LAND DISPOSAL ABATEMENT:

OPTIONS FOR SOLID WASTE REDUCTION AND RECOVERY

JANUARY 1981

Metropolitan Council of the Twin Cities Area

300 Metro Square Building, 7th Street and Robert Street, Saint Paul, Minnesota 55101 Area 612, 291-6359

February 1981

TO: Metropolitan Area Citizens and Local Officials

The enclosed report, entitled Land Disposal Abatement: Options for Solid Waste Reduction and Recovery, is being sent to you to encourage your cooperation with Metropolitan Area counties in developing alternative programs to disposing of mixed municipal solid waste in sanitary landfills. Such land disposal abatement alternatives include waste reduction at the source of waste generation, recycling of waste materials, high-technology energy and biological recovery, and the shredding and baling of wastes to reduce the space they take up in landfills.

The report is intended to provide a planning framework and guide that local governmental units can use in developing waste abatement proposals. It contains objectives and recommendations for both government and private industry, discusses potential methods of financing abatement programs, estimates potential program costs and describes possible economic incentives to encourage the participation of private industry in abatement programs. The report also contains information on the time needed to implement different kinds of abatement programs.

Between now and April 1, 1982, each Metropolitan Area county will be developing specific waste abatement proposals. You and your staff are encouraged to work with your county in that effort. In addition to county solid waste planning staff, the Metropolitan Council and the Minnesota Pollution Control Agency (MPCA) have specialists who can provide technical assistance if necessary. Attached for your information is a list of solid waste planning staff from various agencies.

I would like to call your attention to the MPCA's demonstration program in waste reduction and source separation being carried out under the 1980 State Waste Management Act. Some funds are available for innovative projects initiated by a local governmental unit that could be applied to other parts of the

state. Such projects include programs demonstrating the feasibility of a particular abatement program, education and public information projects, and waste reduction and recycling programs. Please call Don Kyser at the MPCA if you have questions about this demonstration program. The telephone number is 297-2727.

If you would like additional copies of the enclosed report or have any questions, please call the Council's solid waste program staff at 291-6546 or 291-6408.

Sincerely,

Charles R Weaver

Charles Weaver
Chairman

/bg
Enclosure

SOLID WASTE PLANNING STAFF
OF COUNTY, REGIONAL AND STATE AGENCIES IN
THE TWIN CITIES METROPOLITAN AREA

METROPOLITAN COUNTIES

Anoka
Robert Hutchison
Anoka County Health Department
4th Floor
Anoka County Courthouse
Anoka, Minn. 55303
421-4760

Carver
Virginia Harris
Carver County
Carver County Courthouse
Chaska, Minn. 55318
448-3435

Dakota
David Gurney
Dakota County
1560 Highway 55
Hastings, Minn. 55033
437-0398

Hennepin
Luther Nelson
Hennepin County
Department of Environment and Energy
320 Washington Av. S.
Hopkins, Minn. 55344
935-3381

Ramsey
Doug Wood
Ramsey County Environmental Health
934 Woodhill Dr.
Room 118
Roseville, Minn. 55113
298-5972

Scott
Allen Frechette
Scott County
Scott County Courthouse
Shakopee, Minn. 55379
445-7750

Washington
Paul Brandt
Washington County Highway Department
11660 Myeran Rd. N.
Stillwater, Minn. 55082
439-6058

METROPOLITAN COUNCIL

300 Metro Square Building
St. Paul, Minn. 55101

Solid Waste Program Staff:

Ray Thron	291-6409
Paul Smith	291-6408
Daniel Krivit	291-6546
Carl Michaud	291-6579

MINNESOTA POLLUTION CONTROL AGENCY
Solid Waste Division
1935 W. County Road B-2
Roseville, Minn. 55113

Resource Recovery Planning Staff:

Curtis Sparks	297-2724
Don Kyser	297-2727
Sam Hasson	297-2725
Kirk Rosenberg	297-2730
Mark Huddleston	297-2728

MINNESOTA DEPARTMENT OF ADMINISTRATION

Resource Recovery Program:

Norma Cameron
Resource Recovery Office
Minnesota Department of Administration
671 N. Robert St.
St. Paul, Minn. 55101
296-2397

LEGISLATIVE COMMISSION ON WASTE MANAGEMENT

Michael Robertson
Legislative Commission on Waste Management
46-B State Capitol
St. Paul, Minn. 55155
296-2406

MINNESOTA WASTE MANAGEMENT BOARD

Robert Pulford
Minnesota Waste Management Board
123 Thorson Building
7323 85th Av. W.
Crystal, Minn. 55428
536-0816

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JANUARY 1981

Adopted by
Metropolitan Council
December 18, 1980

Metropolitan Council
300 Metro Square Building
7th and Robert Streets
St. Paul, Minnesota 55101

Publication No. 12-80-081

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1. SUMMARY

This report contains goals, guidelines and recommendations that the seven Metropolitan Area counties may use in developing alternatives to sanitary landfills as the Region's near-exclusive means of disposing of its solid waste.

The objective is to reduce, or abate, the amount of solid waste that would have to be landfilled in future years. Difficulties in siting new landfills, risks of groundwater pollution and growing demand for natural resources in relation to supply have all raised serious questions about the Region's continued reliance on landfills for dealing with solid wastes.

The Minnesota Legislature recognized these problems when it passed the 1980 State Waste Management Act. The act requires that the Metropolitan Council prepare a land disposal abatement report to provide a framework and guide for county planning of abatement programs.

Abatement programs can be categorized according to four basic methods:

- Waste reduction--reducing the amount of waste material that is thrown away at the source of waste generation.

- Waste separation--sorting waste to recover recyclable materials, such as metals, glass and paper.

- Waste processing--shredding and baling of wastes, thereby reducing the volume of solid waste and the amount of space it would occupy in landfills.

- Resource recovery--for example, burning waste to recover heat and composting organic materials.

The Metropolitan Area is expected to produce 2.5 million tons of solid waste in 1981, and about 3.1 million tons annually by the year 2000, not including the amount of waste that is currently being recycled. To accommodate these wastes, the Region could need as much as four times the landfill capacity it has now by the year 2000, unless abatement programs reduce the amount of waste requiring landfilling.

Even if five of the Region's 11 landfills are allowed to expand as proposed by the year 2000, the Region could need four times the landfill capacity it has now. If waste generation trends continue, the Region will run out of capacity at its existing landfills between 1985 and 1987, even if the proposed landfill expansions are approved.

Although abatement programs, such as recycling and resource recovery, will never completely eliminate the need for landfills, the Region could substantially abate the amount of waste that has to be landfilled in the future. According to Council estimates, an additional 12 to 15 percent of the net waste stream in the Metropolitan Area could be recycled by the year 2000. This is in addition to the estimated 14 percent of the gross discards currently being recycled. Most of these recyclable wastes would consist of paper (including corrugated cardboard) and residential yard waste (leaves and grass clippings) that could be composted on a small scale. The remainder of these recyclable items are expected to be glass, ferrous materials and nonferrous metals, like aluminum.

About 56 to 75 percent of the year-2000 total could be handled by high-technology resource recovery systems, like furnaces that incinerate wastes to produce heat energy. The remaining wastes--10 to 32 percent--would have to be put in landfills.

As the numbers show, the lion's share of future wastes is expected to be handled by high-technology resource recovery systems, such as trash-burning furnaces and biological recovery plants.

Typically, such systems use large-scale, expensive equipment; they need a large, reliable supply of trash, entail substantial financial risks, and require long planning lead times.

Waste separation, on the other hand, involves fewer financial risks and less costly equipment. Consequently, the Metropolitan Area can expect to see community-wide recycling programs sooner than the more elaborate, costly resource recovery systems.

The report recommends several steps to foster recycling, including:

- Formation of an intergovernmental committee to promote use of existing and new collection centers for recyclable materials, in cooperation with private industry.

- Management and training programs dealing with operation of collection centers.

- In-office paper conservation and recycling programs.

- Increasing the percentage of recycled and recyclable materials used by government and private industry.

- Separation and salvaging of materials at transfer stations and landfills, when possible.

- Model source separation ordinances for use by cities and counties.

- Local planning for curb-side pickup of recyclable materials.

Several other recycling possibilities need to be investigated further. These include:

- Satellite collection centers that would make it more convenient for people to drop off their glass, paper and scrap metal.

- Recycling cooperatives that would enable small collection centers to market recyclable materials together, thereby gaining economies of scale.

- Mechanical separation of recyclable materials at landfills and transfer stations.

- Methods to expand current markets and create new ones for recyclable materials.

- Methods to increase the amount of residential yard waste that is composted.

- School district recycling programs as a possible revenue source for district operations.

Though not as important now, resource recovery is expected to grow in importance in future years. The report recommends that the Metropolitan Area counties, and others, continue planning for recovery systems, but that they also develop other abatement programs in the meantime. Such an approach would provide a more comprehensive, flexible system, without an over-reliance on high-technology systems.

Small modular combustion units could prove feasible for small, rural towns to operate as resource recovery facilities. The report recommends that the counties study the feasibility of such systems. They should also encourage backyard and centralized composting to deal with residential yard wastes--leaves, small tree branches and grass clippings.

The report recommends that the Council establish a task force to examine the feasibility of a region-wide, organized system for collecting trash. Such a system could eliminate the duplication of hauler routes in communities served by several trash haulers. It could also enable haulers to collect recyclable materials in a cost-efficient way, and help communities better manage the handling of solid waste, especially for recycling.

Also recommended in the report as possible actions:

- Public education programs to promote waste reduction.
- Consideration by counties of ways to finance abatement programs.
- Study of high-technology composting, methane recovery and alcohol production systems.
- Feasibility study of shredding and baling wastes at landfills and transfer stations.
- Study of product surcharges as a way to reduce wastes.
- Further study of the amount and composition of future solid waste.

2. INTRODUCTION

PURPOSE

This document, Land Disposal Abatement: Options for Solid Waste Reduction and Recovery, was adopted by the Council on Dec. 18, 1980. It will serve as a guide to local governmental units in developing alternatives to landfills for disposing of solid waste. The Minnesota Waste Management Act, passed by the State Legislature in April 1980, requires the Council to prepare a report by Jan. 1, 1981, that identifies ways of dealing with solid waste other than by use of sanitary landfills. The basic methods include waste reduction (at the source of generation), waste separation (to recover recyclables), waste processing (to reduce the amount of space wastes would occupy in landfills) and resource recovery (to recover energy or useful organic material).

