a certain number of plastic manufacturing jobs would be lost. Some of those would be local, but most, due to the small plastic bag manufacturing industry in-state, would be lost out-of-state.

The intent of H. 1172 is to replace the plastic bags with paper, remove the entire 216 million bags from the waste stream, and create markets for their use in the recycled materials market. This process, if it succeeds, **will turn that portion of the waste stream which is presently a cost to society into a benefit.** The only question is whether or not it will succeed.

There is good reason to believe that H. 1172 will work as designed in the case of paper versus plastic bags. Table 17 indicates, in the case of the one-sixth plastic and paper bags, a price differential of approximately 3 cents. If the price of manufacturing paper bags were lowered enough to be competitive with the relatively fixed price of approximately 8 cents that plastic bags would carry under H. 1172, then paper bags would recapture this particular give-away market at retail stores. Initially the price of paper bags would not be expected to change as they could enjoy the benefit of being both recyclable and made from recycled materials. Furthermore, a long-term drop in the manufacturing costs of recycled paper bags can be expected if the Commonwealth's commitment to recycling under the Solid Waste Act of 1987 (Chapter 584) is realized. As materials recycling facilities provide a steady flow of recycled materials--the raw materials of secondary manufacturing--to manufacturers, production and therefore product prices will drop.

The above scenario depends on several assumptions. First, it is assumed that plastic bag manufacturers cannot drop their prices to compete with paper bag manufacturers. Certainly some will, while other, smaller manufacturers operating close to the margin will be

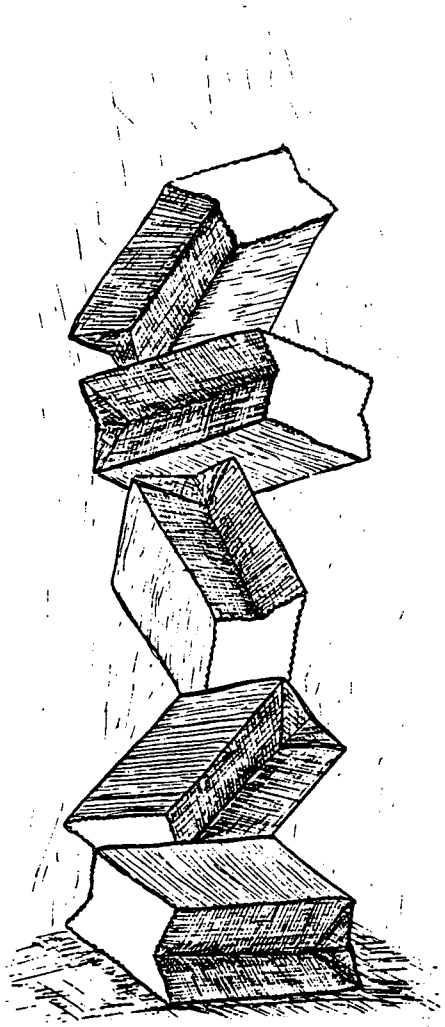
forced from the business. The net result may be that no shift in the market share for paper over plastic will occur, but that the more efficient, and larger plastic bag manufacturers will receive a larger market share.

The second assumption is that paper manufacturers will be able to produce kraft paper strong enough to satisfy both their customers and the requirements of H. 1172, which call for recycled paper to contain 80% secondary materials by weight. If bags do not meet this standard, they will not be exempt from the 2 cent fee mandated by the bill. Though David Carlton indicated that new technology to incorporate higher percentages of recycled paper in kraft paper production is a possibility, he is not aware of any body conducting such research. Eighty percent recycled paper by weight may be too high a percentage to produce a bag that will satisfy manufacturers' present customers.

Third, it is assumed that manufacturers of recycled bags are poised and ready to locate in the Commonwealth. Most of the people interviewed with some knowledge about the paper industry indicated that it would take two to three years for potential manufacturers to locate and begin operation. First they would have to be assured that there were markets for recycled paper products. That, of course, depends on whether H. 1172 would create a demand for recycled paper products.

Because this case studied only the tip of the iceberg no conclusive statements can be made. However, based on conversations with representatives of the retail chain it is apparent that such stores presently pay large sums for bags, and their decision about whether to use paper or plastic is based wholly on price. At the first, cursory glance this study takes, it appears that a number of factors will work in favor of recycled paper being used instead of plastic bags by that one firm: H. 1172 will make the prices of recycled paper bags less than their plastic counterparts,

and the State Solid Waste Act of 1987 will generate cheap raw materials for the production of recycled paper bags. As the price of paper bags drops and stabilizes, retail firms will switch back to paper. The end result will be a reduction of the solid waste stream, lower prices for firms and consumers, a loss of jobs in the plastic industry, and the creation of jobs in the recycling and paper manufacturing industries.



Fast Food Packaging: The Clamshell

The following case study investigates the materials used to manufacture the McDonald's foam sandwich box and the Burger King paper sandwich box, and explores the impact of H.1172 on each type of container. The case study includes a description of the materials and manufacturing process of the boxes; a discussion of the environmental consequences of using and disposing of each box; and the volume and costs involved in buying the containers at the retail and distribution levels in Massachusetts.

Methodology

The techniques used to acquire data for this study involved personal interviews and literature review. Researching manufacturing costs proved to be difficult, since most companies prefer not to disclose their costs or mark-up prices. Additionally, the decision-making involved in changing manufacturing techniques due to price increases was hard to ascertain, as the two fast-food corporations were reluctant to discuss how the proposed fee affect their actions.

McDonald's Foam Container

The foam clamshell container that McDonald's uses for its sandwiches is a light-weight, square, hinged box. There is a special container for each sandwich that the restaurant offers: the Big Mac, the Quarter Pounder and the Quarter Pounder with Cheese, the McChicken, Filet-O-Fish, and any generic hamburger that the customer desires (the exceptions are the regular hamburger and cheeseburger, which are wrapped in a wax/paper). According to McDonald's, the foam clamshells are the optimum choice because the

food stays moist, "fresh," warm, and safe from damage or unsanitary conditions.[66] The clamshells are used whether the customer eats in the restaurant or takes the food "to go."

A brief explanation of the necessary materials and machinery will be given to clarify the origins of this container. The technical term for the foam clamshell box is extruded polystyrene. Polystyrene is a plastic that has various end uses, most of which are forms of packaging[67] (see Table 18). The two polystyrene resins used in manufacture are impact and crystal; both are used extensively in fast-food packaging. Extruded polystyrene is one of three forms of crystal polystyrene (see Table 19).

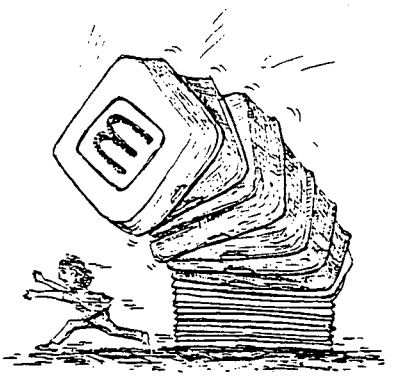
Long chains of the molecule styrene (C6H5CHCH2) make up polystyrene. Styrene is a colorless, transparent thermoplastic, and is resistant to acids, alkalies, oils, and alcohols. It is formed from a chemical reaction between benzene and ethylene, combined with

Table 18. 1985 Polystyrene Consumption--Major Market End-uses.

Major Market	Millions of Pounds	
Packaging	1,292	
Building/Construction	449	
Electrical/Electronics	309	
Furniture & Furnishings	47	
Consumer/Institutional	1,090	
Other - Transportation - Industrial Machinery - Adhesives, Ink coatings	837	
Total		4,024

Source: Jean Hektner, The Society of the Plastics Industry, Inc. Washington, D.C.; personal communication to Diane deConinck, University of Vermont; August, 1987.

dehydrogenation (removing hydrogen atoms). Both benzene and ethylene are petroleum by-products, derived from crude oil or natural gas. This is why polystyrene containers are described as "energy in solid form."[68]



A machine known as an "extruder" is used to fabricate the polystyrene resins into extruded foam polystyrene. The resin is fed into the "hopper", and is sent through the "screw" which mixes and melts the polymer. A blowing agent, commonly a type of chlorofluorocarbon (CFC) or hydrocarbon, is mixed in the extruder with the melted polystyrene resin. The mixture is fed into a second extruder, where it is sent through a die and eventually flattened into a sheet. As the mixture leaves the die, the blowing agent expands the resulting foam. After airing for approximately three days (the air displaces some of the blowing agent), the foam sheet is reheated in molds, in a process called thermoforming, which forms the shape of the final product.

Polystyrene foam containers are controversial. One argument in defense of polystyrene containers is that the manufacturing of polystyrene is a way to recycle petroleum by-products. Utilizing material from the refining of oil, as well as reclaiming excess polystyrene pellets during the manufacturing process, decreases waste and promotes efficient technology. A counter-argument points out that the production of a plastic material still uses up non-renewable resources. Further, the energy required to produce ethylbenzene, the component of styrene, compounds the amount of energy used during the production of material.

Disposal of the foam box also generates controversy. Advocates contend that foam containers "provide a clean burning" during the incineration process. "When properly incinerated, they do not pollute our water or air or produce toxic emissions."[69]

Table 19. 1986 Polystyrene Packaging and Disposable End-Uses (millions of pounds).

Products	Amount		
Molded Solid PS:			
Rigid packaging	86		
Closures	78		
Produce baskets	20		
Cocktail glasses	108		
Flatware, cutlery	116		
Dishes, cups,bowls	43		
Blow molded items	8		
Total		459	
Extruded Solid PS:			
Oriented film & sheet	184		
Dairy containers	122		
Vending & portion cups	190		
Lids	138		
Plates & bowls	56		
Total		690	
Extruded PS Foam:			
Stock food trays	180		
Egg cartons	84		
Plates	112		
Hinged containers	70		
Cups (non-thermoformed)	36		
Total		482	
Expanded PS Foam:			
Cups & containers	162		
other packaging	80		
Total		242	
Total			1,873

Source: Robert J. Martino, ed., "Materials '87," Modern Plastics, January 1987, p.57.

Because foam burns at a very high temperature, toxins are burned out and little ash is left.[70] "When buried in a landfill, foam cups are as stable and harmless as rocks and other inert fill."[71]

Complaints about polystyrene's toxicity during disposal counter the arguments given by polystyrene's proponents. Burning plastics, including foam products, results in increased nitrogen oxides (NO_x) emissions. Nitrogen oxides are a precursor to acid rain and to

harmful ozone pollution in the lower atmosphere. Other pollutants, such as sulfur dioxide (SO_2), particulate matter, and dioxin, are also emitted into the atmosphere.

"Incineration at proper temperatures" to avoid hazardous emissions cannot be guaranteed.[72] Because foam products do not physically degrade, they help create pockets of differential settlement in landfills. This creates soil conditions that promote the leaching of other wastes. Plasticizers from flexible plastic packaging are a class of substances that leach through the soil. Additionally, since it degrades slowly, foam is a large marine litter problem.[73]

The question of how much volume fast-food containers occupy in the waste stream, particularly in landfills, is widely debated. Many experts maintain that fast-food packaging is not a critical percentage of waste. W.L. Rathje, a professor of anthropology at the University of Arizona, asserts that fast-food packaging is a very minimal percentage of landfills. "Less than one-third of 1 percent" of three landfills studied contained fast-food packaging "of any kind."[74] In a Time magazine advertisement, Mobil Chemical Corp. contends that "paper substitutes for fast-food foam packaging add as much weight to a landfill as does foam."[75] Supporters of foam products, using figures compiled by Franklin Associates, calculated that by weight, disposable foam products account for only .14 to .20 of 1 percent of all trash.[76]

On the other hand, Adam Marks, an engineer for Solid Waste in Rhode Island, measured the density of plastic foam and maintains that "foam takes up 30 times as much space per unit of weight as other products in a state landfill." He further calculated that 1400 to 2000 tons of plastic foam a year are buried in landfills; "that works out to 70,000 cubic yards--enough foam to cover one acre 40 feet high."[77] One reason for this is that "foam expands, while general waste compacts."[78]

The CFC blowing agent used to produce extruded polystyrene is a substantial environmental concern. The international scientific community has concluded that when CFCs enter the upper atmosphere they deplete the earth's protective ozone layer. The ozone layer functions as a shield from harmful ultraviolet sunrays. Only recently have manufacturers of polystyrene conceded that their use of CFCs has a substantial impact on ozone depletion. In September 1987, the United States and nearly 50 other nations signed an agreement to freeze CFC production and cut back its use internationally by 35 percent by 1999. In a communication to Senator Robert T. Stafford (R-VT) from Clifford H. Raber, a vice-president of McDonald's, Raber stated that McDonald's will review alternatives to the use of CFCs in the production of its products:

> We have completed our review with considerable input from our suppliers and other industry experts, and have concluded that there are reasonable alternatives to possibly harmful CFCs available...We therefore have directed our United States suppliers to begin a prompt phase out of the use of these CFCs in the manufacture of McDonald's packaging in the United States. We estimate that this voluntary transition will be completed within eighteen months.

As a result, many plastic manufacturers who use CFC's are switching to another type of blowing agent. While the use of this new blowing agent has only 5% of an impact on the ozone layer that CFC's have, it is a precursor to ozone in the lower atmosphere. Ozone is a pollutant harmful to human health and to agriculture.

Costs and Volume. Massachusetts has 268 McDonald's restaurants throughout the Commonwealth. The restaurants are required to keep a minimum number of clamshell cases in stock. Depending on its size, location, and popularity, a restaurant will order between five and ten cases of foam sandwich containers each week. Some restaurants report ordering up to 35 cases each week. These numbers vary according to promotion campaigns, as well as

hours that the restaurant is open.