The land disposal abatement report is a planning tool or guide for counties, cities and townships in the Metropolitan Area that are considering specific solid waste abatement programs. Under the Waste Management Act of 1980, the report is to be used by the seven metropolitan counties in developing land disposal abatement proposals. The Council, in turn, reviews the proposals and amends its regional solid waste policy plan to include specific and quantifiable objectives for land disposal abatement. The counties must implement the Council's abatement plan, in part, through amendment of their solid waste master plans.

Concurrent with this process of land disposal abatement is a process, also required by the Waste Management Act of 1980, for the planning, siting and operation of waste facilities to process and dispose of mixed municipal waste (refuse), hazardous waste and sewage sludge residuals. Such facilities include landfills. To accomplish these tasks, the Legislature has assigned specific responsibilities to various state, regional and county levels of government. In this regard, the land disposal abatement report can serve as a basis for discussing solid waste disposal alternatives during the county landfill siting process--especially the relationship of future landfill needs to solid waste abatement programs.

This land disposal abatement report contains descriptions of alternative strategies and their potential for reducing the need for new landfills. It also contains proposed specific objectives and degrees of abatement that could possibly be achieved in the Region through implementation of these alternative strategies. This report also contains

recommendations on how the Region can best accomplish the specified abatement objectives and a recommended schedule for implementing abatement programs. These recommendations and development schedules are merely guides to be used as a basis for county proposals and specific projects. The Waste Management Act of 1980 requires the Council to adopt specific land disposal abatement policies and standards by 1983 after considering the counties' proposals. Therefore, the statements in this report are not adopted Council policies, but rather recommendations for county proposals as the first planning step toward a regional abatement plan.

RELATIONSHIP TO METROPOLITAN COUNCIL'S SOLID WASTE POLICY PLAN

Land disposal abatement is part of the Council's comprehensive approach to solid waste management planning in the Region, as described in its solid waste policy plan. The policy plan, adopted in February 1979, establishes an order of preference for solid waste management practices that will achieve environmentally safe disposal, conserve energy and material resources, and minimize total costs. Policy 1 in the plan states:

> "The Metropolitan Council shall consider waste reduction practices as having the greatest benefit to improved solid waste management, followed, in order of preference, by source separation, waste processing and utilization, and land disposal."

It is inevitable that new landfills will have to be sited and constructed in the Region to dispose safely of the wastes generated. However, the Council's policy plan and the 1980 Waste Management Act state that landfilling should be considered only after it has been determined that other solid waste management practices are not feasible.

PROCESS FOR LAND DISPOSAL ABATEMENT PLANNING

The State Waste Management Act of 1980 establishes a schedule for land disposal abatement planning in the Metropolitan Area (see Appendix for statutory citations). A summary of the schedule follows.

Completion Date		Planning Step
Jan. 1, 1981	1.	Metropolitan Council identifies the various potentials of alternatives to reduce the need for new landfills.

April 1, 1982	2.	Each county prepares a proposal on its specific disposal alternative plans.
Jan. 1, 1983	3.	Metropolitan Council amends solid waste policy plan to include specific objectives for abating land disposal of solid waste based on standards for county waste reduction, source separation and resource recovery programs and activities. Amendment will also include a reduced estimate of the added landfill capacity needs based on the abatement objectives.
June 1, 1983	4.	Counties revise master plans to include a land disposal abatement element to implement the Council's land disposal abatement plan.

The steps outlined apply to the abatement planning process. The Waste Management Act also specifies a landfill siting process that will take place (see Appendix for statutory citations). The landfill siting process began when the Council adopted a report in July 1980 that identifies the additional landfill space required by the Region through the year 2000, assuming no land disposal abatement programs to reduce solid waste that would otherwise be landfilled.

Under the landfill siting process, the counties are required to adopt an inventory by June 1, 1981, of four proposed sites in each county for sanitary landfills and one proposed site for demolition debris. By Oct. 1, 1981, the Council is required to adopt a disposal site inventory based on the county-proposed sites. By Jan. 1, 1982, the Council will submit a report to the Legislative Commission on Waste Management on methods of mitigating and compensating for the local adverse effects of solid waste disposal facilities. By Jan. 1, 1983, the Council will determine the number of sites to be acquired within each metropolitan county for solid waste disposal. By June 1, 1983, each county-established site selection authority will select specific sites within the county based on the number required by the Council.

3. STRATEGY DESCRIPTIONS AND PRELIMINARY EVALUATION

This section describes all reasonable disposal abatement strategies and contains basic conclusions concerning the technical feasibility and potential degree of abatement for each. Later sections discuss economic constraints and propose recommendations for action and development schedules for implementing feasible strategies. Because this report is to be submitted to the metropolitan counties for purposes of developing their land disposal abatement proposals, it emphasizes strategies that the counties, cities and townships (in close cooperation with the private sector) might reasonably implement. Strategies that are most appropriate for state and federal authorities are also described and evaluated, and recommendations are made for regional, state and federal actions. In addition, recommendations for county support of these legislative actions are developed in Section 6.

Each strategy was evaluated according to the following criteria:

1. Degree to which the strategy can practically be implemented; that is, ease of strategy development and administration.

2. Waste stream impact. Estimates of both predicted and maximum potential levels of land disposal abatement.

3. Appropriate implementing body. Neighborhood, municipal, county, regional, state or federal government; or private industry.

4. Costs and revenues of strategy, including viability of markets for any products or secondary materials produced.

5. Schedule of implementation. Earliest year of start-up and time required to reach predicted potential.

6. Impact of strategy on solid waste industry.

7. Secondary community and environmental benefits, including increased employment and pollution abatement.

8. Appropriate population density; that is, urban, suburban or rural.

WASTE REDUCTION

Waste reduction (or source reduction) involves controlling the quantity of waste produced by changing product designs, consumer behavior or both. The policies adopted by the U.S. Environmental Protection Agency (EPA), the Minnesota Pollution Control Agency (MPCA) and the Metropolitan Council place the highest priority on waste reduction methods of solid waste management.

Reducing the amount of waste could reduce:

- Product production costs.
- Public expenditures for waste management.
- The rate of resource consumption.
- Potential adverse environmental impacts.

Waste reduction works as a solid waste management tool by preventing waste where possible. Waste reduction is accomplished through redesign of final products and packaging, increased product lifetime and reduced consumption levels. Although waste reduction will reduce the volume of solid waste by, at most, a few percentage points, waste reduction has been given a favored status in solid waste management policies because the total savings from disposal costs, reduced energy use and reduced materials use are greater than those achieved through after-the-fact recycling and energy recovery programs.

There are several approaches that can be used to reduce waste generation at its source:

1. Container deposits.
2. Packaging reduction.
3. Office paper reduction.
4. Product charges.
5. Waste charges.
6. Bans.
7. Extended warranties.
8. Newsprint conservation.

9. Mulching of grass clippings.

10. Public education and awareness.

CONTAINER DEPOSITS

A deposit is an extra charge to the consumer to encourage reuse of a product. The deposit is refunded when the reusable portion of the product is returned. Although the deposit may be mandatory, the consumer may elect to forfeit the deposit and not return the reusable product. Deposit measures are limited to products that have a readily reusable component, such as beverage containers, tires or automobile hulks.

Deposits provide an economic incentive to return a product to a central collection point so it can be used again with minimal recovery costs. Another benefit is that a portion of the deposit may be used to defray the cost of recovering and properly disposing of products that are not returned.

Mandatory deposit measures have been enacted by Connecticut, Oregon, Vermont, Michigan, Delaware, Iowa and Maine, and have proven to be effective as a method of waste reduction. Similar action by the Minnesota Legislature would be required to implement mandatory deposit programs in Minnesota.

National estimates indicate that container deposit legislation can reduce the solid waste stream by an average of two to four percent. Michigan has experienced one of the highest reductions in its waste stream--six percent--due to recent deposit legislation.

Additional benefits of container deposits include reduction of roadside litter, energy savings for container production, reduction of virgin material consumption, and an increase in recycling and redistribution of containers. Disadvantages of container deposit legislation include higher consumer costs when the container is not returned, potentially higher costs due to added handling, added handling and storage requirements for the retailer, reduced consumer convenience, and reduced material available for other recycling systems.

PACKAGING REDUCTION

Three basic approaches to packaging reduction exist: the regulatory approach, standardized packaging laws and the industrial education aproach. The regulatory approach allows the state to review and suspend the use of packaging

that constitutes a serious solid waste or environmental problem. Minn. Stat., Ch. 116.06 and Minn. Rules SR-1 through SR-6 represent one form of the regulatory approach.

The second approach--standardized packaging laws--would require certain products to be sold in packages meeting requirements for standard size, weight, durability and reusability. For example, based on national data for both the United States and Canada, generation rates (measured as packaging weight per capita) experienced in 1958 could be achieved today using alternative manufacturing technologies to produce lighter packages and through elimination of "over-packaging" (Love, 1974). These accomplishments could potentially reduce the solid waste stream by five percent. Lighter packages can be produced simply by using thinner packaging materials where customer specifications allow. However, Minnesota's current packaging law will not be able to reduce waste to a comparable degree since the majority of wasteful packaging is outside the scope of the law.

The third approach--industrial education--seeks to provide industry with information and assistance in researching and developing packaging methods that reduce solid waste. It is difficult to know how effective industrial education would be in reducing solid waste since information is not available on such a program in the United States.

OFFICE PAPER REDUCTION

Office paper reduction, establishing policies that shrink office paper consumption, can be implemented by the public and private sectors to reduce solid waste. These policies could include increased use of microfiche and magnetic media (computer discs and tapes), and reducing use of carbon paper, computer printout paper, letter paper, machine copy and business forms.

It is estimated by the MPCA that office paper reduction could reduce paper consumption by 4.5 percent annually (MPCA, 1979). But, since only 52 to 53 percent of all consumer office paper is discarded, the potential reduction of solid waste amounts to only 0.7 percent of the solid waste stream.

PRODUCT CHARGE

Today's prices for products generally do not reflect the costs imposed on society for disposal of solid waste. The goal of product charges is to incorporate those costs into the cost of the product. The charge could take three forms: a unit charge, a weight charge or a combination of both. The unit charge has the least administrative burden,

while the combination would have the greatest reduction impact. Product charges have appeal in that they use the market to encourage solid waste reduction, and provide funds to defray the solid waste management costs imposed by products.

Three studies commissioned by the U.S. EPA indicate that general conservation through the use of product charges could reduce waste by two to three percent (Bingham, 1974; Miedema, 1976; Miedema, in preparation). For purposes of this report, a maximum waste reduction potential of 2.6 percent was assumed.

Product charges could potentially solve financial problems encountered by local government for solid waste collection and disposal and at the same time provide a revenue source for other recovery programs. However, it is doubtful whether a product charge could be applied on a state level because of potential conflict with interstate commerce. Federal legislation would provide for more efficient and consistent implementation of product charges.

WASTE CHARGE

A waste charge is a fee levied on each ton or cubic yard of waste being disposed. The fee would be collected at landfills or processing facilities as a part of the disposal fee. Although there is little literature available about the impacts of waste charges, such a charge would probably be less effective than a national product charge in curbing waste. It is estimated that a waste charge would reduce waste by less than two percent. Hence, a waste charge may be more effective as a funding mechanism than as a waste reduction technique.

BANS

Bans can be used to eliminate solid waste that creates waste management problems. Such product controls can generally be applied only if alternative products and materials exist. For example, the Minnesota Legislature has banned nonreturnable plastic milk containers because they were deemed to pose a major waste problem. Bans on certain kinds of tires and packaging may lead to a reduction in solid waste generation.

EXTENDED WARRANTIES

Warranties on durable goods could be extended for a specified length of time to reduce the flow into the solid waste stream. The EPA has determined that if all autos and trucks were sold with radial-ply tires, the solid waste

stream would be reduced by 0.7 percent (EPA, 1975). Minnesota could facilitate this waste reduction technique by requiring a 40,000 mile warranty on new tires sold in Minnesota and providing incentives (for example, deposits) for tire recapping. Since little literature is available, it is difficult to judge the waste impact of other warranty programs.

NEWSPRINT CONSERVATION

Newsprint conservation is accomplished through thinner paper and changes in printing format. The American Paper Institute has reported that newsprint weighing five percent less than common newsprint has performed satisfactorily (EPA, 1977). Also, changing the standard six-column printing format to eight columns for news and nine columns for advertising could reduce current usage by five percent (EPA, 1975).

Based on MPCA estimates, if both forms of newsprint conservation were used in Minnesota, about 20,000 tons of waste could be prevented annually. This represents about 0.7 percent of the municipal solid waste stream (MPCA, 1979).

MULCHING OF GRASS CLIPPINGS

Mulching involves mowing or trimming of lawns in such a way that the grass clippings are reduced to a fine mulch and left on the lawn. No raking or gathering is required, and thus no clippings are added to the solid waste stream. Advantages are a decreased waste volume and an increase of nutrient flow back to the mowed lawn. Disadvantages include increased risk of lawn diseases, weed problems, the increased possibility of insect pests and increased layer of thatch.

Based on U.S. EPA estimates (1975) yard waste makes up 17.4 percent of the total solid waste stream. From this it is estimated that grass clippings represent about three to five percent of the total.

PUBLIC EDUCATION AND AWARENESS

Voluntary waste reduction has had moderate success in the past. Consumer preferences for purchasing products in bulk, for more durable products and for smaller and more efficient automobiles are indicators of voluntary waste reduction. However, more comprehensive and systematic attempts to reduce solid waste generation are needed.

The primary means of encouraging voluntary waste reduction is through increased consumer education and advertising. A program to reduce litter through education has had moderate success in Washington state. A large well-run advertising and education campaign is, perhaps, the only way of stimulating personal initiative, which is the heart of such a program.

One educational tool is requiring that designated products have information about the cost of the package and the composition of the product, in particular, whether it contains recycled or recyclable materials. Such aids to consumers in the marketplace may greatly enhance any educational efforts.

Since very little literature is available on the reduction impacts of public education programs, an adequate method of estimating potential reductions is not available. Education programs, however, may provide the most effective means of waste reduction because of political and economic problems with regulatory approaches.

CONCLUSIONS

Container deposits, packaging reduction, public education and office paper reduction seem to offer the greatest potential in Minnesota at this time. Container deposits and packaging reduction offer the largest potential reductions of waste. Public education has great potential because it may provide a politically acceptable and cost-effective alternative to regulatory approaches to waste reduction. Finally, office paper reduction has significant potential economic savings to state taxpayers.

From an implementation standpoint, voluntary waste reduction seems promising. While the percentages for reduction are considerably lower than those for mandatory programs, they show the most potential for immediate action by metropolitan counties and municipalities. In addition, all of the voluntary measures may prove to be most cost-effective and politically acceptable in the short run.

In the long run, and after further analysis of the potential effects, mandatory waste reduction measures may be enacted on the legislative level.

Mulching of grass clippings, while not costly to implement, may require coordination through public education strategies. Newsprint conservation does not represent a very large percent of the solid waste stream, but nevertheless is worthy of consideration.

Counties should be encouraged to evaluate waste reduction strategies during the development of their land disposal abatement proposals. Inasmuch as broad-scale government intervention may have a significant impact on the market, legislative action on waste reduction should be initiated only after potential effects have been thoroughly analyzed. The Council should expand its evaluation of specific waste reduction strategies to prepare for the solid waste policy plan amendments on land disposal abatement required by 1983.

WASTE SEPARATION

Waste separation includes methods and procedures for extracting useful materials from solid waste that can be returned to the economy. The prime objectives in the development of waste separation systems are: 1) to conserve natural resources and energy; 2) to reduce land requirements for disposal; and 3) to facilitate the preparation of refuse-derived fuels for energy recovery systems. There are four basic types of waste separation systems: collection centers, source separation, salvaging (a technique whereby an employee manually removes items from mixed waste) and mechanical separation.

Component separation is a necessary operation in the recovery of energy from solid wastes. The required separation may be accomplished manually or mechanically. When manual separation is used, preprocessing of the wastes is not required. In most mechanical techniques some form of size reduction, such as shredding, is required as a first step (see Section 3, "Waste Processing").

The basic methods for waste separation include use of collection centers, source separation, salvaging and mechanical separation.

COLLECTION CENTERS

Collection centers for recyclable materials are currently widespread throughout the Metropolitan Area. Collection centers are either operated as drop-off depositories, taking in one or more types of recyclable material, or as redemption centers where cash is paid for the more valuable materials such as aluminum or corrugated cardboard. Typically the neighborhood drop-off centers are organized and operated by nonprofit civic or church groups. Redemption centers are combined with existing metal salvaging facilities or actual secondary materials markets and are operated as profit-making businesses. Recently there has been an emergence of new aluminum redemption facilities in

the Region because of the increasing market price and intent of the beverage container industry to provide an alternative to potential mandatory deposit legislation.

There are currently 135 collection centers in the Region listed in the Council's May 1980 edition of the Recycle It! directory. Approximately 70 percent of these are operated by nonprofit organizations. There is no reliable data concerning the total quantity of materials processed by these facilities. However, it is reasonable to assume that the vast majority of materials recycled from municipal waste in the Region are handled by collection centers. The balance is accounted for by personal reuse, used furniture and clothes exchanges, and other similar recycling systems.

SOURCE SEPARATION

Source separation is defined as the separation of materials for individual storage at the source of generation for later pick-up and processing or reuse. Source separation is a very effective materials recovery system because of its inherent flexibility and cost-effectiveness. It differs from most other forms of solid waste processing in that it is decentralized and relies heavily on the continuous participation of the individual generator.

There are many types of source separation, including office paper recycling programs, mandatory or voluntary curb-side pickup of recyclables complementing mixed municipal refuse collection, leaf pickup and other commercial and industrial programs aimed at specific materials. There are currently several aggressive but relatively limited source separation programs in the Region. Several paper processing firms have ongoing office paper recycling campaigns aimed at capturing the higher-quality white office bond grade material. Four nonprofit collection centers also provide curb-side pickup service for recyclables on a voluntary basis. Two independent haulers have combined refuse removal service with a newspaper pickup service for their customers and one firm may expand pickup service to include other materials in the near future. One independent scrap processor/redemption center provides a curb-side pickup service for all recyclable materials in five neighborhoods in Minneapolis on a voluntary basis.

Curb-side pickup programs across the country have proven to be more effective in increasing participation than neighborhood recycling centers. This is supported by results from a region-wide survey conducted for the Council which indicated that more people would be willing to participate in a source separation program if they were provided with curb-side pickup service.

A residential curb-side, source separation program in Marblehead, Mass., is currently recovering about 20 percent of the solid waste stream. Another highly successful curb-side program is the Boca Raton, Fla., municipal newsprint recovery program, which recovers about 82 percent of all generated newsprint (MPCA, unpub. data). Both communities have adopted mandatory source separation ordinances, which require the residents to set aside their recyclables.

Mandatory source separation ordinances are difficult to enforce (very few programs propose significant enforcement actions), but receive significantly higher participation and recovery rates. Although the demographic and market conditions for these two programs differ from those of the Twin Cities Metropolitan Area, they serve as examples of the abatement potentials of well-run curb-side programs.

Source-separated organics can be collected from citizens who separate solid wastes and nonrecyclable paper from other components of solid waste. Source separated organics provide an excellent feed stock for composting since the material is relatively free of glass, metal and plastics that reduce the value of the final compost product. Approximately 8,000 people in Portland, Ore., currently participate in such a program. Residents place food waste and other organics in plastic pails with sealable tops. The pails are then taken to a site where the organics are composted. When the compost is ready, area citizens use the compost for gardening.

There are several examples of successful composting operations currently in progress within the Region. Hennepin County and St. Paul operate leaf composting sites as a free service to the public. Leaves are deposited in the fall and compost mulch is available for pickup in the spring. The City of Roseville provides free curb-side leaf pickup service for residents, using specialized vacuum trucks. Roseville's municipal composting site is also available for drop-off and pickup similar to the St. Paul and Hennepin operations. Statewide leaf recycling programs handle about nine percent of all yard waste generated (MPCA, 1979). The Metropolitan Waste Control Commission has also been windrowing (large-scale composting) filter cake sewage sludge from its Metro plant and reports excellent success and more-than-adequate market demand for the compost product. In general, composting has excellent potential as an alternative to landfilling organic wastes, depending on final product quality and market demand.