Each case of foam boxes costs $23.00, and at 800 containers a case,[79] each box costs slightly under $.03. At a range of 5 to 10 cases per restaurant, between 1300 and 3000 cases are bought each week by all the restaurants, or between 67,600 and 156,000 cases each year. That is equivalent to 1 million and 2.4 million individual foam boxes weekly, and between 54 million and 125 milliony clamshells annually. The weekly cost for the cases is thus between $30,000 and $70,000; yearly, their costs total $1,560,00 to $3,600,000.

The Martin Brower Company in Ayer, Massachusetts distributes single service supplies to the McDonald's restaurants. Martin Brower buys the foam boxes from the Fort Howard Corporation (also known as the Sweetheart Corp.), marking up the price of each case by $1.50 when selling it to the restaurants.[80] Thirty people are employed to work in the factory, and about 25 people work on the management level.

Impact of the Legislation. The Fort Howard Corp. supplies foam boxes to distributors between Rhode Island and Canada. The corporation has three locations around Massachusetts, the main one in Wilmington. People at Fort Howard were reluctant to disclose their costs. They did mention that all packaging design decisions for McDonald's are specified through a company in Chicago known as Persico, which authorizes the buying of specific containers for McDonald's. Persico submits requirements to the suppliers, who manufacturer the desired single service item. Persico relies on the research and development capabilities of the suppliers to devise the manufacturing methods.[81] Both the manufacturer and Persico research alternatives to present techniques of design and manufacturing, and negotiate any changes.

We believe that McDonald's R&D department has considered

alternative materials. In order to meet the requirements of H. 1172, McDonald's would have to make its foam box from recycled material. Recycled plastic, however, does not meet Food and Drug Administration (FDA) requirements for food if there is no way to verify that "poisonous or deleterious substances"[82] are not in the recycled material. McDonald's would have to switch to a paper product.

The technology to recycle polystyrene foam is available. Mobil Corp. and Amoco Corp. are presently researching methods to recycle foam products, but the recycling process is complicated and expensive. Because "used disposable foam is usually contaminated with food, there are questions about whether it can be easily separated from other trash, collected and cleaned."[83] The collection process is very expensive and time-consuming.

Unless McDonald's is able to switch to a manufacturing process that utilizes recycled materials and is able to make the containers recyclable, the cost per each container would double to 6 cents. The cost per case, then, would increase to $48.00, more than double the original price of a case of foam clamshells. If each restaurant in Massachusetts ordered an average of 10 cases per week, the fee would raise the price from $2,683,000 to $5,391,000. Even if the restaurants averaged 5 cases per week, the cost would skyrocket from $1,602,640 to $3,344,640.

Burger King's Paper Container

Background. Unlike McDonald's restaurant, Burger King uses a paper hamburger container. The Burger King boxes are similar in size and shape to the McDonald's foam boxes. While the McDonald's foam box has the unique spongy texture of foam, the exterior of Burger King's container is smooth from a coat of varnish.

Briefly, paper is made from wood that is debarked, chipped, and

run through a pulping process. The wood chips are sent into a machine called a digester, where they are mixed with sodium hydroxide, sodium carbonate, and sodium sulfate. The solution is cooked under high temperature and pressure, and digested into a fibrous mass which is washed, screened, and bleached. While the organic materials from the digester liquids can be recycled in the plant, the chemicals from bleaching generate pollution from waste water, air emissions, and solid wastes. The bleaching effluent are extremely toxic and can cause carcinogenic and mutagenic effects.

After bleaching, the pulp is refined and has additives included to prepare the stock, which determines the outcome of the paper product. The pulp is mixed with water in a "beater," a machine that removes impurities, strengthens the bonds of the fibers, and mixes additives with the beaten fibers. The mixture is passed through a refiner and is then sent to a paper making machine.

The primary paper-making machine for fast-food packaging is the fourdrinier machine.[84] The fibers are drained of water on a mesh, under a press, and over steam-heat cylinders (the most energy-intensive option). The paper is then smoothed over metal rolls, where the exact thickness is obtained, and additives, such as sealants, grease, and water repellent are applied.

Environmental and Disposal Considerations. In 1978, Burger King switched packaging materials from a paper/wax container to paperboard. According to Tim Hermaly, a research editorial assistant at Lisnik and Co., a subsidiary of Burger King, there were three reasons for the change: paper is environmentally safer, easier to handle, and cheaper than a container made of polystyrene.[85]

Burger King considers the paperboard container easy to handle. Paper allows heat to enter the container while on a conveyer, which polystyrene does not. Burger King also finds the paper easier to imprint with designs, therefore more marketable.

Environmentally, paperboard is a good choice for packaging because it degrades easily. In a landfill, paper products absorb water and subsequently compact and degrade. Per unit, paper occupies significantly less volume than foam in a landfill.

Another environmental reason for preference of paperboard over foam is that paper is manufactured from renewable resources. The polystyrene container consumes a substantial amount of energy in the refining of oil for manufacturing resins and in the production of the foam container. The paper container consumes energy during the preparation of the pulp, with roughly 60 percent of the required energy being self-generated.[86] "Pound for pound, paper requires less total energy to manufacture than polystyrene foam"[87] (see Table 20).

It should also be mentioned that the chemicals used to prepare the pulp and to bleach the wood may leach through the landfill. Because of their high toxicity, these chemicals would cause hazardous pollution if they enter the water table. If incinerated the chlorine bleaches may also cause emissions of dioxin. Incineration of both kinds of container would be environmentally problematic.

Costs and Volume. Burger King has 110 restaurants throughout Massachusetts. Managers at the restaurants around the Boston area report that they order 3 to 6 cases of burger boxes each week. Orders in some restaurants can go as high as 15 cases or more. With an estimation of 3 to 6 cases per restaurant/week, approximately 300 to 600 cases of clamshell containers are sold each week, with deliveries twice a week.[88] Between 15,600 and 31,200 cases are sold each year. At 800 containers in a case, between 240,000 and 480,000 containers are sold per week; between 12,480,000 and 24,960,000 are sold each year. At the cost of approximately $23.00 per case, restaurants in Massachusetts spend between $6,900 and $13,800 a week, or $358,000 and $717,600 each year. Those

amounts are equivalent to about $.03 per container.

Impacts of the Legislation. Worcester Quality Co. supplies the clamshell containers to the Burger King restaurants. Depaco Co. in Pennsylvania manufactures all fast-food packages made from paperboard, and supplies the Burger King container to Worcester Quality. The production department at Depaco decides on the package design, but the "customer makes the final decision" about whether a package is suitable.[89]

According to the packaging research and development department at Burger King, packaging design decisions are made by both Burger King and their manufacturers. Burger King is responsible for most of the designs. Two people in the packaging R&D department at Burger King coordinate the specifications and criteria, spreading out the responsibilities to the various suppliers, who do the prototypes. The Burger King employees "don't have enough time to do all the designs."[90]

Table 20. Summary of Energy Inputs for Paper and Polystyrene Packaging in Btu's/unit.

Package	Weight (lb)	Wood Processing	Input Energy	Total
Cold Cups:				
9 oz.				
Bleached board	0.012	293	160	453
Polystyrene	0.012	0	480	480
16 oz.				
Bleached board	0.022	540	240	780
Polystyrene	0.029	0	1130	1130
Meat Trays:				
6 by 8.5 in.				
Pressed Pulp	0.035	280	360	640
Polystyrene	0.0095	0	330	330

Source: L.L. Gaines, "Energy and Materials Use in the Production and Recycling of Consumer-Goods Packaging," Argonne National Laboratory, Argonne, Illinois; Feb. 1981, p.11.

Changing the input of materials to make the paper clamshells out of recycled materials would not require a change in technology. However, the availability of recycled paper as a raw material is a significant factor in the decision to switch manufacturing materials. It is the thickness of the final product that will determine any change in cost.

The Division of Retail Food Protection of FDA recommends against the use of recycled materials for packaging that holds food. For paper wastes to be reused, the package must not be composed of any poisonous substances "which may render the contents adulterated or injurious to health."[91] Recycled paper CAN be used in a clamshell container as long as the secondary material is not touching the food. That is, only the outside and middle layers of the box can be produced from recycled paper.

While paperboard can be recycled, plastic coating on paper cannot. The Burger King paper clamshell is coated with a wax and low density polyethylene grease masking agent. Though the varnish does not interfere with degradation (in fact, it is biodegradable), it does prohibit the container from being recycled. As with the foam containers, paper containers are difficult to recycle if they are contaminated with food. Paper is harder to clean than foam, because juices and grease from the foods soak in. Recycling these products requires that they be pulled from the waste stream before they are mixed with food, and that they get sent through an extensive cleaning process before being recycled.

Under H. 1172, the current model of clamshell would double in price. Manufacturing the clamshell with a percentage of recycled material would offset that fee by 2 cents. Since recycling the clamshell is difficult, the one cent fee would apply. This would increase the cost of a case of clamshell boxes by $9.00, from $23.00 to $32.00. If each restaurant in Massachusetts ordered 10 cases of burger boxes per week, the costs of cases per year with a $.01 fee

increases from $1,315,600 to $1,830,400. At 6 cases per restaurant/week, the cost per year with the fee increases from $789,360 to $1,098,240. No change in technology would be necessary, and therefore no additional costs would be incurred.

Analysis

Whether or not these corporations will change their packaging process and design, due to the influence of legislation, depends on a combination of economic factors and government pressure. As more and more states pass legislation banning polystyrene, McDonald's may have no choice except to switch to paperboard. The likelihood of manufacturing with recycled paperboard and of making a clamshell recyclable depends on how the corporations and their packaging companies view their options. They are certainly aware that broader use of recycled products is an environmentally sound decision. Because a switch from the use of virgin materials will involve complex negotiations, however, we can only guess at the influence of the package recycling bill on corporate decisions.

It seems that the research and development capability is available to any corporation deciding to change their manufacturing process. Bob Theophilus, a purchasing agent at Persico Corp. (which does the purchasing negotiations with suppliers for McDonald's), admitted that they have looked into the possibility of using paperboard. Currently economic factors do not warrant a switch of materials; foam is cheaper than paper. But what would happen if the price of foam doubled?

The increase could be passed on to the consumer. Considered individually a $.03 rise in the price of a Big Mac, or a $.01 rise in the price of a Whopper does not seem substantial. If people are willing to pay the cost increase, the likely result is that a switch of manufacturing materials will not take place because of H.1172. And if this is the case, revenues will be raised but the wastestream will not be reduced.

However, Bob Donahue from McDonald's indicates that competition is a factor when determining costs. If the total purchase of a family meal is noticeably cheaper at other fast-food restaurants, sales at Mcdonald's will decline. It may well be that a price increase of fifteen to thirty cents for a family meal would be a significant factor in patronage.

It is worth noting that the legislation does not single out biodegradable products. Even if the Burger King paper box were not coated with a masking agent, it would not be recyclable simply because of food contamination. The fact that it still can biodegrade is a benefit. The ability of a package to compost might be considered worthy of the $.01 credit.

Because the research and technological capability is available, Burger King will certainly consider making their single service clamshells out of a percentage of recycled paper. The only present barrier to switching manufacturing methods is economic; the recycled paper costs more to purchase and to implement in thc manufacturing process (initially). Lack of a strong market in recycled paper raises transportation costs. But these costs will not be significant if new markets in recycled paper can be created. A switch to recycled input material is therefore likely in the Burger King segment of the fast-food container market. Although company officials claim that all fees would simply be passed on, it is certainly possible that this legislation would cause Mcdonald's to phase out the much-maligned styrofoam container.

Markets for Recycled Materials

Our analysis of House Bill 1172 begins with a consideration of post-consumer recycling for a number of common household materials, some of which we considered in the case studies: paper and paperboard, aluminum, steel and tin, glass, and some of the many varieties of plastic. For most of these products there exist well-established manufacturing markets that use both virgin and recycled raw materials. However, we will see that there exist institutional barriers to many uses of recycled materials. These barriers range from government subsidies for virgin materials to technical limitations on recycling, particularly with plastics. The Packaging Reduction Act addresses only some of these barriers. As we will suggest in the following section on policy analysis, either this bill be revised or other legislation be filed to insure that these barriers be eliminated. We end the section on analysis with a discussion of the bill's pros and cons and recommendations.

By waiving the two cent fee for products made with recycled materials and by using revenues to create "favorable market conditions for the recycling industry through grants, loans, and technical assistance to both communities and businesses," H. 1172 will help to create a demand for recycled products. This is an important step because recycling is usually limited by a lack of demand rather than inadequate supply.[92] An analysis of the present markets for recycled materials and the current obstacles to their use in packaging will help to clarify what exactly is recyclable, what markets exist for recycled materials, and what obstacles must be overcome.

Table 21 shows which recycled materials have already established markets. We see that aluminum and paper are competitive with virgin materials and have significant markets, whereas steel and plastics have little value as reclaimed material. In order to expand market share, recycled materials must first of all compete more effectively with virgin materials in terms of price. This can only occur with the assistance of state and local governments intent on reducing the amount of trash being generated.

Table 21: Recycling of Municipal Solid Waste

Material	Current Recovery Rate (%)	Percent in MSW (%)	Percent of MSW Recycled (%)
Aluminum	27	1	0.4
Paper	21	42	8.6
Glass	7	8	0.7
Steel	3	9	0.2
Plastics	1	7	0.1
Other	1	33	0.2
		100	10.2

Source: Franklin Associates.