Yard waste, on the average, represents 17.4 percent of the total waste stream by volume, depending on the season. Some haulers contend that, in Minnesota, yard waste can increase the volume of waste during spring and fall by as much as 50 percent. Since curb-side leaf programs don't require citizens to bag or box yard waste, a high participation rate may be anticipated from a well-run program. Based on recovery rate results of other programs, it is reasonable to assume that a 30 percent recovery rate could be achieved for yard waste through a combined curb-side pickup and backyard composting campaign. Therefore, yard waste recycling has the potential to reduce the solid waste stream by four to five percent.

SALVAGING

Salvaging, or picking, is the process of removing valuable materials from the mixed waste stream for later sale or reuse. Salvaging is typically an unstructured materials recovery system that can occur at any point along the collection and disposal route. Frequency of salvaging activities and recovery rates directly correspond to the materials' market prices.

Salvaging is a common practice throughout the collection and disposal industry. However, organized programs are rare because of the cost of labor and the complex and fragmented structure of the Region's solid waste management system. Salvaging is often used in combination with mechanical separation technologies at the front end of refuse-to-energy facilities. Some transfer stations and landfills currently pick out materials on a more random basis. In California, large-scale salvaging crews are employed at sanitary landfills as mixed refuse is dumped. Valuable items are retrieved using a conveyor system before the refuse is buried.

MECHANICAL SEPARATION

Mechanical separation methods capable of segregating solid waste into valuable components have developed based on techniques used in mining and paper industries. Although still somewhat experimental, there are two basic approaches to mechanical material separation: wet processing and dry processing. Both approaches utilize a series process that begins with volume reduction using a shredder, then classifies the stream into light and heavy fractions, and final processing to recover marketable materials using magnetic separators and other equipment. Mechanical separation often precedes incineration within refuse-to-energy facilities. Ferrous-aluminum magnetic separators are currently being used throughout the Region at larger-scale recycling

centers and scrap metal processors, and at materials market facilities. In general, only ferrous and aluminum metal recovery is currently technically and economically feasible using mechanical separation technology.

CONCLUSIONS

Approximately two-thirds of all solid waste is capable of being recycled, including paper, glass, metals, plastics, rubber and textiles. However, only about one-third or 33 percent is realistically recoverable (MPCA, 1979). The entire recyclable component of the waste stream cannot be recovered because of the economics of sorting and removing contaminants from recyclable materials. It is estimated that the Region currently recycles about 14 percent of the total solid waste generated through source separation of the following materials: newspaper, office paper, corrugated, other paper, plastic, rubber, wood, yard waste, ferrous appliances, ferrous cans, aluminum scrap, aluminum cans, and glass. The existing recovery system consists of neighborhood collection centers, scrap dealers, commercial office paper and corrugated recovery programs by local mills and several leaf and composting operations. Based on current market trends and improving source separation systems, it is reasonable to assume that an additional four to six percent of the total waste generated may be recycled by the year 2000 through office paper, glass and aluminum recovery programs without any new effort from the government sector. Any additional recycling will require a cooperative effort from both local government units and solid waste collection, recycling and disposal industries.

The separation programs with the greatest potential waste stream impact are curb-side pickup of recyclables, yard waste composting and mechanical separation of metals. Mandatory programs will have greater potential for recovery but will require county, city and township elected officials to adopt ordinances. A recent survey conducted for the Council indicated that 54 percent of Area residents would support a law that requires people to separate the recyclable portion of their trash. Twenty-eight percent of the respondants strongly opposed such a law. While the Council recognizes the political sensitivity of this issue, the Council recommends that each community examine the costs and benefits of mandatory source separation ordinances.

Centralized yard waste composting systems are readily implementable but require additional capital for equipment, land and publicity. Aggressive campaigns to increase backyard composting may prove to be the most feasible short-term

waste separation strategy. Mechanical separation systems are expected to be developed in conjunction with resource recovery facilities.

Because of the fragmented nature of the Region's present solid waste management system, waste separation programs will probably be developed by individual counties, cities or private haulers and not on a region-wide basis. Notwithstanding, with appropriate technical assistance from MPCA and the Council and through implementation of the counties' solid waste master plans, waste separation programs can be increased to play a more significant role in reducing dependence on landfills (see Section 5 for regional objectives for source separation).

WASTE PROCESSING

Waste processing, for purposes of this report, is defined as volume reduction techniques that are employed prior to landfilling, with or without materials recovery systems.

SHREDDING

Shredding is a solid waste volume reduction technique that consists of milling the wastes to reduce waste constituents to smaller, more uniformly sized particles.

A shredding operation normally consists of a shredding unit, a transport network and the shredfill (landfill accepting shredded wastes). Several types of shredding devices are used, including vertical and horizontal axis hammer mills, vertical axis grinders and horizontal axis impactors. These shredders also usually include a variety of conveyors for waste routing scales, truck loading and unloading platforms and storage bins or areas.

In the shredding process, solid wastes are milled to produce uniform particle sizes two to four inches in diameter. Waste size reduction results in up to 30 percent greater in-place waste density at the shredfill site. On a site-specific basis, daily cover may not be required, since litter and pathogen problems are reduced. Decreased settlement and improved operation during cold and wet weather have also been noted.

BALING

Baling is a solid waste volume reduction technique that consists of compacting solid wastes into high-density (approximately 1,800 lbs. per cubic yard), rectangular-shaped bales.

An on-site solid waste baling operation includes a baling plant and a specially designed balefill (landfill accepting baled wastes). Alternatively, the baling plant may be located at a large-quantity source of solid waste or at a waste collection point.

The basic advantages of the process are reductions in required landfill volume, ease of waste transport and placement, litter reduction, decreased settlement, reduced requirements for cover material and increased potential for materials recovery due to centralized processing and decreased pollutant loadings per unit weight of refuse. A potential disadvantage is that the compacting process slows the decomposition process, thus potentially extending the period of time during which the landfill will continue to generate gas and leachate. Accordingly, the conditions that favor this alternative are in areas where there is a shortage of landfill sites, thus requiring maximum utilization of available land.

There is currently a study underway by the EPA to determine the relative environmental advantages of balefill sites over conventional landfills. This information is not yet available in final form.

CONCLUSIONS

Research on shredding technologies has increased in the past few years. Preliminary indications are that shredding is a viable means of reducing landfill space requirements through volume reduction and elimination of cover requirements. Based on increased density alone, without considering potential materials recovery, shredding has the potential to reduce significantly landfill space needed.

Results from environmental studies of balefills have concluded that although leachate volume production may be greater for balefills due to lower moisture retention and channelization through spaced between bales, actual pollutant loadings per unit weight of refuse are less. Baling systems also appear to be a cost-effective means of processing and permit opportunities for materials recovery because of centralized transfer facilities.

RESOURCE RECOVERY

The types of resource recovery methods discussed in this section include recovery of heat energy, biological treatment and recovery, and tree waste recovery. Even though waste separation involves the recovery of reusable waste materials, "resource recovery," as used in this report,

refers to strategies that recover resources through various high-technology processing methods--for example, incineration or biological treatment.

ENERGY RECOVERY

Energy recovery methods include production and processing of refuse-derived fuel, and use of waterwall furnaces and modular incinerators. The following descriptions of energy recovery technologies are from the Minnesota Resource Recovery Plan (MPCA, 1979).

Refuse-Derived Fuel (RDF)

The basic RDF system processes municipal solid waste to produce a transportable alternative solid fuel for use in fossil-fuel-fired energy systems.

RDF fuel may be classified as coarse, fluff or dust, depending on the degree of processing. Coarse RDF can be used in boilers equipped with grates, fluff RDF can be used in suspension-fired boilers, and dust RDF can be burned alone or emulsified with oil to form a slurry for use in conventional boilers. Each of the fuels can be substituted for others that have received less processing.

Coarse RDF is prepared by shredding raw refuse. During this stage of processing, the size of the incoming refuse is reduced, resulting in partial homogenization of the waste. Coarse RDF contains large quantities of grit. All the undesirable components of the refuse (glass, grit, metal, chlorinated plastics) that present corrosion, erosion, and material-handling problems are contained in the fuel. Coarse RDF bridges easily (hangs up in hoppers and will not flow) in storage. Coarse RDF has the same thermal properties as raw solid waste; that is, 4,600 Btu/lb., and burns to 26 percent moisture and 29 percent ash.

Fluff RDF is prepared by air-classifying and screening coarse RDF to remove most of the grit and large inert material such as cans, rocks and metal debris. Air-classification vacuums off light material, separating it from most of the chlorinated plastics. Unfortunately, large wood fragments are also separated, thus causing the loss of a desirable fuel component. Removal of screenable dirt, grit and glass fragments to decrease the fuel ash content further increases the heating value of the fuel, while reducing the amount of material to be handled in the boiler's ash handling system. Fluff RDF has a nominal shelf life of about five days. Longer storage encourages spontaneous combustion. The material has the same bridging and flow characteristics as coarse RDF. Unscreened fluff RDF has a

heating value of 5,000 Btu/lb., and burns to 26 percent moisture and 22 percent ash. Screened material has a higher heating value of 5,550 Btu/lb., and burns to 12 percent ash. Less total tonnage of screened fluff RDF is made because of grit removal; hence, while screening improves the fuel product, some recoverable energy is sacrificed.

Dust RDF is the most advanced RDF form. Fluff RDF is blended with an embrittling agent (a chemical that hardens cellulose so that paper and cardboard will shatter upon impact) and processed in a heated ball mill until the product will pass a 100 mesh screen (0.15 mm). The product is homogeneous and is believed to exhibit the least variability of any RDF. Dust RDF consists primarily of small paper fiber platelets. Consequently, it behaves like a powder, can be stored in silos, and can be handled with conventional flour and pulverized coal handling equipment. It is important to recognize, however, that an explosion potential exists when dust RDF, mixed with air, comes into contact with a spark. This is not a major drawback to the system, because explosion-proof handling equipment and fixtures are routinely employed when handling coal dust and flour. Of particular interest, dust RDF can be slurried with oil and burned in conventional oil-fired boilers. Dust RDF has a higher heating value of 6,900 Btu/lb., and contains 10 percent ash and two percent moisture. It appears to have unlimited shelf life.

Finally, any of the three forms of RDF may be agglomerated or densified to form densified RDF (d-RDF). Coarse and fluff RDF agglomerate well in pelletizers, briquetters, and extruders, but agglomeration of dust RDF requires a lignin binder and processing in a briquette.

Waterwall Furnaces

Municipal refuse is delivered to the facility and deposited on a tipping floor or in the storage pits from which it is transferred to the furnace feed hopper. From the feed hopper, wastes are continuously drawn into the furnace where they are burned and heat is recovered.

Waterwall furnaces are enclosed by closely spaced water-filled tubes. Water circulates through the tubes to recover heat radiated from the burning fuel bed. Integrally constructed (attached) waste heat recovery boilers generate steam while reducing the temperature of the exhaust gases. Heat is transferred by convection from hot gases passing over boiler tubes in the convection section of the boiler. Thus, a marketable product is created while reducing the stack gas volume and, consequently, permitting the use of smaller gas cleaning equipment.

In the combustion process, oxygen is required to burn the fuel and release heat. The combustion process can be improved considerably by agitating the fuel bed. Agitation results in rapid ignition, effective mixing, and leveling of the fuel bed. These factors combine to ensure that all refuse particles will come in contact with air and thus increase the completion of combustion and minimize the amount of residue to be disposed.

Bottom ash falling off the end of the grate is generally quenched in a water trough and taken to an ash storage area prior to disposal. Fine materials (siftings) fall through the grates and are conveyed to a residue collection system. In some designs, siftings are reinjected into the furnace to recover the heat loss they represent by not burning to completion. Bottom ash and siftings are usually disposed of in a sanitary landfill.

Flue gases leaving the boiler may also be passed through an economizer where some waste heat is used to heat the boiler feed water. Economizers improve the thermal efficiency of the unit.

The cooled combustion gases are passed through air pollution control devices and, after cleaning, are vented to the atmosphere through a stack.

Modular Combustion Units

Modular combustion units that recover energy are considered to be an effective resource recovery approach for small communities or smaller energy users. These units are prefabricated and shipped to the site and consequently are suitable for smaller volumes of waste (5 to 30 tons per day per unit), although several may be colocated to achieve capacities of up to 160 tons per day. Modular units operate as a mass burning incinerator, which does not process the waste before combustion. Extremely large or dangerous objects may be sorted prior to incineration, but the remainder of the noncombustibles are landfilled as part of the residue.

The modular combustion units, generally consisting of a primary and a secondary combustion chamber, employ controlled air techniques to reduce the amount of air required for combustion in the primary chamber and to lower the level of their particulate emissions.

Ash and other noncombustible residues that settle on the hearth of the primary chamber after the combustion process are periodically removed by manually or automatically operated systems. In the manual system, the operator scoops out the ash (by shovel or front-end loader) after

the unit has been shut off and cooled down. In the automatic system, the ash is pushed or forced ahead of the burning waste until it exits the chamber, generally through a drop chute into a water-sealed pit or an air-lock chamber.

BIOLOGICAL TREATMENT AND RECOVERY

Research and demonstrations of biological treatment of solid waste have increased substantially in the last five years. Anaerobic (oxygen-free) treatment produces methane gas and humus. Aerobic (oxygen-rich) treatment produces a sterilized humus or compost. These biological treatment methods can reduce the weight of solid waste by 50 percent. Aerobic treatment, or composting, can be applied to several different kinds of solid waste including leaf waste, source-separated organics such as food waste and mixed waste.

Existing systems for biological treatment and recovery of solid waste include the following technologies.

Backyard Composting

This is a low-technology biological process of composting using small bin containers where the leaves, grass clippings and other garden and yard wastes are stored for a period of one to two years. An alternative method involves frequent turning of the material and adding water to accelerate the process, which can be reduced to as little as six weeks (see Section 3, "Source Separation").

Windrowing

This is a biological process of composting similar to backyard composting only on a larger scale using heavy equipment. Windrowing involves aerobic decomposition through frequent turning of long rows of organic material. Windrow turning can be accomplished through a variety of methods utilizing special machinery. Sewage sludge and/or solid waste can be composted using this technique.

Aerobic Chambers

A variety of aerobic chambers are used throughout Europe to compost solid waste. While this compost technology is more capital intensive than windrowing, aerobic chambers speed up material processing because moisture, oxygen and temperature levels can be controlled. Two of the most notable processes are the Dano drum process developed in Europe and the Metro process developed in Texas. Similar to windrowing, solid wastes can be composted in combination with sewage sludge utilizing aerobic chambers.

Clay Digester

This is an experimental technology that requires shredding of all solid waste. The shredded wastes are placed in a clay-lined cell that is designed to hold one year's waste. The bottom of the cell is sloped to one end so that leachate can be easily collected. A clay cap is placed on the waste to prevent oxygen from entering the cell. Perforated paper is placed in the cells and pumps are used to extract methane and carbon dioxide from the waste material. Water pipes are also placed in the cell to increase moisture content and increase methane yield. After 10 years of methane recovery, the material in the cell could be aerated and then distributed as a humus. With such a management practice, cells could be reused and would provide an alternative to landfill expansions.

Landfill Methane Recovery

This technology is similar to the clay digester except that shredding and landfill design are not as important. Seven landfills in the United States are currently recovering methane. Landfill methane recovery is not an alternative to landfill expansion unless shredding is employed or humus is recovered from the landfill.

Composting of mixed waste is also feasible as an alternative to land disposal. Altoona, Pa., and about 10 other cities in the United States currently compost mixed waste. Mixed waste includes not only food wastes and yard wastes, but also undesirable materials such as glass, metal and plastic. Mixed waste and source-separated organics are both suitable for composting with sewage sludge. Solid waste is a good bulking agent for sludge and the sludge enhances the overall nutrient value of compost.

OTHER SYSTEMS

There are several other, more experimental processes that may prove to be viable alternatives, including alcohol production from cellulose materials, cement-like "guup" processes that use demolition debris as part of an aggregate and large-scale brush chipping machinery. As research data becomes available for these systems, further assessments of their disposal abatement potentials should be completed.

Recently there have been indications of new tire chipping operations in the Region. Tests by MPCA and the United Power Association have shown that tire chips can successfully be used as a five percent fuel supplement to coal in compatible boilers.

The disposal of shade tree waste in the Region has historically been an additional burden on the landfills. In the past two to three years, however, landfill operators have purposely raised the drop charge for tree waste to the point that it is now prohibitively expensive. Also, the recovery rate of this valuable wood resource has increased through the use of tree chippers, sawmills and firewood production. Still, small amounts of wood waste are being landfilled that could be potentially utilized.

CONCLUSIONS

Resource recovery technologies, in conjunction with waste separation and waste processing methods, are capable of reducing the solid waste stream by over 75 percent. Several existing high-technology facilities already recover 70 to 75 percent of the solid waste stream, including Madison's RDF facility (Boley, Madison Public Works) and the Dano composting process (Dano Resource Recovery, Inc., 1978). Both of these high-technology processes rely on materials recycling to attain these high recovery rates.

ORGANIZED REFUSE COLLECTION

There are basically four different types of residential refuse collection in the Metropolitan Area:

1. In most Area suburbs and St. Paul, homeowners contract directly with a private hauler of their choice; there is no municipally financed refuse collection.

2. In some Area suburbs, the city provides mandatory, municipally financed refuse collection for all residents by contracting with a private hauler, selected on either a negotiated or a competitive bid basis.

3. In Minneapolis, under a mandatory collection system, approximately 40 percent of the city is served by municipal crews and the remaining 60 percent is under a negotiated contract with a consortium of private haulers. Both municipal crews and private haulers transport refuse to a transfer station owned by a private operation. All refuse is then transported to suburban landfills.

4. Two communities, Hopkins and Farmington, provide mandatory, municipally financed refuse collection by city crews. No private haulers are involved.

The commercial and industrial collection systems in the Metropolitan Area are more complex and capital intensive than residential collection. Collection agreements are established through both oral and written contracts, with some limited bidding for larger corporations and institutions (such as hospitals and colleges). Nonresidential service often requires specialized equipment for light commerical, heavy industrial and demolition materials, which makes commercial and industrial collection more expensive. Another factor is that collection hours vary for commercial and industrial accounts (for example, from midnight to dawn) because there is limited access due to traffic during business hours. In some cases, local ordinances restricting access to storage containers result in increased commercial and industrial collection costs. Therefore, while the problems of developing an organized commercial and industrial collection system are greater, the potential savings are also greater because of the higher costs.

The efficiency of solid waste collection in the Region varies from community to community. Much of the Region's waste is collected under an "open hauling" arrangement, alternative 1 above, where a householder selects a hauler or elects to haul his own rubbish. This system promotes competition among haulers, which helps moderate price increases; however, there are many inefficiencies built into this system. Often, there are several hauling trucks collecting on the same streets and alleys the same day. The net effect is that haulers generally have longer collection routes, which increase the cost of collection and limits crew productivity. Moreover, there is often more wear and tear on streets and alleys, as well as noise and air pollution.

An alternative to the open hauling system is an organized collection system. In such a system, routes are established to serve all residential units in a specific area on the same day. An objective is to reduce the length of the collection route by reducing the distance between consecutive stops. A second objective is to reduce the number of trucks that travel through each residential neighborhood each week. Shortening the distance between consecutive collection stops would help improve collection crew productivity. Based on a recent analysis for the cost factors associated with such a system, the City of St. Paul found that an organized collection system may reduce collection and disposal costs.

An organized collection system could greatly facilitate the possibilities for recycling and resource recovery. Currently, a major drawback to implementing recycling programs and resource recovery is the lack of control over the collection of the waste. Under an organized collection system, a community could work directly with the hauler or haulers in implementng such programs. For example, recycling districts could be established in a community and awarded to haulers under a competitive bidding process. Another arrangement under the system might involve passing the savings back to the community's general fund to finance recycling activities and programs. An organized collection system could also facilitate control over the final destination of the collected waste and, thus, provide for the large waste supply guarantee necessary to ensure the viability of large central solid waste energy recovery facilities.

In cities where an organized collection system has replaced open hauling, the city has generally either negotiated or solicited bids from waste haulers to provide collection services for specific districts within the city or for the entire city. The solicitation generally specifies the level of service to be provided and the necessary performance guarantees. The contractual period may be three to five years, with escalation clauses tied to the Consumer Price Index and Presidential guidelines. The city's responsibility may include handling delinquent accounts and enforcing municipal solid waste ordinances. The city may also be responsible for billing and receiving payments for solid waste collection services.

4. FINANCING AND PROGRAM COSTS

This section discusses market conditions affecting secondary materials, abatement program costs, methods of obtaining financing to develop abatement programs and facilities, and economic incentives that could encourage private sector participation in abatement projects.