Packaging Materials

H. 1172 is aimed at packaging materials because they constitute over 30% of the waste stream that can be easily identified. Packaging products are made primarily from five materials: plastics, paper, steel, glass, and aluminum. Other packaging materials include wood and cloth, but these are used only on a limited basis. The markets for packaging products depend on the specific characteristics of each of these materials in a given product, the institutional barriers to recycling, and the available recycling technology.

The Packaging Reduction Act is aimed at packaging for two reasons: packages are easily identified in the municipal solid waste stream and they represent one-third of it.

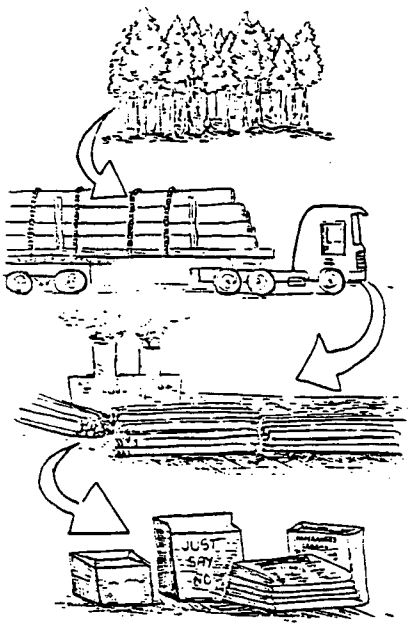
Aluminum. Aluminum has the highest recovery rate of all materials in municipal solid waste. Aluminum is created by extracting alumina from bauxite and then refining it into aluminum. To produce two pounds of aluminum requires eight pounds of bauxite. Besides being capital-intensive, this process requires enormous amounts of electricity, which is a relatively inefficient energy source. Another drawback of virgin aluminum production is that 85 to 95 percent of the bauxite used in the U.S. must be imported.

Recycled aluminum uses one twentieth of the energy needed for virgin aluminum and it does not have to be imported. It can be used for all common alloys, although recycled aluminum does not meet the stringent purity requirements for such products as airplane parts. Aluminum is also easy to recycle, requires minimal processing (crushing and baling), and can be reused in food packaging because of the high temperatures involved in smelting and the low level of contaminants in the recycled material. However, contamination is becoming a problem with the new plastic cans, which are difficult to distinguish and separate when mixed with aluminum cans.

Beverage cans are the largest source of aluminum scrap, and approximately 50 percent of them are being recycled.[93] The cans are melted down and formed into aluminum ingots, which are then

rolled and pressed into "new" cans. It is possible to use almost 100 percent aluminum scrap in the production of cans. This is the ideal in recycling: a "closed loop" in the lifecycle of aluminum cans because they can be recycled back into the same product.

Only a few aluminum cans (juice cans) will be affected by this bill, which exempts all 5 cent deposit containers covered under the bottle bill. Since recycling of aluminum cans is already highly developed, the impact of this bill on non-deposit aluminum packaging will be minimal. The only question is whether or not non-deposit aluminum can manufacturers can meet the 50% reclaimed material minimum.



<u>Paper and Paperboard</u>. The markets for recycled paper are already strong for some paper and paperboard products, namely newspaper, corrugated containers, and office paper. Demand for recycled paper depends upon the grade of paper. Pulp products are broken into many specific categories under two main headings: paper and paperboard, (commonly known as cardboard). The most common paper grades are newsprint, printing and writing, tissue, and kraft papers. The primary paperboard grades are unbleached kraft, semi-chemical, bleached, and recycled paperboards. Paperboard products include corrugated boxes (made from unbleached kraft linerboard on the outside and semi-chemical paperboard used as fluting in the center); folding cartons; paper tubes, cans, and drums (composite packaging); aseptic bottles and milk cartons; cardboard backings of writing tablets; and gypsum wallboard (used in construction).

Waste paper and paperboard are also broken into specific grades: old newspaper, old corrugated containers, deinking, and mixed papers. Old newspapers are recycled back into newsprint, paperboard products, molded products (e.g., egg cartons, trays, and flower pots), cushioning material for shipping products, or cellulose insulation. Old corrugated containers are recycled into the same

products as newspaper, excepting newsprint (a higher grade of paper). Deinking grades, which are high quality grades of paper (such as computer, ledger, and office paper) are recycled into a wide variety of products, including office paper, paper towels and tissues, and paperboard (although this is an atypical use for such a high grade of paper). Mixed grades are the lowest grade of waste paper (they can include newspaper, folding cartons, old corrugated containers, and office paper) and are recycled only into paperboard products.

Current recycling involves mainly newspapers and office paper products, neither of which are packaging items. The paper product primarily used in packaging is kraft paper (paper bags), a product that can be made from recycled paper (depending on the strength requirement of the bag) and is recyclable. However, heavy-duty paper bags used in supermarkets can only use limited percentages of recycled material because of high strength specifications.

Among paperboard products, corrugated boxes, which also do not fall under the scope of this bill, are extensively recycled. All paper/paperboard products are recyclable as long as they are uncontaminated by food, glue, plastics, and any other non-paper material. However, recycling does degrade the strength of paper/paperboard products by making the fibers shorter. This means that certain paper products like office paper, which demands long fibers (high strength), can only be made from recycled office paper. Paperboard is the only pulp product that can use all the different grades of paper/paperboard reclaimed material except contaminated pulp products.

Not surprisingly, paperboard consumes over 50 percent of all waste paper. In 1986, according to the American Paper Institute, 8.7 million tons of waste paper were used to make 8 million tons of paperboard. (The loss of .7 million tons occurs during re-pulping and cleaning.) Most of this paperboard material, 6.1 million tons, is

used to produce folding cartons (e.g., shoe and cereal boxes).[94]

Recycled paperboard folding cartons can be used in food packaging when the paperboard material does not come in contact with the food or when the product must be boiled before serving (e.g., pasta). The boiling reduces the risks posed by possible contaminants, enabling the recycled paper to meet FDA packaging standards. Also, such packages can be made from reclaimed material if the inner layer that comes into contact with the food is made of wax or plastic film, so there is the possibility of a two cent waiver. H.1172 will have a definite impact on the market for paperboard folding cartons because the recycling technology already exists and in many cases (e.g., a box of spaghetti) 2-3 cents will make a noticeable difference in the price of a product.

Barriers to Recycling Paperboard. The most significant barrier to recycling the paperboard packaging covered by H.1172 is high levels of contamination from foods, plastics, and glues. The contamination caused by oily or liquid foods is practically unavoidable, and places serious restrictions on recycling. Non-food paperboard packaging is difficult to recycle because it is often contaminated by plastic coatings, metal laminates or blister wraps (see glossary for card packages definition).

Limitations to paperboard packaging recycling can be caused by the function and/or by the design of the package. When the paperboard package is a container (for instance, a single serving aseptic drink carton) usually only an alternative material such as a glass drink bottle can replace paperboard and be recyclable. The aseptic container is an instance where convenience and product differentiation are as much a rationale for the package as function. This is a perfect example where disposal costs are ignored in the design of a packaging product.

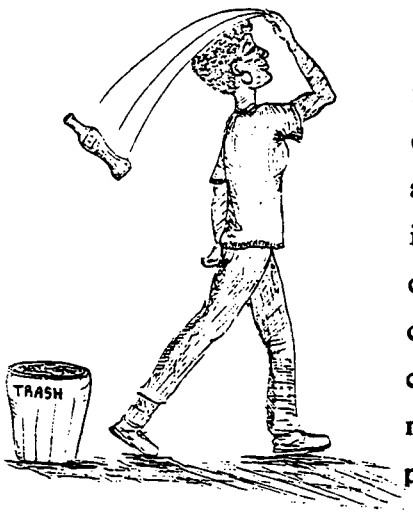
When the paperboard package is designed to display the object

prominently (e.g., carded packages), to make the product easy to shelf, often by hanging, and/or to serve as space for advertising, the packaging is frequently excessive and made of materials that are difficult to recycle. Again, such packages completely ignore the social costs of disposal.

Glass. The uses for reclaimed glass (also known as cullet), like paper/paperboard products, depend on its origin; not all glass is alike. Glass is made from glass sand (silicon dioxide), soda ash, lime or limestone, and feldspar or borax for color. The three major glass products are container (bottles), flat (windows), and pressed and blown (these include light bulbs, vases, and ornamental glass objects) glass. The cullet used in glass production must come from the same product that is being manufactured. For example, container glass is only used in bottle production, not in the manufacture of window panes or vases. Flat cullet is derived from windows and is only collected from in-house waste due to specific product compositions. Container glass accounts for the majority of post consumer cullet and represents approximately 90 percent of the glass in the solid waste stream.[95] Cullet is attractive to glass manufacturers because it burns at a lower heat than virgin materials, increasing furnace efficiency and thereby lowering fuel costs, increasing the lifetime of the furnace, and reducing the air pollutants emitted by furnaces.[96] The production uses of container cullet are primarily in "new" containers, with secondary uses including insulation (fiberglass), paving material, and construction material. The secondary uses account for only a small share of the container cullet market because cheaper virgin materials exist (e.g., sand and gravel for paving and construction material), and the container manufacturers are willing to pay a higher price than are secondary users.

Barriers to Glass Recycling. Despite cullet's positive attributes in glass container production, its current recovery rate is low. This is partially due to the need for a better collection process and to problems in finding markets for the recycled glass.

Unlike aluminum cans, which command a high price as scrap and are recycled extensively even in non-bottle bill states, or newspaper, which is often the object of recycling drives, or other waste paper grades like old corrugated containers and deinking grades, which are recycled because of their high market value, glass is seldom the object of any major recycling efforts. And, as noted previously, deposit laws are a disincentive to retailers to sell beverages in glass bottles.

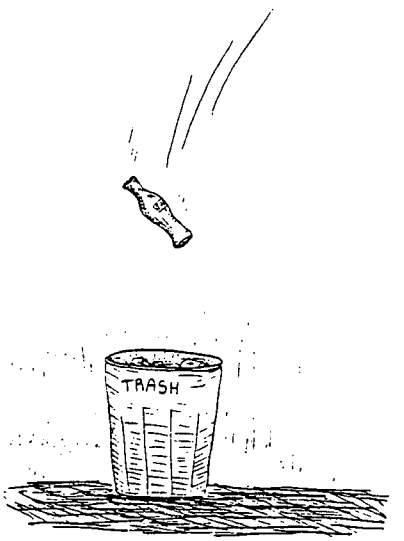


When glass is recycled many hurdles must be overcome in finding markets for it. First of all, cullet must be delivered to the user, usually in ground form. Transporting cullet distances greater than 300 to 400 miles is rare because of high transportation costs relative to its value.[97] Another difficulty is that prior to reuse, contamination by pieces of ceramics and metals must be removed, and cullet also must be separated according to color. The cost of installing high-volume processing systems to sort cullet and remove contaminants is high, ranging from $0.5 to $2 million.[98] Glass containers are typically made from three different glass colors: clear (flint), green, and amber. Clear glass accounts for the majority of the container market, 70 percent; amber accounts for 18 percent (which include beer bottles, juices, and light-sensitive chemicals); and green, which accounts for 12 percent, is used mainly for wine and other beverage bottles.[99]

One instance of the difficulties associated with glass recycling is the problem of recycling green glass on the East Coast. Producers of glass containers are normally located close to their customers. In the case of green glass, these customers are mainly wineries in California and breweries in Europe and Canada. Because of the high cost of transporting cullet, this means there is little demand for it on the East Coast. Conceivably, with a significant quantity and consistent supply of green glass, this cullet may have a market in Canada.

The impacts of this bill on glass products will probably be limited to glass producers in the New England region. Wineries in California will have a hard time qualifying (limited supply of green glass cullet) and little incentive (a two cent price increase on a wine bottle) to meet the requirement of 50 percent cullet in the bottle. Glass producers in the New England area, however, will be likely to use the cullet because of its cost advantages, and consistent supply from the Massachusetts recycling program.

Steel. Steel packaging comes in one form, steel (tin) cans. The tin in a steel can is used as a protective layer which prevents the steel from rusting. The virgin materials in steel production are iron ore (a third of the iron is imported from Canada), coal (processed to form coke), and limestone. Most tin is imported into the U.S., but tin only accounts for 0.05 percent, by weight, of the steel can. Recycled steel cans are used as scrap in steel furnaces. However, steel furnaces can only tolerate a minute amount of tin contamination, often on the order of 0.01 percent tin.[100] Removing the tin from the can increases the value of steel as a scrap product and leaves a relatively pure and valuable supply of tin. Once de-tinned, the steel can is melted down and formed into a new product, or into another can.



Tin accounts for only .05% by weight of a steel (tin) can.

Steel cans that are de-tinned can be sold close to No. 1 bundle prices (this is a term for scrap steel), whereas when mixed with other scrap materials, these steel cans are sold at lower No. 2 prices. Steel scrap is charged into open hearth, basic oxygen, or electric furnaces or is used in iron casting. A traditional open hearth furnace can use 50 percent scrap, a basic oxygen furnace 30 percent, and a mini-mill (electric arc) furnace can use 100 percent scrap.[101]

Barriers to recycling steel cans are similar to those encountered by glass, mainly due to difficulties in collection and transportation of steel cans. Transporting steel cans is costly because bales of

them are bulky and light in comparison to bales of other steel scraps. The de-tinning plant closest to Massachusetts is in Pittsburgh. The bonus with recycling steel cans, like glass containers and aluminum cans, is that they can be re-used to make more steel cans, in a closed-loop lifecycle. Thus steel cans are eligible for the full three cent credit of the bill; however the question remains whether getting the cans to a de-tinning plant will be cost effective even with this bill. Encouraging a de-tinning mill to locate in the state would offer greater flexibility in marketing the volume of scrap to be generated by the regional recycling program.