MARKET CONDITIONS

MATERIALS MARKETS

Prices for recyclable materials are determined by the laws of supply and demand in the marketplace. Historically and currently, the markets for recoverable materials have shown considerable fluctuation. The wide swings of the price pendulum can be attributed to a number of outside forces. Some of these are supply and demand for specific materials by specific industries; strikes in virgin materials industries; governmental influence through tax or price incentives and product specifications; and foreign purchases of recovered materials. Energy economics and demand for virgin materials have profound influences on secondary materials markets. Geographic location of markets also plays a key role in materials recovery economics because of transportation costs. In general, however, markets for recoverable materials have shown an upward trend similar to that of most other commodities (HDR, 1975).

Since 1971, secondary ferrous metals, newsprint and corrugated containers have experienced dramatic fluctuations in price (Minnesota Resource Recovery Plan, 1979). Though not as pronounced, price changes for secondary aluminum have also occurred over the same period. In contrast, prices for glass cullet have experienced a steadier trend--generally upward--since 1971.

Forecasting future market developments for any product is difficult, and this is especially true for the volatile market for recovered materials. All of the secondary materials markets are keyed to the national economy, as are most markets. Recycled or recovered materials are affected by changes in the economy because they are generally substitute or supplementary goods--used mainly when demand for the finished product is so high that the supply of virgin materials cannot keep pace. Consequently, when the economy suffers a downturn, recovered materials are the first supply source to be cut back.

According to industry spokesmen, the 10-year forecast is good for all recovered materials, especially ferrous metal and aluminum in the Midwest market. There will be periodic fluctuations, but major expansions of electric steel furnaces by steel companies located along the Mississippi River indicate a continued strong demand for recovered ferrous. The aluminum industry is opening new recycling operations and making major expansions. Thus, the future aluminum market seems fairly secure as well. Glass and paper markets totally depend on local conditions (Minnesota Resource Recovery Plan, 1979).

The following summary of materials market conditions in the Twin Cities Area was developed from the MCPA Resource Recovery Plan and consultations with representatives from local secondary paper, glass and aluminum processors.

Waste Paper

The newsprint market has had a record of extreme price fluctuations. Many recycling programs died out after the market peak and subsequent drop in 1974 because of the economic recession. Since then, many new paper recovery efforts have been established and have been operating somewhat more consistently. The cellulose insulation industry has been very active after a slump two years ago stemming from bad publicity concerning fire hazards, although the present building slowdown is having some effect. Champion International has stated that its St. Paul plant can process about 36,000 tons per year (TPY) of newsprint and that insulation contractors can process about 40,000 to 70,000 TPY. One insulation company, Shelter Shield Products, has stated that in 1980 -- a poor year for consumer purchasing -- it will have processed about 20,000 TPY and that the cellulose insulation industry as a whole processed about 60,000 to 80,000 TPY, slightly higher than the Champion International estimate. Shelter Shield Products hopes to double or triple its annual processing rates within the next four to six years. Shelter Shield Products says it is willing to enter into long-term, base-price contracts with any county, municipality or other recycling effort to develop reliable sources of their raw material. Regional demand for waste paper from a new newsprint mill in Ontario may also be favorably influencing the Twin Cities market.

These indications of improving newsprint market demand must be evaluated within the context of past instability. Also, it is difficult to predict future trends in any commodity market, given the complexity of the many influencing factors. Nonetheless, one of the factors that will help stabilize this demand in the Region is the development of local, reliable sources of secondary newsprint from private and public source separation programs.

The Region's corrugated and office paper markets are excellent. Champion International recently estimated that 70 percent of the corrugated generated in the Metropolitan Area is presently being recovered. Also, the demand for office paper from Wisconsin and local mills is far in excess of what the Midwest area generates.

Glass

Market prices for waste glass on a national level have remained relatively stable since 1970. In the Twin Cities, the two large glass manufacturing firms provide excellent market conditions for cullet.

Aluminum

Aluminum prices have remained stable since 1970 and have recently shown slight increases. Aluminum markets in the Twin Cities Area are considered to be excellent.

Ferrous

Ferrous markets in the Region are generally good but subject to price fluctuations. Little data is available on market capacity.

Compost

Compost, as a secondary material, is a soil enhancer and fertilizer-like material. It serves as a carbon source to plants and supplies moderate quantities of nitrogen, phosphorous and potassium. The existing compost markets include sod farms, mines, nurseries, golf courses, forestry and recreational areas, state parks, flower growers, county fairs, highway departments and general contractors. At the present time, compost materials are not available to satisfy market demand. Market demand is now being satisfied by a somewhat nonrenewable black dirt resource. A recent MPCA study (1979) has identified over 250 individual markets in the Seven-County Area.

Other Materials

Currently the market situation for tree waste products is very good and improving. Wood chip boilers and pelletizing plants provide a more-than-adequate demand for the higher-quality chips less than six inches in length. The market for longer chips of lower quality produced from brush chippers is less certain. However, some of the newer wood chip boilers apparently can utilize brush chips effectively.

Markets for tires are currently in the developmental stage. There are two firms identified in the Region that will be chipping tires for power companies to use as a fuel supplement in their boilers. The two major problems with incineration of tire chips are its possible incompatibility with coal-fired boilers and controlling air pollution. Tests have shown that with the proper boilers and a five-percent tire chip mixture, tire chips can be successfully incinerated, and even increase burning efficiency. United Power Association has been working with MPCA to develop adequate air pollution control equipment to control particulate emissions from tires.

Old tires can also be used in breakwater levies and playground equipment. However the demand from these uses is certainly less reliable than the use as a fuel supplement.

POTENTIAL ENERGY MARKETS

In a study conducted by Hennepin County (1979), several markets for refuse-derived energy have been identified. These markets are shown in Table 1. This table shows the size of the market in tons of waste per day, and a preliminary estimate of feasibility. Probably the best potential market for steam in the Twin Cities is the Champion International plant in the Midway district of St. Paul. Champion International is a large consumer of steam and would be a good candidate for a waterwall combustion system.

If all of these promising markets listed were developed, approximately 3,210 tons per day of refuse could be burned to generate steam. However, there are several factors that complicate the picture, including the seasonal changes in refuse generation, variations in operating costs for different facilities, and the need for dependable capacity, that is, a reliable way to dispose of solid wastes when, for any reason, a resource and energy facility is out of service.

CONCLUSIONS

Although secondary materials markets for newsprint, ferrous and aluminum have experienced wide price fluctuations, all materials have generally increased in price over the long run. All materials are subject to price variations that parallel the trend of the national economy. Barring any unforeseen circumstances, the secondary materials market demand, other than the near-saturated corrugated market, could sustain a greater supply than is currently being recovered from existing programs. Although a preliminary survey by MPCA has indicated favorable markets for compost products, the actual demand and price for this type of organic secondary material is unknown, and further analysis is necessary.

Table 1
POTENTIAL MARKETS FOR REFUSE-DERIVED ENERGY

Consumer	Average Refuse Requirements (Tons/Day)	Preliminary Estimate of Feasibility	Comments
Promising Markets			
Cargill	80	Possible	Modular technology.
FMC Northern	140	Low	Refuse requirements under 50 TPD refuse equivalent.
Champion			High, stable
International	1,110	Good	energy use.
Munsingwear	75	Good	Modular technology.
Olympia Brewing*	240	Good	Cluster member.
3M (Bush Av.)*	250	----	Good feasibility as cluster member.
Whirlpool*	50	----	Low summer energy use. Good feasibility as cluster member.
3M (Maplewood)	375	Good	Energy use may increase 20 to 40 percent in five years.
Subtotal	2,320		
Northern States Power Co.	1,000		
Minnegasco Energy Center, Inc.	250		
TOTAL	3,570		
Uncertain Markets			
Buckbee Mears Co.	----	----	Market instability.
Minneapolis-St. Paul International Airport	----	----	Limited refuse requirements but should be considtered with Northwest Airlines.
Twin Cities Ammunition Plant	----	----	No contact.

* 3M/Olympia/Whirlpool Cluster - Good estimate of feasibility for integrated project.

Source: Hennepin County, 1979

Several recent energy market studies in the Region indicate a very favorable potential for refuse-to-energy facilities. Factors in selecting suitable energy markets include degree of seasonal variation of demand, long-term reliability and capacity. Several large industries and power-generating plants have been identified in the urbanized area of the Region as being suitable for either RDF- or mass-burning waterwall boilers. Less is known at this time about the smaller-capacity markets suitable for modular combustion units, especially in the more rural mcounties.

PROGRAM COSTS

WASTE REDUCTION

The waste reduction methods described and evaluated in the previous section can be divided into two major categories for purposes of discussing program costs: first, methods requiring state or federal legislation; second, methods requiring adoption of municipal or county policies.

Waste Reduction Methods Requiring State or Federal Legislation

Many methods--including container deposits, packaging reduction, product charges, bans, extended warranties, and newsprint conservation--would be most effective if enacted at the state or federal level. Local and county governments, however, could support this type of legislation through resolution and incur no program costs while receiving the benefits of waste reduction. It is also important to keep in mind the net, long-term consumer savings derived from more efficient and less wasteful packaging systems and products.

Waste Reduction Methods Requiring Municipal or County Policies

Two waste reduction techniques are more easily implemented at the county or municipal level: office paper reduction and extended tire warranties. Both of these programs involve only a minimal amount of planning, with implementation through resolution. Each county or city procurement administrator could restrict purchases to follow the adopted waste reduction guidelines and assist with employee education. Both programs have the potential for net savings, especially when implemented in conjunction with post-generation recycling programs (see Section 3, "Waste Separation").

A more controversial waste reduction strategy that could potentially be instituted by county or city governments is the waste charge. With the enactment of the 1980 Waste

Management Act, cities or counties may place reasonable conditions on waste processing and disposal facilities. One such condition could be a per ton waste charge to help defray any planning and management costs of monitoring the facility or waste recovery program. In addition to funding recovery efforts, such a change would increase the generator's incentive to reduce waste output.

WASTE SEPARATION

Waste separation program costs will vary according to the type of system (that is, collection centers, source separation with curb-side pickup, picking or mechanical separation), materials handled, population densities and quality of program administration.

Table 2 represents a typical breakdown of capital investment costs, by type of equipment, for various community source separation programs. The data is summarized from an EPA report. These figures show a wide variation in costs, depending on items used in a source separation program.

Results from collection centers where data is available indicate that a range of net savings from $10 per ton to a net cost of $10 per ton is possible (MPCA, unpub. data). This data assumes that all the collection centers analyzed were operated as a profit-making business. In other words, volunteer labor was calculated at minimum-wage labor costs. When calculated without this assumption, considering only paid labor and not including volunteers, the program costs range from no net cost to $25 per ton savings from revenues.

Curb-side source separation programs have a wider range of costs, from $10 per ton costs to $77 per ton savings (Boca Raton newspaper collection program). The Boca Raton program may not be representative because of its near ideal market conditions. (A high-capacity newsprint mill is located in Georgia.) Nonetheless, most curb-side programs do break even in terms of materials revenues and transportation and disposal cost savings, at least for meeting the program costs.

The cost of curb-side leaf collection and centralized composting through the windrow method can vary between $4.75 and $7.35 per ton (MPCA, 1980). Of course, if backyard composting is used as a community's preferred program, the only cost incurred will be from public education materials and staff time.

Table 2

EQUIPMENT FOR COLLECTION AND PROCESSING OF SOURCE-SEPARATION WASTES

Description	Community	Capital Cost
Onion Sacks	Seattle, Wash.	$.30 ea.
"Treesaver"	University City, Miss.	$4.00-$6.00
Roll-out Carts	Greenbelt, Md.	$56
Compartmentalized Truck	Somerville, Mass.	$22,000 (1975)
Compartmentalized Truck	Newton, Mass.	$13,000 (body)
Compartmentalized Truck	Santa Rosa, Calif.	$6,000
Modified Stake Body	Boca Raton, Fla.	$450/month rental
Van with Crusher	West Orange, N. J.	$10,000 (used)
Beverage Truck	Grand Rapids, Mich.	$1,200 (used)
Trailer with Trash Cans	Davis, Calif.	$900
Cushman Scooter	Davis, Calif.	$3,000
Self-Dumping Trailer	East Hartford, Conn.	$3,200 (1975)
Wooden Trailer	East Lyme, Conn.	$300
Trailer with Bins	Modesto, Calif.	$3,000
Trailer with Drop-off Bins	Seattle, Wash.	$3,500
Trailer with Self-dumping Bins	Temple Terrace, Fla.	$1,000
Under Side Rack	Madison, Wis.	$175
Under Side Rack	Racine Wis.	$175
Under Side Rack	Temple Terrace, Fla.	$200 (materials)
Overhead Rack	Temple Terrace, Fla.	$200 (materials)
Roll-off Containers	Davis, Calif.	$3,000
Open Trailer (Modified)	East Hartford, Conn.	$5,000 (used)
Storage Pit (Cinder Block)	East Hartford, Conn.	$10,000
Recycling Center	Wellesley, Mass.	$5,000 (site)
Baler	Carmel, N. Y.	$1,200 (used)
Glass Crusher	Seattle, Wash.	$1,500
Magnetic Separator	Modesto, Calif.	$2,000
Can Flattener	Seattle, Wash.	$5,000

Source: Resource Planning Associates, Inc., Washington, D.C., 1980

In-office paper recycling programs are generally recognized to have the potential for net savings to any agency or business with at least 200 employees, depending on the type of organization. Since the paper markets will supply most of the necessary employee education literature, including desk-top recycling files, and conduct the first "how to" instruction seminars, the only costs to the organization are usually the price of centralized containers where the employees dump their desk-top recycling files, and start-up staff time. The savings from reduced mixed-waste collection costs and revenues usually exceed the minimal capital and operating costs. Essentially, once this type of program begins, it runs itself with only a minimum of monitoring and occasional employee reminders.

Separation program costs involving manual picking will vary, depending on the system and amount of labor time. In order to break even, a program must generate enough revenue from the materials to recover costs of wages, including fringe benefits and transport costs. Probably the most extensive program today is in California, where excellent corrugated markets, availablity of a minimum-wage labor force and favorable weather provide the ingredients for a successful program.

The economics of mechanical separation programs are better known because of the research completed by existing industries and the National Center for Resource Recovery (NCRR). A New Orleans demonstration project showed that capital and operating costs for mechanical separation of recyclable materials were:

Glass	$200 per ton
Aluminum	$200 per ton
Ferrous	$5 to $20 per ton

Current market prices in the Region for these materials are:

Glass	$40 per ton
Aluminum	$460 to $600 per ton
Ferrous	$0 to $10 per ton

WASTE PROCESSING

Full-scale shredder technology is not currently economically feasible at small disposal sites. For a 300-ton-per-day (TPD) facility, current costs are about $7.00 per ton ($7.89 per metric ton). A detailed analysis would be required to determine if the benefits, in terms of saved landfill space and reduced cover, would be sufficient to justify the capital and operating costs incurred to implement shredder systems.

Full-scale baling technology is probably more economically feasible at small disposal sites. For a 300-TPD facility, current costs are about $5.00 per ton ($5.60 per metric ton).

RESOURCE RECOVERY

The following discussion of resource recovery program costs is based on the economic feasibility analysis conducted for the City of St. Paul (1980).

The City of St. Paul selected 17 sample industries to study the breakdown of costs and revenues associated with the various types of energy recovery technologies. Each candidate industry was selected on the basis of its possible role as an energy market for energy-recovery technologies.

Table 3 is a summary of the data from the St. Paul report. Individual industries are listed to give a better picture of the size and type of operations considered in the study. The costs listed in the table should be reviewed with several considerations in mind:

1. Fluctuations in system operation lead to economic inefficiencies of facilities. For example, Hospital Linen Services, which operates eight to 10 hours per day, 260 days of the year, would be a less steady customer of heat than Champion International, which operates 24 hours a day, 365 days a year.

2. All RDF and dedicated boiler systems have been prorated by 75 percent.

3. Since ferrous metals and steam are marketable by-products of the combined systems, a commensurate amount of revenue is deducted from total costs to achieve each system's net costs (1985 dollars).

4. The mass-burning and modular incinerator systems are single-purpose facilities with direct conversion of waste-to-energy. Their net system costs are therefore a matter of subtracting revenues from each system's cost.

5. The information in Table 3 may change because the City of St. Paul is currently refining its energy recovery feasibility analysis.

Table 3
PROGRAM COSTS FOR ENERGY RECOVERY FACILITIES

System	Average Daily Capacity (Tons/Day)	Total Capital Costs (In Millions)	Operating Costs (Dollars/Ton)	Total Revenues (Dollars/Ton)	Average Net Cost (Profit) (Dollars/Ton)
RDF Processing Plant					
1.1 No Example Given	625	At 4" RDF - $7.70 At 3/4" RDF - 20.80	At 4" - $22.62 At 3/4" - 26.24		
1.2 No Example Given	1,500	At 4" RDF - 22.80	At 4" - 17.13		
Dedicated Boilers (With 4" RDF					
2.1 Champion Int'l	950	$41.60	19.54	$39.33	$2.66
2.2 3M, Whirlpool	280	10.60	21.77	39.55	4.84
2.3 Schmidt Brewing Co.	145	5.30	23.48	32.06	13.96
2.4 Olympia Brewing Co.	110	5.00	26.98	38.71	10.89
Boiler Retrofits for Firing RDF					
3.1 NSP - High bridge	375	$ 4.70	10.72	11.01	25.95
3.2 NSP - 3rd St. Plant	50	1.20	25.46		
Mass Burning Systems					
4.1 Champion Int'l	1,200	$84.40	34.95	37.54	(2.59)
4.2 3M, Olympia Brewing, Whirlpool	565	36.90	41.36	37.56	3.81
4.3 3M	320	21.80	40.38	37.08	3.30
Small Modular Incinerator					
5.1 Olympia Brewing	170	$ 6.40	43.78	34.18	9.60
5.2 Knappen-Vylactos Nor.	50	2.00	65.73	36.41	29.32
5.3 Hosp. Linen Serv.	11	.82	81.32	55.25	26.07
5.4 Sperry Univac Corp.	12	.95	95.37	62.63	32.74
5.5 Land O'Lakes Creamery	7	.55	104.85	56.10	48.89
5.6 Whirlpool Corp.	50	3.10	72.20	42.63	32.83

Note: This energy market information, based on 1985 projections, is subject to change.

Source: City of St. Paul, 1980

Generally, capital costs for high-technology systems are fairly well documented; operating cost estimates are less reliable. Construction costs have been documented for several facilities, but shakedown-related problems and long construction time lags have hampered the development of representative operating cost information. Furthermore, in many cases, existing operations data does not represent the cost of a system operating at its optimum level. However, it does seem that some systems may be over-designed. Anticipated solid waste streams in some cases have not materialized; therefore, operating costs are often higher than expected.

The most readily available program cost information pertaining to biological recovery systems relates to two brands of enclosed chamber type of composting systems: Dano composting drum and Arus-Ruthner systems. Based on the MPCA Resource Recovery Plan (1979), the Dano system may cost $1.6 million for a 100- to 500-ton-per-day facility, with annual operating costs of $6 per ton. The existing Arus-Ruthner facility in Salzburg, Austria, handles 400 tons per day of mixed solid waste, combined with 150 tons per day of sewage sludge. A range of 14 products of different quality are sold, from unscreened materials ($5 per ton) used for land reclamation, to a compost/peat moss/mineral/soil material ($125 per ton) used in greenhouses or sold in department stores. There was an initial capital investment of $20 million (1979 dollars) by private investors for construction of the Salzburg facility. Current operating costs are $11 per ton and depreciation costs are $11 per ton. Some of the cost of the facility can be attributed to the stringent health and nuisance avoidance measures employed, since all equipment and operations are completely enclosed and operated under low pressure.

The information for both of these composting systems is based primarily on European experience. Therefore, the costs of similar facilities in the United States may be different because of variations in market, labor and energy factors.

CONCLUSIONS

Waste reduction is the least expensive of the four major categories of land disposal abatement. However, some of the hidden costs for both voluntary and regulatory waste reduction programs are not well documented. Waste separation, and especially source separation, is the next most expensive type of program to develop, in part because of the reliance on the generator's time and labor to separate materials. Given favorable market conditions, curb-side and drop-off recycling strategies can be cost-effective

when the entire system is analyzed. Backyard composting is the cheapest recovery alternative to landfilling, although higher-capital centralized composting may be necessary to have a significant impact on the waste stream. Large-scale resource recovery facilities are currently the mostexpensive alternatives, but because of economies of scale and viable energy markets, energy recovery facilities will compete favorably with landfilling over the long run. Economic success of any resource recovery facility will depend on accurate analysis of local waste composition and quantity, adequate planning for front-end separation (including both source separation and mechanical separation), appropriate system capacity and market conditions.