Plastics. Current markets for recycled plastics are varied, depending on the resin or resin mix. But plastics, like paperboard products, cannot be recycled into food containers. Therefore plastics in food and beverage packaging cannot form a closed-loop system.

Plastics are divided into two resins: thermoset and thermoplastic resins. Thermosets account for 13 percent and thermoplastics account for 87 percent of the plastic resin sales in the U.S. (see glossary for explanation of terms). The major plastic types are polyethylene terephthalate (PET), polyethylene (high density polyethylene and low density polyethylene), polystyrene, polypropylene, and polyvinylchloride. Plastics are processed for recycling in homogenous (one single resin) or in heterogeneous (mixed resins) forms. Because plastics are a relatively new and complex product material, plastics recycling is in its infancy. Homogeneous recycling of plastic packaging poses special problems: due to differing chemical structures among plastics, different resins must be processed separately. At present only one percent of the 13 billion pounds of plastics used in packaging in 1986 was recycled.[102] A little over half of the plastic was used in rigid containers and the remainder was used in flexible packaging.[103]

The two single resins used in packaging that show the greatest

promise for recycling from the post-consumer waste stream are PET (soda bottles) and HDPE (milk jugs) containers. This is because they are easily identified and separated from the waste stream. Roughly 20 percent of the PET bottles are being recovered, mostly from bottle bill states.[104] For a listing of products made from PET see Table 22.

Of all the plastics, HDPE is the easiest resin to reuse because recycling does not damage the polymer, as with PET. This allows the material to be recycled several times. However, removing the

Table 22: Products Made From Recycled PET Bottles.

* Strapping
* Scouring Fences
* Fence posts
* Parking space bumpers
* Industrial paints
* Paint brushes
* Fiberfill for:
  - Pillows
  - Cushions
  - Ski jackets
  - Sleeping bags
* Fibers
  - Carpet face yarns and backing
  - Twine
  - Filter material
  - Rope
* Textiles
  - Belts
  - Woven bags
  - Webbing
  - Sails
* Polyol
  A chemical component used by urethane foam manufacturers to produce:
  - Laminated board stocks for both wall and roof housing insulation
  - Refrigeration truck paneling
  - Home and commercial freezer insulation
  - Storage tank insulation
  - Automobile bumpers
  - Furniture
  - Sporting goods
* Unsaturated Polyester
  A chemical component used to produce:
  - Bath tubs, sinks and shower stalls
  - Boat hulls
  - Swimming pools
  - Marbleized material
  - Automobile exterior panels
* Thermoformable Sheets
  Used to produce:
  - Six-pack carriers
  - Audio cassette cases
  - Non-food containers

Source: Plastic Bottle Recycling Directory and Reference Guide 1988.

label of the HDPE bottle is expensive, labor intensive, can result in landfilling up to 40% of the bottle, and is necessary because single resin recycling cannot tolerate paper contamination. The process for recycling HDPE is 1) sorting (visually), 2) de-labelling, 3) magnetic separation of ferrous contaminants, 4) grinding, 5) removal of fine particles (cleaning), and 6) paper separation system.[105] For a listing of products made from HDPE see Table 23.

Polystyrene is not being recycled at present in the U.S., nor is it likely to be in the near term. Post-consumer waste of LDPE and polypropylene is not being recycled to any significant extent.

Plastics can also be recycled by mixing, or "commingling" different plastic resins to form a new product. Commingled plastics are the paperboard of plastics in that they are a mixture of many different materials. Commingled plastics are substitutes for wood, concrete, and metal (see Table 24 for a listing of products made from commingled plastics).

Several firms, Advanced Recycling Technologies (ART) of Belgium, Recycloplast of Germany, and Plastics Recycling, Inc., of

Table 23: Recycled Products Made From HDPE.

* Lumber substitute for:
  - Boat piers
  - Pig and calf pens
  - Garden furniture
  - Outdoor furniture, litter receptacles, and signs
* Soft drink bottle carriers
* Milk bottle carriers
* Base cups for soft drink bottles
* Flowerpots
* Pails and drums
* Traffic barrier cones
* Golf bag liners
* Kitchen drain boards
* Toys
* Trash cans
* Pipe
* Signs

Source: Plastic Bottle Recycling Directory and Reference Guide 1988.

Table 24: Products Made From Commingled Plastics.

* Posts	* Car Stops	* Composting boxes
* Stakes	* Pallets	* Cable reels
* Slats	* Grates	* Sound absorbing walls
* Poles	* Man-hole covers	* Sign post bases

Source: Gretchen Brewer, "Mixed Plastics Recycling: Not A Pipe Dream," Waste Age, November 1987.

the U.S. have developed machines for recycling mixed plastics. For example, ART has developed "Extruded Technology 1" (ET/1), which blends mixed plastic resins together into new products.[106] What makes this new technology unique is its ability to tolerate high percentages of contaminants such as paper, dirt, metal, and glass. ET/1 uses 60 percent polyolefins (PP, HDPE, and LDPE) and 40 percent contaminated materials for fillers--which can include PVC, PS, and PET. Thermoset plastics are incorporated as fillers into the final product, which include posts, poles, and stakes.

Barriers to Plastics Recycling. Obstacles to recovering plastics include lack of infrastructure for collection, lack of processing technology for recyclers, and high costs of transportation. Very few recycling programs are structured for plastics recycling. As already noted, PET bottles are the only post-consumer waste plastic being extensively recycled, due to bottle bills. Once recycled, plastics are processed into one of three possible forms: ground, baled, or loose. Most buyers of plastic scraps prefer them in ground form, already processed for the end-user.

As we have noted, single resin plastics processors can only tolerate a contamination level of 1 to 5 percent. This makes recycling single resin post-consumer plastics hard because identifying with certainty what resin(s) are contained in a product is difficult. A standard code is necessary to assist recyclers in identifying the resin so it can be recycled. Both SPI and ASTM are working on

developing and implementing a plastic container coding system. Most single-resin plastics recycling uses wastes from manufacturing, which offer a clean and steady supply of a specific resin, since buyers of plastics often demand 100% homogeneous plastic. Processors of PET bottles and of commingled resins are the exception to this rule.

Plastic's two greatest advantages in packaging are also its two greatest weaknesses in recycling: high strength and light weight. These characteristics make plastics more expensive to collect and transport than any other recyclable material.[107] Due to the high costs of transportation and the need for relatively "pure" plastics, most plastics recycling is occurring "in-house" or where outside companies collect industrial plastics scraps and process them for resale.

Once plastics are recycled they face an uphill battle in fighting for market share with inexpensive, uncontaminated virgin resins. Recycled plastic must be one-third to one-half the price of virgin resin, or else it cannot compete. For example, recycled PET is only worth about 23 cents/pound, because the most common use for it, fiberfill, is oversupplied.[108] Because of a lack of closed loop opportunities, recycled plastics are forced to compete in markets where prices are marginal and demand potential limited. "The single greatest problem facing plastics recycling of any kind is the absence of stable end markets for recovered materials."[109]

At present, only 1% of the 13 billion pounds of plastic used in packaging in 1986 were recycled.

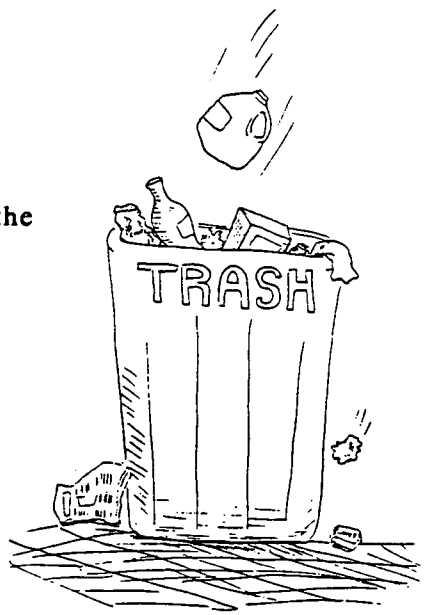
"In summary with the current relatively low prices for prime resins, the economics of recycling most plastics appear marginal at best....Clearly, government initiatives to stimulate demand for post-consumer plastic waste will be necessary to shift current trends."[110]

Institutional Barriers to Recycling

Although recycled materials have taken a limited share of the virgin materials markets, institutional as well as technical barriers

exist to their expanding role in the market. The financial support provided by this bill will obviously help expand market share, but other impediments also need to be addressed. Current obstacles besides those discussed above include taxes at all levels of government, federal management assistance to virgin material exploiters, and transportation rate structures. Recycling is also inhibited in the United States, in part, because of a plentiful supply of cheap but non-renewable natural resources. These virgin materials frequently also benefit from generous subsidies provided by local, state, and federal governments, which are not available to recycled materials. This section will focus on those measures that represent barriers to a range of products.

Taxes/Federal Management. Subsidies to producers of virgin materials are provided in the form of tax breaks, services provided by governments below market cost, and foreign subsidies. Subsidies that favor virgin materials in the federal tax codes include capital gains treatment of income, deductions for expenses, depletion allowances, favorable treatment of vertical integration, and the foreign tax credit (see glossary for an explanation of these terms).[111] These features of the tax code represent generous assistance to the timber, mining, and petroleum industries. They make it difficult for recyclers to compete with virgin products sold at artificially low prices. Rescinding many of these tax breaks is difficult because of powerful timber, mining, and petroleum interests; and in many cases such an action may not achieve the objective of increasing recycling. They can be offset by offering equal incentives to recyclers.

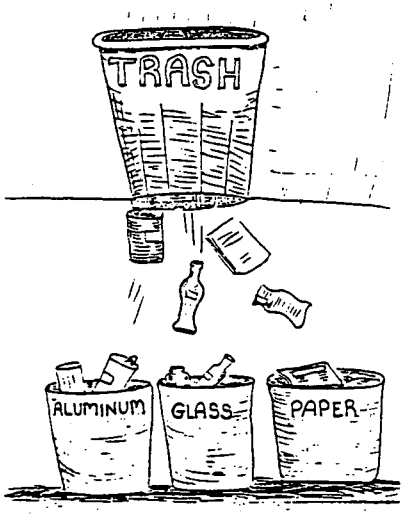


One example of a tax code subsidy of virgin production is in the petroleum and mining industries, where percentage depletion allowances have generated "deductions nineteen times greater than its [the well's] original adjusted basis, ...which measures the costs of establishing a well or mine."[112] In 1975 the allowance was ended for the seven largest oil companies, but it is still in effect for other

oil companies and for mining companies. Another typical tax subsidy to virgin materials is California's expense deduction rule, where a manufacturer is allowed to deduct up to 50% of the cost of virgin materials from taxes; recycled materials enjoy no such benefit.[113]

Timber companies are subsidized by management, road building, and tree-planting services provided gratis by the United States Forest Service. Not including these services in the price of timber sales from federal lands, a practice known as "residual value pricing," has cost the government $2 billion between 1975 and 1985 on timber sales, and artificially depressed virgin material prices.[114]

The Canadian federal and provincial governments also provide liberal subsidies to their timber industry and to pulp mills. These allow Canadian newsprint to sell at extremely competitive prices, giving Canada over 50 percent of the U.S. newsprint market.[115] In 1986 Canada produced 7.4 million tons of the 13 million tons of newsprint used in the U.S.[116]



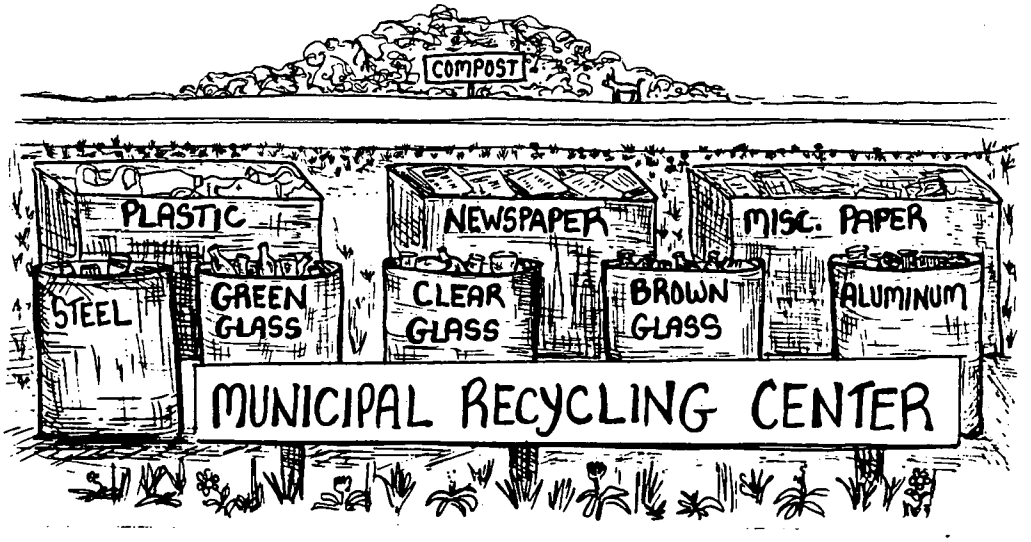
Fortunately states (notably Oregon) and the federal government are beginning to provide investment tax credits for recyclers. States are also providing grants to help recycling industries get on their feet. This trend will continue as states realize that if recycling is to occur, subsidies to virgin material exploitation must be eliminated or circumvented with similar subsidies to recycled products.

Transportation Costs. Transportation costs are frequently higher for recycled goods not only because of material characteristics but because of regulated rate structures, and indirect transportation subsidies. This represents a serious impediment to recycling low cost materials that are already marginally competitive. Trucking and rail tariffs have historically favored virgin materials over scrap and other recyclables.[117] The interstate highway system, built at public expense, is an often overlooked subsidy that has made remote

regions accessible to urban areas and thus made it economically possible to locate paper mills next to forests, rather than in urban areas with massive supplies of waste paper.[118]

Conclusion

Between the institutional and technical barriers to recycling, and the lack of demand, recycled materials have a tough uphill battle in increasing their market share against established virgin materials. Without a stronger government role in the recycling process packagers will not work towards greater use of recycled and recyclable materials, and without outside stimulation the demand for recycled materials will stagnate. The policies that help spur on the exploitation of natural resources are now necessary to spur on the exploitation of post-consumer resources. Ultimately, citizens will pay for the lack of recycling with the increased costs of disposal and environmental degradation.



Policy Analysis

As with any piece of legislation where one group feels that it is being made to bear the exclusive burden of society's failure to anticipate problems associated with growth and technological change, there have been many criticisms leveled at the "unfairness" of the bill, its assumptions and the logic of its proposals. This section considers these criticisms and summarizes our conclusions, making recommendations for change where that seems appropriate.

The most common criticism of the bill is that it is nothing more than a tax, and a regressive one at that. One hears the comment "they'll just pass the cost along." This criticism has two parts: one is the judgement that the bill's mechanism is unfair, and the other is the contention that it will not work. For if the bill works as intended then the fee will be self-extinguishing, and when producers of packaging have adapted their technology and choice of materials then the "tax" will be repealed, and fairness will not be an issue.

But leaving the bill's eventual effectiveness aside, what of the argument that the bill is regressive in application, since the greatest part of packaging is associated with the basic necessities of life, food and consumer non-durables? The response to this argument is two-fold. The bill's "regressiveness" is a consequence of its basic logic, which makes the producers and generators of packaging assume some of the external costs of disposal. As we have seen, there is a rough relationship between the aggregate amount of the fees which might be collected and the costs of the packaging consumption that the bill seeks to reform, so considered from a social cost-benefit point of view, there is some justification for this approach. But more to the point, to the extent that consumers participate in the generation of solid waste by choosing products that are packaged in non-recycled, non-recyclable materials, it does seem fair for them to pay more for those products. The basic issue becomes whether or not there is a choice for the consumer, which brings us back to the issue of the bill's effectiveness. If there is a choice, and if that choice is enlightened by a process of public education and by the availability of recycling opportunities, then the bill's operation is "fair." If on the other hand the bill simply adds to the price that ordinary people have to pay for the basic necessities of life, without working at all to encourage any alternative, then it will be unfair. So we conclude that a judgement about the bill's fairness depends on an evaluation of its effectiveness and on the progress of other recycling programs.

In any discussion of equity, we must also consider how the present system works. The property tax is the source of most municipal revenues, out of which solid waste disposal is claiming an increasing part. Although the amount that people pay for shelter varies somewhat more than what they spend on food, the property tax is still a fixed percentage, a component of the cost of rental housing as well as a direct expense for property owners. So the present allocation of the costs of disposal is regressive: it bears no relation to ability to pay. In fact, it bears no relation to the amount of trash that any individual or family generates. It seems to us "fairer" to offer people an incentive to deliberately reduce the amount of non-recyclable, virgin-material trash they generate than to force them to bear the cost of others' decisions not to do so.

The second part of the argument about the bill's "fairness" involves an analogous criticism of the bill itself, that the fee structure does not correspond to the actual cost of disposal. To take this criticism to its logical conclusion, one would propose that all trash be weighed at curbside, or at the town disposal facility, so that each family would bear a cost directly proportional to the amount they produce. But of course the amount of labor involved would outweigh the savings for any family that did generate less trash unless we assume a remarkable reduction of total solid waste due to greater public awareness would result from such a scheme.

We conclude that a judgement about the bill's fairness depends on an evaluation of its effectiveness and on the progress of other recycling programs.

The second logical improvement along these lines would have the fee correspond to the weight of the non-recyclable, virgin material package, and thus to presumed cost of disposal. In some ways this proposal is attractive, but the immediate problem is again a practical one. The imposition and collection of such variable fees presents a book-keeping and administrative nightmare. Every manufacturer would expend a lot of energy litigating the arbitrariness of whatever decision was reached by those in charge of assigning these fees. Furthermore, such a variable fee does not encourage the use of recyclable materials in the same way, because in many cases

alternative materials would continue to be attractive due to their high volume to weight ratio. We must face the basic fact that solid waste is our common problem, and that focusing exclusively on issues of equity will prevent us from taking effective steps to solve that problem. In short, the present system is unfair, and certain aspects of the bill are also unfair, because there is no conceivable way to allocate the costs of disposal perfectly in proportion to the amount of trash that an individual family generates. Calling the bill "regressive" is merely restating this inescapable fact. If the bill works, then it will save the average taxpayer money in the long run if not immediately, and it will, as we have discussed throughout, also contribute to the quality of life in the Commonwealth in ways that may be hard to quantify.

A final criticism of the bill's fairness is that it will have a greater impact on small businesses which are less able to absorb such dislocations. We saw in the bag study that some small businesses might very well be forced to close. The argument for the bill points out that the bill's impact is not discriminatory per se. It simply considers each package on a functional basis, without prejudging any specific material or kind of package. If the technology existed for plastic bags to be recycled, and if paper bags could not be returned, then the bill would have the opposite effect on the small manufacturer.

A different kind of criticism addresses the bill's effectiveness in accomplishing its stated objective, rather than the inequity of the proposed means. One kind of criticism describes consumer preferences for new kinds of packaging and lack of willingness to recycle as insurmountable obstacles. Another lists various technological and economic barriers to recycling. Finally, a broad category of criticism lists problems with the bill's functioning, the vagueness of its wording, the difficulty of enforcement, the negative impacts on the economy, the creation of yet another bureaucracy and so on. Let us take these criticisms in order, and as much as

possible try to use the results of the case studies and the overview of packaging in the waste stream to help us answer the fundamental question: will this bill work, and what could be done to improve it?

The success of recycling programs elsewhere and the results of consumer surveys to which we have referred in this report lead us to conclude that consumer fascination with the new and exotic forms of packaging being developed today is not an insurmountable barrier to recycling or the success of this bill. Furthermore, the considerable ingenuity of the engineers and designers who developed such wonders as the six-layer Cribari bottle and the Impromptu package could be applied to the redesign of much "convenience" packaging to respond to both perceived consumer lifestyle changes and the need for better use of resources. As we explained earlier, it is time for every package in the market to be evaluated on the basis of its ability to be recycled and/or reused; if plastics recycling is to work, then packages must be designed with that potential in mind. Consumer preferences for packages that are lightweight, squeezable, dual-ovenable and so on are doubtless real, but the alarming volume of trash is even more real. The shift to materials with poor disposal characteristics is neither so rapid nor so irreversible as has been reported, and we feel that the educational component of the bill, including the excellent proposal for a logo, could also have a significant impact on consumer attitudes. In sum, the real barrier to recycling packaging materials is in the minds of corporate decision-makers, not consumers. Consumers are ready to accept the "inconvenience" of recycling, which in a well-designed program will be minimal. Corporate decision makers, on the other hand, will only be persuaded by economic incentives: we cannot expect some vague notion of environmental benefit to alter their patterns of packaging use.

It seems to us more fair to offer people an incentive to deliberately reduce the amount of non-recyclable, virgin-material trash they generate than to force them to bear the cost of others' decisions not to do so.

Other barriers to recycling discussed in this report include state policies on procurement, federal and state tax codes, and other regulations. These are only relevant to this bill to the extent that

the state must demonstrate its commitment to a viable, practical recycling program for this bill to make sense. This bill would not work if recycling were as inconvenient and cumbersome as it is today in most localities. Conversely, this bill will work to strengthen the state's recycling program by creating markets for recycled materials. But there are many other measures which can help create a favorable climate for recycling, the most significant of which is a shift in state procurement policies. State support for private sector investment in such facilities as deinking mills and detinning plants, perhaps through industrial revenue bonding or other long-term financing mechanism, could be another significant factor. This bill works well only in the context of a major effort to promote recycling; most of the criticisms that raise issues of technological infeasibility do not take this into account.

This bill will not work if recycling remains as inconvenient and cumbersome as it is today in most localities.

We have tried to give a complete analysis of whether or not the bill makes sense economically. We believe that it does, but that one has to consider the costs and benefits over the long term. We got into the solid-waste crisis through a combination of technical ignorance about the dangers of landfills and political unwillingness to plan ahead. The state's economy is strong now and we should be more willing to look ahead ten, fifteen, or twenty years. It is clear from the material presented in this report that the future economic and environmental health of our Commonwealth requires us to consider alternatives to exclusive reliance on incineration and landfilling. This bill makes sense because the trend in packaging is towards more and more non-recyclable materials, materials whose disposal presents grave environmental risks as well as becoming more and more costly.

We have tried to outline the potential for recycling by describing the composition of the state's waste stream, and to anticipate how much revenue would be generated by such a scheme. As was explained in the section on cost-effectiveness, The Packaging Reduction Act will "pay for itself" by reducing the amount of waste

that cannot be recycled, when considered over the long-term. We have noted that the bill's relationship to the solid waste bill is important in several ways: it helps to create markets for recycled materials, and it will encourage recycling by promoting public awareness and encouraging development of recycling technologies. If we consider this added effect, then the 15% figure we used seems conservative.

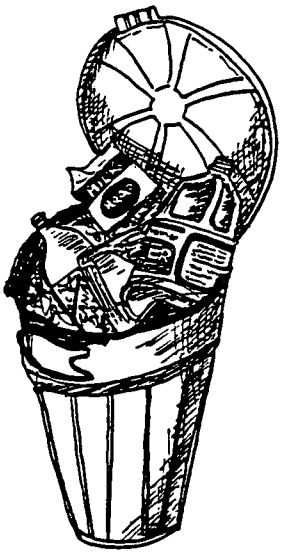
One suggestion for improving the bill's effectiveness is similar to the sliding scale for the fee based on package weight: this proposal would vary the fee based on progress in percentage of recycling for any given package category. We have seen that milk packaging would probably continue to use the non-recyclable materials that are now common, for a variety of technical and economic reasons, if the fee were set at only 3 cents. One might argue that the fee should be set at whatever level is necessary to make the more ecological package competitive--i.e. that the fee be acknowledged as a definite intervention into the market. This idea deserves consideration, but it would open the administrators of the bill to charges of arbitrary and subjective decision-making. The present set-up may not be the most theoretically effective, but it is certainly more workable.

The economic benefits of packaging are out-of-state. The costs are all too much in-state, in the form of high disposal costs.

The final criticism of the bill focuses on the negative economic impacts of the bill: on the loss of jobs, the dislocations of business, the increased cost of living. This report investigated these possibilities and decided that the economic impacts of the bill would be minor in terms of jobs and business dislocation. In fact, the state of Massachusetts "imports" packaging. We get the costs but not the positive effects of employment and business vitality. To the extent that in-state activity can replace the manufacturing that uses virgin materials, this bill will be a net economic benefit to the state in terms of jobs and business growth. As for the second part of the argument, under one set of assumptions about the bill's effectiveness we found that the overall cost of living would increase

during an initial period of transition and then decline. The economic benefits of the programs, which revenue from the bill would support, are not included in this calculation of benefits: this is simply an estimate of how much this bill would cost the average person. We concluded that over a period of time it would achieve a net savings for the average household by reducing disposal costs.

Conclusions and Recommendations



1. The bill will have a significant effect on decisions about material use in some kinds of packaging, but not all; because of the different functional requirements and the variety in unit cost among packages, we could not generalize about its impact, except by looking at the waste stream in terms of general potential for recycling.

2. Considered on the basis of cost-effectiveness, the bill's benefits in reducing expenditure on solid waste would outweigh the negative economic impacts of the fee.

3. The important "symbolic" commitment to reducing solid waste is an equally important part of the bill's effectiveness. By raising public consciousness about the need to reduce packaging waste, the logo proposed for packaging meeting the bills criteria will potentially have as great an effect on consumer choices as the economic incentives.

4. We preferred the fee structure as proposed to measures that have been suggested elsewhere, among them the outright ban of certain materials. However, if the fees suggested do not have the desired effect, then the bill should include a mechanism for increasing the level of the fees, either across the board, (simpler), or for specific packages. The bill might also include consideration of outright bans on certain materials, in cases where the proposed fee proved ineffectual.

5. There needs to be an inventory of packaging use which will include more specific figures on types of material, potential for recycling at present levels of technology, and description of packaging alternatives so that efforts funded by the bill could be more effectively focused where the greatest likelihood of benefit

could be expected.

6. Some of the revenue from the bill should be devoted to the remediation of economic dislocations as well as to the purposes which are enumerated in the bill of education, administration, research and so on.

7. Education, outreach to business and enhancement of public awareness should have a very high priority, reflected in a greater percentage of revenue devoted to these purposes. This would capitalize on the public's concern about the solid waste issue.

8. Many people have suggested that the state should change its procurement policies in order to encourage recycled materials. (As we were editing this report, the Governor announced an executive order to implement such a policy.) Whether included in this legislation or elsewhere, such a change should be legislatively mandated, in language that makes it explicit that price is not to be the sole determining criterion for the award of procurement contracts. Action should be taken against the types of legal and regulatory barriers to recycling in Massachusetts which we have discussed, such as transportation rate structures, subsidies and tax breaks.

9. There needs to be a means for adjusting the minimum percentages of recycled material required to reflect individual functional requirements of packages, i.e. more detailed and specific adjustment than by material category. For example, the recycled material content in grocery bags could never be as high as for other bags, because of their unique function. This should not require that percentages for other paper products be set lower. Also, the size limitation should be reconsidered, so that grocery bags and other such containers over 2 gallons dry measure would be covered by the bill.

Endnotes

Endnotes from pages 1-44.

1. Division of Solid Waste Management, Department of Environmental Quality Engineering, "Solid Waste Fact Sheet."

2. ibid.

3. Written communication, Natalie Roy, DSWM, DEQE

4. Estimate made by John Schall, former Director of Recycling, Commonwealth of Massachusetts.

5. op cit. Division of Solid Waste Management.

6. Division of Solid Waste Management, Department of Environmental Quality Engineering, "Solid Waste Costs."

7. Personal Communication, John Schall, former Director of Recycling, Commonwealth of Massachusetts.

8. op cit. Division of Solid Waste Management, "Solid Waste Costs."

9. Figure from John Schall.

10. Presentation given by Manager of Wheelabrator plant in Millbury, Massachusetts, Tufts University, April 14, 1988.

11. ibid.

12. ibid.

13. op cit. Division of Solid Waste Management, "Solid Waste Fact Sheet."

14. Jeffrey B. Stevens, "Solid Waste Incineration: What Risks, What Roles?," Commentary, Health and Environmental Digest 1(9):1-3 (October 1987).

15. "Municipal Solid Waste: Can We Burn It," Health and Environmental Digest 1(9):1-3 (October 1987).

16. ibid.

17. Citizen' Clearinghouse for Hazardous Wastes, Inc., Recycling...The Answer to Our Garbage Problem. (Arlington, VA: Citizen's Clearinghouse for Hazardous Wastes, Inc., 1987).

18. "Could Towns Compost Garbage?," The Recorder Greenfield, MA, July 23, 1987.

19. ibid.

20. Environmental Defense Fund, "Summary of EP Leaching Tests Performed on Ash from Municipal Solid Waste Incineration," booklet, March 1987.

21. op cit. "Municipal Solid Waste: Can We Burn It."

22. Evelyn Herwitz, "Trash Story," Worcester Magazine 12(11):13-15 (December 2, 1987).

23. op cit. Citizen's Clearinghouse for Hazardous Wastes, Inc.

24. "New York Landfills Fail Incineration Test," The New England Environmental Network News 7(4) (Fall 1987).

25. op cit. Citizen's Clearinghouse for Hazardous Wastes, Inc.

26. Based on comparison of EPA figure of 1300 pounds per capita per year and assuming 1.3 million tons of construction debris and industrial waste not to be counted in municipal solid waste.

27. "Waste Composition Study," literature review by Ferrand and Scheinberg Associates for Bureau of Solid Waste Disposal, Massachusetts Department of Environmental Management, October 1985.

28. Franklin Associates, "Composition of Municipal Solid Waste," 1985.

29. Sources of information for the material in this section: Rauch Associates, Inc.; "The Rauch Guide to the U.S. Packaging Industry" 1986 edition; also U.S. Department of Commerce, Bureau of the Census; "Current Industrial Reports" and "Annual Survey of Manufacturers;" and United States Department of Commerce.

30. David J. Freiman, "Managing Packaging Wastes in the 1980's," Key Social Issues for Packaging in the 1980's, ed. David J. Freiman (AMACOM: New York, 1980).

31. ibid. p. 31.

32. "Glass Provides a Class Image," Packaging (July 1987).

33. Mark Spaulding, "Survey Reveals Plans for '88," Packaging (October 1987).

34. "The Outlook for Rigid Containers," Packaging Encyclopedia 1987.

35. Melissa Larson "The Year's Most Exciting Packages," p.8., Packaging Encyclopedia 1987.

36. ibid.

37. "Consumer Survey Reveals Surprises," Packaging (June 1987).

38. Ad Age, May 1987

39. ibid.

Endnotes from pages 45-88.

40. Gretchen Brewer, Recycling Program Coordinator for the Massachusetts Division of Solid Waste. 'Plastics Recycling Action Plan for Massachusetts', April, 1988.

41. ibid.

42. Hare, Michael J., "Environmental Guidelines for Consumer Packaging: The Total Packaging System Approach," Official Proceedings of the Conference on Solid Waste Management and Materials Policy, Session 25, Volume XX, February 11-14, 1987.

43. A research study conducted in the Netherlands for dairy products in May 1981 by Hank Middelveldt, the Head of the Department of Liquid Milk and Liquid Milk Products, Commodity Board for Dairy Produce.

44. Middelveldt, Hank, "Milk Packaging and the Environment," Container Costs, Edited by J. Butlin and K. Lidgren, 1983.

45. Backman, Mikael, "Milk Packaging and Its Costs: A Literature Study," Container Costs, Edited by J. Butlin and K. Lidgren, 1983.

46. ibid.

47. ibid.

48. Packaging in the New Zealand Environment: Issues and Options, Discussion Paper, Ministry for the Environment, November, 1987.

49. ibid.

50. Gaines, L. L., "Energy and Materials Use in the Production and Recycling of Consumer-Goods Packaging," Argonne National Laboratory, February, 1981.

51. ibid.

52. ibid.

53. op cit. Brewer, "Plastics Recycling Action Plan for Massachusetts."

54. ibid.

55. op cit. Hare, "Environmental Guidelines for Consumer Packaging: The Total Packaging System Approach."

56. op cit. Brewer, "Plastics Recycling Action Plan for Massachusetts."

57. ibid.

58. Personal Interview with anonymous manager of a retail chain, February 23, 1988, March 28, 1988.

59. Paul Gentile, President, Ace-Lon Corporation, Personal Interview, March 8, 1988.

60. Rick Thorneberg, Information Director, Flexible Packaging Industry Association, Personal Interview, March 7, 1988.

61. David Carlton, Manager, Kraft Paper Division, American Paper Institute, Personal Interview, April 22, 1988.

62. Patrick Scanlon, Director of Environmental Resources, North Shore Recycled Fibers, Personal Interview, March 14, 1988, May 2, 1988.

63. U.S. Bureau of the Census, U.S. Department of the Commerce, County Business Patterns 1985 Massachusetts. (Washington, D.C.: U.S. Government Printing Office, 1987).

64. ibid.

65. ibid.

66. Fort Howard Co., Wilmington; personal communication, 3/88

67. Diane de Coninck, A Policy Analysis of Fast Food Packaging, Submitted to University of VT., Environmental Program,2/88, p.117.

68. Nancy Sherman, Food Service & Packaging Institute; personal communication, 3/88.

69. J. Lammers, Dart Container Corp.; communication to J. Erickson, Rhode Island State House, 2/88.

70. Nancy Sherman, Food Service & Packaging Institute; personal communication, 3/88.

71. Dart Corp.; communication to Rhode Island State House, 2/88.

72. Rhode Island Source Reduction Task Force; communication to Dart Container Corp., 3/88.

73. ibid.

74. New York Times, letter to the editor, 1/26/88.

75. Time magazine, 2/29/88; p.30.

76. Providence Journal, 2/21/88.

77. ibid.

78. Adam Marks; personal communication, 4/88.

79. Craig Dixon, Martin Brower Co.; personal communication, 2/88.

80. Ibid.

81. Bob Theophilus, Persico purchasing agent; personal communication, 4/88.

82. Code of Federal Regulations, Title 21, Section 176.260.

83. Adam Marks; personal communication, 3/8.

84. op cit. de Coninck, p.53.

85. Tim Hermaly; personal communication, 3/88.

86. op cit. de Coninck, p.53.

87. Rhode Island Source Reduction Task Force; 2/88.

88. Worcester Quality Co.; personal communication, 3/88.

89. Depaco Co.; personal communication, 4/88.

90. Personal communication, 3/88.

91. Code of Federal Regulations, Title 21, Section 176.260.

92. Walsh, Patrick and Phil O'Leary, "Recycling Offers Benefits, Opportunities ... and Challenges," Waste Age, January 1988, 54-60.

93. Phone interview with Robert Garino of the Institute of Scrap Recycling Industries, Inc., April 27, 1988.

94. American Paper Institute, Inc., "Paper Recycling and its Role in Solid Waste Management," 1987.

95. Resource Conservation Consultants, et al., Background Report too Recycling Feasibility Studies: Volume I - Markets, Michigan Department of Natural Resources, 1986.

96. Franklin Associates, Ltd., Paper, Glass and Metals Market Development Study, Michigan Department of Natural Resources, 1987.

97. Franklin Associates, Ltd., Statewide Market Study for Recyclable Paper, Glass, and Metals, Michigan Department of Natural Resources, 1987.

98. Phone Conservation with Chas Miller of the Glass Institute on April 11, 1988.

99. op cit., Recycling Feasibility Study.

100. Franklin Associates, Ltd., Statewide Market Study for Recyclable Paper, Glass, and Metals, Michigan Department of Natural Resources, 1987.

101. op.cit., Franklin Associates.

102. Weis, Robert and Wayne E. Pearson, "Plastics Recycling: A Strategic Vision," Plastics Recycling Foundation, Inc., March 1988.

103. ibid., 8.

104. ibid., 15.

105. op.cit., Resource Integration Systems, Ltd.

106. Brewer, Gretchen. "European Plastics Recycling, Part I," Resource Recycling, May/June 1987.

107. Resource Integration Systems, Ltd., Market Study for Recyclable Plastics, Michigan Department of Natural Resources, 1987, 82.

108. op.cit., Resource Integration Systems, Ltd.

109. ibid., 56.

110. op.cit., Resource Integration Systems, Ltd., 76.

111. Ruston, John F. "Developing Markets for Recycled Materials," EDF, New York.

112. ibid., 8.

113. Case, Clifford P. "Increasing Demand for Recycled Materials," BioCycle, November/December 1985, 32-34.

114. Ruston, John F. "Developing Markets for Recycled Materials," EDF, New York.

115. Franklin Associates, Ltd., Statewide Market Study for Recyclable Paper, Glass, and Metals, Michigan Department of Natural Resources, 1987.

116. American Paper Institute, "Paper Recycling and its Role in Solid Waste Management," 1987.

117. op.cit., Ruston.

118. Case, Clifford P. "Increasing Demand for Recycled Materials," BioCycle, November/December 1985, 32-34.

Appendix I

Glossary

Aseptic Packages

They are typically made from a polyethylene-paper-foil-polyethylene mix or from a six-ply laminate. These single-service packages are popular in the 250 milliliter brick-style box for juices and juice drinks. They range in size from 200 milliliters to 1 liter.

Composite Cans

Spirally wound containers with both end permanently closed. Paper is the primary product, but construction usually includes several layers of plastics and/or foil. The inner surface is usually a thermoplastic material with a foil backing. End closures are frequently a combination of metal, plastic, and paper.*

Carded Packages/Blister

Typical carded blister package consists of thermoformed plastic blister on top of a preprinted card backing which are heat-sealed together. Styrenes and vinyls are the typical plastics used to cover the product. The backer card can be made from recycled products.**

Carded Packages/Skin

Instead of using thermoformed plastics, the skin card uses heated plastic film over the package. Polyethylene and ionomer are the principle film plastics used.***

Grades of Waste Paper****

Pulp Substitutes

Waste materials collected from the manufacturing process and are recycled in-house. The reuse rate of pulp substitutes is almost 100 percent.

Old Newspapers

Simply, post-consumer newspaper. Used mainly in the production of paperboard (cereal boxes, spaghetti boxes, shoe boxes, etc.). It is

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*McGowan, Raymond, Packaging's Encyclopedia 1987, 102.

**Butler, Francis I., Packaging's Encyclopedia 1987, 107.

***Weinman, Howard M., Packaging's Encyclopedia 1987, 108.

****All of this material is from: Franklin Associates, Ltd., Statewide Market Study for Recyclable Paper, Glass, and Metals, for Michigan Department of Natural Resources, 1987.

also recycled into newsprint.

Corrugated Containers (Boxes)

Consists of two grades, clippings and old corrugated containers. Clippings are in-house waste, and like pulp substitutes are almost 100 percent recycled. Old corrugated containers are post-consumer corrugated shipping containers. Most corrugated boxes are used in manufacturing and commercial waste, only a small percentage is represented by household waste.

De-inking Grade

Consists of office and computer papers. De-inked paper is often recycled into tissues, toilet paper, paper towels, and napkins.

Mixed Grade

Consists of unsorted household and commercial waste paper which may include magazines, paperboard, and newspapers.

Cullet

Trade name for recycled glass.

In-house

This refers to materials that are recycled by the manufacturer, they never reach the consumer.

Financial Terms*

Capital Gains

A tax on the appreciation (increase) of capital investments. Prior to the 1986 tax reforms, the tax rate on capital gains was 28 percent, as compared to the corporate income tax rate of 48 percent. Timber stands are taxed as capital gains, and the savings to the timber industry have been calculated as reducing the supply price of timber by 20 percent.

Deduction for Expenses

Allows mining companies to write-off exploration and development costs; these costs are deducted against future income. It also allows timber companies to write-off expenses of timber production as they occur, rather than when it is sold. This amounts to a zero interest government loan.

Depletion Allowance

As the value of a mine or well declines because the natural resources are being extracted a company can deduct a percentage of

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*Ruston, John F. "Developing Markets for Recycled Materials," EDF, New York.

the income made against future mineral sales. The purpose is to provide incentives for exploration of minerals and oil.

Vertical integration

Allows large companies which are involved in both extraction and production (manufacturing of goods) to shift their overall book net income back into their less-taxed extractive operations.

Foreign Tax Credit

Often companies get foreign countries to claim royalty payments as a tax, allowing them to claim it as a business expense which is deductible. Royalties cannot be claimed as a deduction.

Plastic Resins

Polyolefins:	PET	Polyethylene Terephthalate
	HDPE	High Density Polyethylene
	LDPE	Low Density Polyethylene
	PP	Polypropylene
Styrenes:	PS	Polystyrene
	ABS	Acrylonitrile Butadiene Styrene
Vinyls:	PVC	Polyvinyl Chloride
	PVDC	Polyvinylidene Chloride
	EVOH	Ethylene vinyl alcohol

Thermoplastics

Plastics with single-chain polymers. They can be reheated and reformed several times and are commonly used in packaging, appliances, and mechanical devices. The three most common thermoplastics are polyolefins, styrenes, and vinyls. Thermoplastics account for up to 87% of the total polymer production. They can be cooled and hardened, but do lose flexibility, clarity, and strength over time.

Breakdown of thermoplastic production

LDPE	36.0%
HDPE	28.6
PS	10.2
PP	8.9
PET	6.0
PVC	5.9
Other	4.3 (Modern Plastics, January 1986)

Thermoset Plastics

Complex plastics which cannot be reheated once molded. They are widely used as molding compounds and adhesives, but are rarely used for packaging. Thermoset plastics represent 13 percent of U.S. resin plastic sales. Although they cannot be reheated they are sometimes used as filler in commingled plastics.

Low Density Polyethylene

Most popularly known as a packaging film. It represented 43.9 percent of the packaging market in 1984. It is mostly used in trash bags, grocery sacks, sheeting, bottles, and bakery and food containers. 25 percent of the LDPE market is in trash bags.

High Density Polyethylene

Is used primarily in milk cartons, household chemicals, bleach, detergent, ice cream containers, closures, and films for shopping bags.

Polystyrene

Comes in two forms, expanded and extruded.

Expanded. Coffee and tea cups. Natural gas and petroleum is mixed with the PS resin and heated to form little beads. A blowing agent like CFC-12 or pentane creates the form and the desired foamed, insulated quality.

Extruded. The clamshell container is made from extruded PS. Same ingredients as expanded PS, but the raw pellets are extruded through a machine to produce a harder, smoother sheet of plastic that can be molded into different types of containers.

Polypropylene

A popular use for polypropylene is in multi-layer plastic bottles, such as the new squeezable ketchup bottles.

Polyethylene Terephthalate

PET, best known of the family of polyesters, used in soft drink bottles. In 1987 150 million or 20% of all bottles were recycled.*

Polyvinyl Chloride

Primary use is in construction, pipes and conduit account for 48 percent of the PVC market. PVC films are use as packaging around pallets.

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*Gretchen Brewer, "Plastic Recycling Action Plan for Massachusetts" April 1988.

Products made from virgin plastic resins:

Polyethylene

beverage bottles; ovenable and ovenboard coatings; electronics; furniture; magnetic recording film; plumbing parts; rug underlay; sheeting; blister and film packaging; strapping.

Polypropylene

appliances; automobile battery cases; closures; coatings; containers and lids; fibers and filaments carpeting, rope, strapping, string); furniture; film (oriented and unoriented); luggage and cases; medical containers and devices; pipe and conduit; straws; toys; wire and cable coatings; transportation parts; wrapping.

Polystyrene

appliance and consumer electronic casings; dairy containers; refrigerator and air conditioner linings; insulation (solid and foam); board (foam); packing; disposable dishes and utensils; cassettes; vending cups; egg cartons (foam); film; food trays; heels; furniture; lids; personal care items; loose fill (foam); luggage; packaging (rigid); radio and tv cabinets; toilet seats; toys; wall tile; various molded and extruded shapes.

Polyvinyl Chloride

adhesives and sealants; appliances and business machines; auto bumpers; auto parts; baby pants; blood bags; bookbinding; bottles; building interiors; cans; carpet backing; anti-corrosion coatings; credit cards; film; flooring; footwear; gutters and downspouts; handbags; handles; hose; health-care; labels; lighting; luggage; medical tubing; mobile home skirts; novelties; outerware; blister packaging; paneling; pipe fittings; pipe (sewer, drain, water, gas, irrigation, vent, and conduit); plugs and connectors; pool liners; records; shades/blinds/awnings; siding; sports coatings; table cloths/mats.

Chlorofluorocarbon

are a family of compounds containing carbon, chlorine, fluorine, and sometimes hydrogen that are used primarily as refrigerants, specialty solvents, and agents for foamed plastics.

HOUSE . . . . . No. 1172

By Mr. Roosevelt of Boston, petition of Mark Roosevelt and other members of the General Court relative to reducing and recycling of certain waste packages. Natural Resources and Agriculture.

The Commonwealth of Massachusetts

In the Year One Thousand Nine Hundred and Eighty-Eight.

AN ACT TO PROTECT THE ENVIRONMENT BY ENCOURAGING A REDUCTION AND RECYCLING OF PACKAGING IN THE COMMONWEALTH.

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. The General Laws are hereby amended by inserting after chapter 16 the following chapter: —

CHAPTER 16A.
WASTE REDUCTION PACKAGING BOARD.

SECTION 2. Legislative Findings.

(1) The legislature finds that a crisis exists in the commonwealth's capacity to dispose of municipal solid waste. Solutions have historically focused on creating more disposal capacity, rather than on the more critical long-term need to reduce the amount of waste generated. Consequently, citizens of the commonwealth pay increasing economic and environmental costs for the conventional waste management practices of landfilling and incineration. Moreover, 75% of existing landfills require closure by 1990, either due to overcapacity or noncompliance with environmental and health standards. And little prospect exists for new landfill sitings in the future.

(2) The legislature further finds that a lasting solution to the solid waste crisis must begin with a clearly articulated management plan in which the commonwealth recognizes recycling and source reduction — the elimination of excess materials before they enter the waste stream — as its top priorities. The legislature thus declares the following hierarchy of

solid waste management alternatives in the commonwealth: source reduction, reuse, recycling and materials recovery, resource recovery, and landfilling.

(3) The legislature further finds that the commonwealth has achieved some progress in promoting recycling. But the commonwealth still lacks a funding mechanism for a comprehensive strategy including development of recycling markets, research into recycling technologies, and public education programs on recycling. Pursuing source reduction and recycling schemes will prove difficult, however, due to the changes in behavior required of both industry and individuals.

(4) The legislature further finds that a source reduction plan must begin with changes in packaging practices. Packaging accounts for at least one-third of the municipal solid waste stream. The packaging industry consistently manufactures containers that far exceed functional requirements, and utilizes packaging materials more damaging to the environment than their predecessors. Further, industry increasingly produces consumer packaging with materials such as plastics that are more difficult to recycle than readily recyclable paper, glass, and metal materials.

(5) The legislature thus finds that waste reduction and recycling strategies must begin by: a) encouraging the use of recyclable packaging manufactured with recycled materials; b) encouraging reusable packaging; and c) discouraging the use of excessive packaging. Ultimately, the reduction and reuse of packaging materials can contribute significantly towards decreasing the volume of municipal solid waste.

SECTION 3. Declaration of Purpose.

(1) The legislature declares that the generators of waste must pay disposal costs reflecting the real costs to society of waste management and disposal. In particular, the packaging industry must begin to bear a more equitable share of the environmental and social costs associated with manufacturing packaging containers composed of virgin raw materials, having little potential for recyclability, and which place a burden on solid waste management.

(2) The legislature thus declares that it serves the public interest to impose a disposal fee on packaging based upon the recycled

materials content and recyclability of a container. The disposal fee shall serve the objectives of: a) encouraging container manufacturers to use reclaimed materials, produce recyclable packaging, and reduce excessive packaging by providing exemptions to the disposal fee; and b) creating a funding source for the development and expansion of recycling programs; the promotion of recycling markets; and research into new packaging materials and recycling technologies.

SECTION 4. Definitions

When used in this chapter, the following words shall have the following meanings: —

"Account," the packaging disposal fee account.

"Board," the packaging board of the division of solid waste of the department of environmental quality engineering.

"Commissioner," the commissioner of the department of environmental quality engineering.

"Container," a package used to hold a product sold at retail, including but not limited to: bags, barrels, baskets, bottles, boxes, cans, cartons, carrying cases, crates, cups, cylinders, drums, glasses, jars, jugs, pails, pots, rigid foil containers, sacks, trays, tubs, tubes, tumblers, vessels, wrappers and wraps.

"Credit request," the application of a manufacturer, wholesaler, supplier, distributor, retailer, or other person or entity to receive an offset against the fee based on the recycled material content or recyclability of a container.

"Department," the department of environmental quality engineering.

"Disposal," means traditional methods of solid waste management, including sanitary landfills, resource recovery plants, and incinerators.

"Distributor," a supplier, wholesaler, or other person or entity who sells containers to other suppliers, wholesalers, distributors, or persons or entities for resale purposes.

"Division," the division of solid waste of the department of environmental quality engineering.

"Feepayer," the manufacturer, seller, supplier, distributor, wholesaler, retailer or other person or entity of a container

responsible for payment of the fee pursuant to the provisions of this chapter.

"Municipal solid waste stream," all residential, commercial and institutional solid waste generated within the boundaries of any municipality.

"Packaging," enclosures used to protect, store, contain, transport, display, and sell end products, including but not limited to, containers.

"Program," the packaging disposal fee program.

"Recycling," any process by which materials otherwise destined for the municipal solid waste stream are collected, separated or processed and returned to economic markets in the form of raw materials, feedstocks or end products.

"Recycling services," the services provided by persons or entities engaged in recycling, including the collection, processing, storage, and disposition of recycled materials.

"Retailer," any person or entity, other than a distributor, supplier or wholesaler, who sells or otherwise dispenses to consumers any products placed in containers.

"Sale" or "selling," any sale, transfer, exchange, barter, gift or offer of sale or distribution by a manufacturer, wholesaler, distributor, supplier, or other person or entity in any manner or by any means whatsoever.

"Supplier," the first person or entity who sells any container within the commonwealth to another person or entity.

"Wholesaler," any person or entity who sells containers to retailers, suppliers, distributors, or other wholesalers for resale purposes.

SECTION 5. (1) The department of revenue shall administer the fee established pursuant to this chapter. The department of revenue shall establish all rules and regulations necessary to implement the fee and effect the purposes of this chapter.

(2) The packaging disposal fee shall apply to containers made in whole or in part of aluminum, cloth, fiber, glass, metal, paper, paperboard, plastic, wood, or any combination thereof. The fee shall be assessed on containers used for packaging or packing any product intended for retail sale within the commonwealth. "Retail sales within the commonwealth" shall include: a) all sales by

retailers engaged in business within the commonwealth; and b) all sales by manufacturers, wholesalers, distributors and suppliers of products used and consumed within the commonwealth. It shall be presumed that all products sold within the commonwealth by manufacturers, wholesalers, distributors, or suppliers are for use and consumption within the commonwealth. However, products sold within the commonwealth shall be excluded from this definition if the feepayer shows to the satisfaction of the department of revenue that such products are shipped and used outside the commonwealth.

(3) The seller or supplier of a container making the first sale to a container purchaser shall pay the fee. For purposes of this chapter, "container purchaser" means the wholesaler, distributor, retailer, or any other person or entity who either purchases containers used in the retail sale of products or receives containers filled with products intended for retail sale. "Container purchaser" shall not include the ultimate consumer of a retail product. The fee shall apply whether or not the container is filled with a product.

(4) The fee established under this section shall be three cents for each container. Multiple containers used to package a product shall be assessed a separate fee for each separate container.

(5) Each seller, supplier, or other person or entity liable for the fee under this chapter shall pay the fee to the department of revenue on or before the last day of January, April, July and October of each year. With each quarterly payment, the feepayer shall submit a report to the department of revenue in such form and containing such information as the department of revenue shall prescribe.

SECTION 6. (1) The commissioner of revenue shall exempt the following containers from the three cent per container fee:

(a) containers used to package food or food products sold for human consumption. For purposes of this chapter, "food or food products" means cereals and cereal products; flour and flour products; milk and milk products, including ice cream; oleomargarine; meat and meat products; fish and fish products; eggs and egg products; vegetables and vegetable products; fruits and fruit products; herbs, spices and salt; sugar and sugar products; coffee and coffee substitutes; tea; and cocoa and cocoa products;

— This food exemption shall not include containers used to package wine or other alcoholic beverages. This exemption also shall not include food and non-alcoholic beverages packaged in containers when sold in or by: bakeries, bars, cafes, catering services, cocktail lounges, coffee shops, delicatessens, diners, fast food restaurants, grocery stores, hotel or motel dining rooms, lunch counters, markets, private or social clubs, restaurants, snack bars, specialty food shops, taverns, vending machines, or other such establishments and eating places, whether stationary or mobile, permanent or temporary, which sell prepared food at retail for consumption on the premises or off the premises on a "take-out" or "to go" basis;

— Three years after the effective date of this chapter, this food exemption shall cease operation.

(b) containers sold or furnished for retail sale for which the seller, supplier, distributor, wholesaler or retailer requires a refundable deposit of at least five cents per container. This exemption shall include, but is not limited to, refundable beverage containers governed by sections 321-327 of chapter 94 of the General Laws (chapter 571 of the acts of 1981), and refundable milk bottles.

(c) containers used to package medication on prescription of registered physicians;

(d) containers holding 2 gallons or more in volume;

(e) containers manufactured or sold to a supplier, wholesaler, distributor, or other person or entity in the commonwealth, but not intended for retail sale within the commonwealth or actually sold in retail for final use and consumption within the commonwealth; and

(f) containers meeting both the recyclability and recycled material requirements of subsection 3 of section 7 of this chapter.

(2) The department of revenue shall establish procedures to receive and dispose of requests for exemptions under subsection 1 of this section, including, but not limited to:

(a) provisions for temporary nonpayment of the fee owed by a seller, supplier or other liable person or entity while the exemption request is pending;

(b) provisions for refunds in the event an exemption is granted after a fee payment has already been made;

(c) provisions for a refund system for credits pursuant to section 7 of this chapter; and

(d) provisions for an appeals process for applicants seeking to challenge an exemption or credit decision by the department of revenue or the board. The superior court shall have jurisdiction to hear appeals in such cases.

(3) Nothing in subsection 2 of this section shall limit the board of the department of revenue to promulgate other procedures consistent with this chapter.

(4) All persons or entities seeking an exemption under subsection 1 of this section must apply directly to the department of revenue in writing in accordance with the department of revenue procedures promulgated pursuant to this section.

SECTION 7. (1) Pursuant to the criteria and procedures established by the board under subsection 3 of section 10 of this chapter, containers meeting the standard for recycled materials content shall receive a credit of two cents per container.

(2) Pursuant to the criteria and procedures established by the board under subsection 4 of section 10 of this chapter, containers deemed recyclable shall receive a credit of one cent per container.

(3) Containers eligible to receive both credits pursuant to subsections 1 and 2 of this section shall receive a full exemption from the fee.

(4) The board shall approve credit requests meeting the requirements of this section and section 10 of this chapter. The board shall transmit all approved credit requests to the department of revenue. Upon receiving such transmittals, the department of revenue shall authorize appropriate exemptions and refunds under the procedures established pursuant to subsection 2 of section 6 of this chapter.

SECTION 8. (1) The commissioner of revenue shall administer the packaging disposal fee account, a dedicated and nonlapsing revolving fund established in the general fund of the state treasury.

(2) The account shall receive and be credited all fees collected by the department of revenue under section 5 of this chapter. The

department of revenue shall also credit to the account all interest received on fees collected pursuant to this chapter.

(3) The department of revenue shall adopt all rules necessary to implement the fee system established pursuant to section 5 and section 6 of this chapter.

(4) The board shall use and allocate funds from the account to administer the program in accordance with section 9 and section 12 of this chapter.

SECTION 9. (1) The department shall create the waste reduction packaging board within the division of solid waste. The board shall administer the program pursuant to the provisions of this chapter. The secretary of the executive office of environmental affairs shall appoint the director of the board.

(2) The board shall serve three primary functions under the program:

(a) to review and dispose of credit requests in accordance with section 7 and section 10 of this chapter;

(b) to establish and administer the recycling logo in accordance with section 11 of this chapter; and

(c) to allocate monies from the account in accordance with section 8 and section 12 of this chapter.

(3) The board shall consist of two branches: the packaging review branch and the recycling allocations branch.

(a) The packaging review branch shall undertake all packaging review responsibilities and recycling logo responsibilities pursuant to sections 7, 10, and 11 of this chapter.

(b) The recycling allocations branch shall undertake all allocation responsibilities pursuant to sections 8 and 12 of this chapter. The director shall create two special advisory positions in the recycling allocations branch. The director shall appoint such advisors, one each from the staffs of the massachusetts industrial finance agency and the massachusetts technical development corporation.

(c) The director shall establish appropriate staffing requirements for each branch within the board. The chairman shall promulgate all rules and regulations and take whatever actions are necessary for the setup and organization of the board.

SECTION 10. (1) Purpose. Approval of credit requests based on the use of recycled materials and the recyclability of containers encourages the use of:

(a) reusable packaging;

(b) recyclable packaging; and

(c) packaging manufactured with a high percentage of recycled materials.

(2) The board shall consider credit requests for offsets against the fee upon the application of a manufacturer, seller, or supplier of a container. In assessing such a request, the board may require the applicant to provide such information as it may deem necessary to make its determination. Upon petition of the applicant, the board shall hold any information on trade secrets submitted by the applicant as confidential and proprietary. "Trade secret" shall mean any formula, pattern, device, or compilation of information used in a manufacturer's, seller's or supplier's business, and which gives said manufacturer, seller, or supplier an opportunity to obtain an advantage over competitors who do not know or use it. The board shall restrict the use of trade secret information to review of the credit request submitted by the applicant. The board shall restrict disclosure of the trade secret information to board employees reviewing the credit request submitted by the applicant.

(3) Recycled material credit requests.

(a) For purposes of this chapter, "recycled material" means any material otherwise destined for the municipal solid waste stream which a recycling services company collects, separates, or processes and returns to economic markets in the form of raw materials, feedstocks or end products. This term includes, but is not limited to: postconsumer material, industrial scrap material, and overstock or obsolete inventories from distributors, suppliers, wholesalers, and other persons or entities. This term shall not include material and by-products generated from and commonly reused within an original manufacturing process. Constituents of recycled materials include aluminum, cloth, fiber, glass, metal, paper or paperboard, plastic, wood, or any combination thereof.

(b) The board shall approve recycled material credit requests pursuant to subsection 1 of section 7 of this chapter upon a showing that the recycled material content equals:

— 50% for containers predominantly made of glass;
— 80% for containers predominantly made of paper;
— 40% for containers predominantly made of plastic;
— 50% for containers predominantly made of aluminum or metal; and
— 30% for all other types of containers.

(c) Twelve months after the effective date of this chapter, and once every year thereafter, the board shall undertake an evaluation of the recycled material content percentages enumerated in paragraph (b) of this subsection. The board shall assess changes in recycling technologies and reclaimed materials markets, and shall determine whether in light of such changes the recycled material content percentages require adjustment either up or down. The board shall make such adjustments consistent with the intent and purposes of this chapter.

(4) Recyclability credit requests. The board shall approve recyclability credit requests pursuant to subsection 2 of section 7 of this chapter upon a showing that the container is recyclable. The board shall assess the following factors in considering the request:

(a) the ability to prepare and process the container for recycling when such container consists of more than one material;

(b) the ability to separate the container from the municipal solid waste stream to facilitate the preparation and processing of the container for recycling. Whether performed by persons or mechanically, the ability to separate shall include, but is not limited to: A) identifying or distinguishing the container from other containers which may be similar in appearance but dissimilar in material type and variety; and B) preparing or processing the container for recycling if mixed with containers similar in appearance but dissimilar in material type or variety;

(c) the economic feasibility to reclaim, recycle or reuse the container. Economic feasibility shall include, but is not limited to: A) the ability of the recycling industry to absorb the container into the recycled materials market; B) the cost of processing the container into a shape, form, or matter suitable for reuse or use as a manufacturing raw material; or C) the ability or willingness of manufacturers to utilize the container in the manufacturing

process once it is processed into a recycled material suitable as a substitute for virgin raw materials;

(d) the homogeneity of the material comprising the container;

(e) the technological ability to recycle or reuse the container in an economically feasible manner and at production-level capacity;

(f) interference with the commonwealth's goal of reducing the volume of solid waste requiring disposal, such that the container constitutes excessive packaging. "Excessive packaging" shall mean containers or other types of packaging that: A) exceed the functional requirements of containing and protecting a product, and retaining the flavor, odor, freshness, hygienic integrity, shape, form and structural integrity of a product; and B) are manufactured with materials difficult to dispose of and for which satisfactory alternatives exist. Excessive packaging shall also mean the packaging of a product with an excessive number of containers. Where a container qualifies as excessive packaging, the board shall consider this factor as militating against approval of the credit request;

(g) the recycling rate in the commonwealth of the predominant material type used in the manufacture of the container. Where the recycling rate exceeds 50%, the board shall give added weight to this factor as militating in favor of approving the credit request;

(h) other factors deemed suitable by the board and consistent with the purposes of this chapter.

SECTION 11. (1) The board shall develop and adopt official recycling logos for the commonwealth. The recycled material logo shall indicate that a container meets the recycled material criteria of subsection 3 of section 10 of this chapter. The recyclability logo shall indicate that a container meets the recyclability criteria of subsection 4 of section 10 of this chapter.

(2) Containers receiving approval for a credit request under subsection 1 or subsection 3 of section 7 of this chapter may display the official recycled material logo. Containers receiving approval for a credit request under subsection 2 or subsection 3 of section 7 of this chapter may display the official recyclability logo. Containers receiving approval for both credit requests under subsections 1 and 2 of section 7 of this chapter may display the official recycled material and recyclability logos.

(3) The board shall specify the materials used in all logos adopted under this section to ensure consistency and compatibility with the recycled material content and recyclability criteria under section 10 of this chapter.

SECTION 12. Pursuant to section 8 and section 9 of this chapter, the board shall allocate funds from the account for the following purposes:

(1) administrative costs incurred by the board and the department of revenue in implementing the program, including, but not limited to, the hiring of additional personnel beyond the division's current staffing level. This amount shall not exceed 10% of the revenues deposited in the account during each fiscal year;

(2) costs incurred by the department for development and operation of recycling programs, including, but not limited to: regional recycling programs; composting programs; mixed plastics recycling programs; and tire recycling programs. This amount shall not exceed 15% of the total revenues deposited in the account each fiscal year;

(3) public education programs initiated by the department to promote the use and recognition of the state recycling logos and the economic and social benefits of recycling generally. This amount shall not exceed 15% of the total revenues deposited in the account each fiscal year;

(4) research grants to public institutions of higher education, including, but not limited to, the University of Lowell and the University of Massachusetts at Amherst. Such research shall include: a) technological, environmental, and economic feasibility studies in mixed plastic recycling and source separated plastic recycling; b) technological, environmental, and economic feasibility studies in the reduction of excess packaging; and c) technological, environmental, and economic feasibility studies in photodegradation and biodegradation of plastic packaging. The board may establish such grants through the commonwealth's centers for excellence program or directly with the educational institutions and their departments. The amount allocated under this section shall not exceed 25% of the total revenues deposited in the account for each fiscal year;

(5) community grants to establish local public education programs concerning, but not limited to, recycling, source separation, identification of products packaged in an excessive manner, and identification of packaging manufactured with substances damaging to the environment. This amount shall not exceed 15% of the total revenues deposited in the account for each fiscal year;

(6) community grants to facilitate the restoration and subsidization of abandoned industrial facilities for use by new and existing businesses in the recycling services industry. This amount shall not exceed 30% of the total revenues deposited in the account for each fiscal year; and

(7) competitive business loans allocated through the massachusetts industrial finance agency for research, development, and implementation of recycling technologies and markets, including, but not limited to: a) retooling by container and packaging manufacturers seeking to utilize reclaimed materials, produce recyclable products, or both; b) retooling by nonpackaging manufacturers seeking to utilize reclaimed materials in end products, produce recyclable end products, or both; materials research and recycling feasibility studies on containers not presently recyclable nor manufactured with reclaimed materials, or both; d) assisting companies in moving from pilot-scale to commercial scale operations which result in recycling, reuse, or reduction of materials; and e) attracting and retaining companies in the commonwealth that currently manufacture end products with reclaimed materials, or manufacture recyclable end products, or both. This amount shall not exceed 25% of the total revenues deposited in the account for each fiscal year.

SECTION 13. (1) Nonpayment. Failure by a feepayer to make a quarterly payment or to submit a quarterly report in accordance with subsection 5 of section 5 of this chapter shall constitute a violation of this chapter. If a feepayer commits such a violation, a delinquency penalty of 25% shall be added to the amount owed by the feepayer. A feepayer delinquent on a quarterly payment for more than three months shall incur an additional delinquency penalty of 15%. A feepayer delinquent on a quarterly payment for more than six months shall be punished

by a fine of not less than one thousand nor more than twenty thousand dollars, or by imprisonment for not more than two years, or both.

(2)Falsified Reports. Any falsifying by a feepayer of a quarterly report as required by subsection 5 of section 5 of this chapter with the intention of evading payment of the fee shall constitute a violation of this chapter. Any person guilty of a violation under this subsection shall be punished by a fine of not less than one hundred nor more than ten thousand dollars, or by imprisonment for not more than one year, or both.

(3) Every person who fails to pay any fee payment or delinquency payment required by this chapter shall be personally and individually liable to the commonwealth. "Person" includes an officer or employee of a corporation, or a member or employee of a partnership, who as such officer, employee, or member is under a duty to pay fee payments or delinquency payments imposed by this chapter.

(4) Unauthorized display of the state recycling logo shall constitute a violation of this chapter. Any person who willfully displays an official logo on a container in contravention with section 11 of this chapter shall be punished by a fine of not more than one hundred dollars for each offense, or by imprisonment for not more than sixty days, or both.

(5) The department of revenue and the board shall promulgate all rules necessary to implement and enforce the provisions of this section.

SECTION 14. The board shall prepare an annual report for the legislature detailing the allocation of all funds and the overall progress of each program funded under this chapter. The board may require any organization, company, institution, community, municipality or other person or entity receiving funds under this chapter to prepare progress reports describing the nature and progress of programs and projects funded under this chapter.

SECTION 15. If any provision or clause of this chapter or application thereof to any person or circumstances is held invalid, such invalidity shall not affect other provisions or applications