FINANCING METHODS

One of the most frequently asked questions about solid waste abatement is "How will we pay for it?" This section contains a general discussion on fund procurement and other financial strategies for implementation of abatement programs. The financing mechanism actually used will depend upon the size and type of the project, but this overview can provide a basis for further investigation during the planning stages of any specific project.

CURRENT FINANCING OPTIONS

Currently existing financing options include general funds, grants and loans.

General Funds

Appropriations of project funds are available from a variety of sources, each with a varying degree of public and private involvement. The two most traditional acquisition and operation methods for a large-scale recycling facility are the "turnkey" approach and the "full-service" approach. The turnkey approach involves public ownership and operation of a privately designed and constructed facility. The full-service approach entails complete private sector responsibility (ownership, operation and construction). There are other variations on these two basic schemes. The method of acquisition chosen will play an important role in determining the financing method. In general the options available are: 1) pay-as-you-go financing (public): yearly appropriations either by accumulating funds in advance or meeting obligations as they occur; 2) leasing or lease purchase (private): rental with or without intent to purchase or own; 3) subsidies or grants (public): discussed below; 4) borrowed funds (public or private): general obligation bonds, pollution control revenue bonds, lease revenue bonds, solid waste revenue

bonds, or corporate or commercial bonds; 5) equity funds (private): in addition to debt, private industry can provide equity funds in the form of cash contributions, land and equipment, etc.; 6) leverage leasing (public or private): a financial package that combines several financial mechanisms (Brown & Powers, 1980).

Grants

There are some subsidies or grants now available from various governmental agencies and departments. Most of these come from the U.S. Environmental Protection Agency under the Resource Conservation and Recovery Act (RCRA) of 1976. Those RCRA grants are available to both private firms and local governments. An example is the urban resource recovery assistance grant. The Department of Housing and Urban Development offers some block grants for solid waste abatement purposes as does the Department of Economic Development. Finally, as mandated by the Minnesota State Legislature in the 1980 Waste Management Act, grants will be made available through the Council to the metropolitan counties for solid waste abatement planning. Other funding provided by the 1980 act includes source separation and reduction demonstration funds managed by the MPCA and facility loans managed by the State Waste Management Board.

Loans

In addition to the bonding capabilities of local governments, there are also some tax-exempt or discounted loans available in the solid waste area from federal sources. An example of this is the Small Business Administration loans for pollution control or abatement facilities (Fragnito, 1980).

POTENTIAL FINANCING OPTIONS REQUIRING LEGISLATIVE ACTION

In addition to the traditional sources of financial assistance listed above, there are other potential sources.

Connecticut, Nebraska, Virginia and Washington have a system of tax assessments on specified packaged products that is based on an ad valorum tax. This tax is assessed on retailers, manufacturers and wholesalers, and the revenue produced defrays costs of solid waste abatement. In Colorado, an agreement was worked out whereby the money received by EPA from an industry's pollution penalty was reallocated to a nonprofit organization for a recycling facility. In California and Ohio, a percentage of the incorporation tax paid by all corporations in the state pays for solid waste abatement programs. A more elaborate scheme was developed in Michigan. In Michigan, which has a

mandatory deposit law, there is currently a bill before the legislature that would dedicate all unclaimed soft drink and beer container deposits for a fund to be used for recycling and resource recovery facilities. In Alaska, Colorado, Hawaii and South Carolina, a general state appropriation was mandated specifically for certain recycling and resource recovery projects.

CONCLUSIONS

Most of the financing methods discussed are for large-scale projects, probably to provide funds for capital investment purposes, to be developed at the county level or in some of the larger municipalities. Moreover, such projects involve some financial risk. At a time when the public is wary of spending large amounts of money on new projects, expenditures could be more difficult to approve. For this reason, it seems that some of the financing approaches might be more feasible when combined with private industry financial participation. One technique for involving the business and industrial sector is through a set of incentives. This is the subject of the next section.

ECONOMIC INCENTIVES

This section discusses two different aspects of financial incentives that may encourage private sector participation in abatement programs. There are incentives provided by state and federal sources and those the county or city can exercise. Some of these may be viewed as disincentives for not pursuing abatement practices. The incentives would be most helpful to private industry in offsetting operating and materials procurement costs of a facility.

AVAILABLE INCENTIVES

There are several currently available incentives.

State and Federal

The State of Minnesota offers a five-percent pollution control credit to eligible individuals or local governments. The credit can be used to purchase sites, in construction, for equipment purchase, and for similar purposes. There is also available a 10-percent federal tax credit on any new recycling equipment on terms similar to those of the state credit.

The state also allows exemptions from real estate taxes on sites where a facility is engaged in any kind of pollution control operation. However, the 1980 Minnesota Waste Management Act precludes landfills from receiving real estate

tax exemptions. This provision does not take effect, however, until after the property's valuation assessment, which is applicable the preceding year when the property was not used for recycling. This means that the recycler cannot gain the exemption for at least one year of the facility's operation. For small facilities this can be burdensome. Minnesota also offers a low-interest loan mechanism to recyclers through eligibility for industrial revenue bonding. This, however, is expensive enough to preclude all recyclers who have little initial capital. Such loans may also be considered incentives because they make it less costly for a business to undertake abatement projects.

County and Municipal

Where haulers contract with the city to transport waste or the city does its own hauling, it may be possible to work out an arrangement whereby charges to haulers who recycle would be reduced. Similarly, counties or cities could charge haulers an extra fee to use landfills, with the revenue raised by the surcharge going to collection centers. Also, low-interest loans could be provided to haulers for modifying trucks for separated wastes. Low-interest loans could also be made available to individuals operating waste reduction and recovery projects.

POTENTIAL INCENTIVES

Discussed in this section are potential strategies that could provide incentives for business participation in abatement projects.

State and Federal

The state and federal governments have the authority to establish several possible incentives. They could impose a tax on products that reflect the real costs of packaging, the hauling and landfilling cost included. They might also change some of the existing laws that currently favor the production, transportation and marketing of virgin material goods. Other laws could be changed also, such as the provision for property tax exemption discussed earlier, to allow the exemption for the first year of operation of a facility. The MPCA is now considerating a possible state investment tax credit (like the 10-percent federal credit) that would then raise the total credit to 20 percent for new recycling equipment. Other potential legislative options include allowing counties to use the property tax assessment process to provide incentives to individuals, perhaps a lowering of the tax for those who actively recycle. Exemptions from sales tax for business firms that

participate in recycling or resource recovery are another possibility. At the federal level, it may be possible to establish a set of income tax credits for individuals who carry out source separation. Another possibility, needing further study, is market subsidies; that is, guaranteeing the market through a multitiered government purchase system until prices are stabilized. Private industry representatives suggest further alternatives such as tax-exempt mortgages, a reinstatement of the "new jobs" credit and a state income credit for use of secondary materials.

County and Municipal

The MPCA has suggested a model ordinance that, along with other enforcement strategies, recommends a recycler's rebate. The ordinance would allocate to recyclers the money haulers save by dropping off recycled materials instead of making trips to the landfill. Such an arrangement assumes that the haulers are under contract with the city and are not already making all of the trips to the recyclers.

Another potential method involves organized collection of source-separated items. Since the individual now pays a certain fee for garbage to be hauled, why not pay that same fee to a hauler for picking up source-separated materials? Such a system would require that some organization of collection and billing be established among haulers and the municipality or county.

Also, it might be possible (with an organized collection system) to establish a program like SORT (Separate Our Recyclables from Trash), which operates in Seattle, Washington. This would involve a user-based fee on collection whereby those with fewer bags or cans of garbage would pay less (Mulligan, 1979).

CONCLUSIONS

While tax incentives would not provide all of the necessary funds to establish a new project or set up a program, they might present an opportunity for the private and public sector to cooperate and share the burden. Tax incentives have the added advantage of not costing the state money until they are actually used. Once they are used, it is hoped the economic activity generated will help offset the cost. Combined with some capital investment financing options, a comprehensive program could be established that would be both politically feasible and financially successful as well.

5. REGIONAL OBJECTIVES AND POTENTIAL DEGREES OF ABATEMENT

The Waste Management Act of 1980 requires that the Council's land disposal abatement report contain specific and quantifiable objectives and degrees of abatement. Regional objectives for land disposal abatement for the next 20 years are proposed in this section, based on the information in the previous sections. Objectives are proposed for each of the four categories: waste reduction, waste separation, waste processing and resource recovery. The objectives will serve as targets that counties will address in their specific disposal alternative proposals, due by April 1, 1982. These proposals should detail the investigation the counties have made of various alternatives, the realistic abatement each alternative can contribute and the short- and long-term implementation programs to reach the abatement levels each county considers achievable.

Before the objectives were established, it was necessary to develop a clearer picture of how waste originates and to define precisely the waste stream. The total quantity of solid waste material generated from consumer activity can be defined as "gross discards"; that is, total materials generated before recycling or disposal (see Figure 1). The portion of the gross discards that is recycled becomes "secondary raw material" for use in manufacturing in lieu of, or in addition to, virgin raw materials. Finally, the "net waste stream" can be defined as the final residual waste remaining after materials recovery.

To establish meaningful objectives for the Region, the following approach was developed. First, the problem was identified through estimating the relative contribution of specific materials to the disposal problem (see Table 4). Although most of the values shown in Table 4 are national averages, the data is the most specific and accurate available and should generally represent the waste stream in the Twin Cities Metropolitan Area. Second, the existing recycling system was identified and current recovery rates quantified as well as possible. Current recycling rates, shown in Tables 4 and 5, were estimated based primarily on national data (EPA, 1975) and confirmed, where possible, with information provided by regional materials markets. Third, a preliminary market survey was conducted to establish the potential for increased materials recycling (see Section 4, "Market Conditions"). Fourth, a detailed analysis was completed of all possible waste reduction and recovery systems to develop conclusions about the relative feasibility and potential of each strategy (see conclusions in Section 3). Fifth, the past work of Hennepin County,

Figure 1
SOLID WASTE FLOW

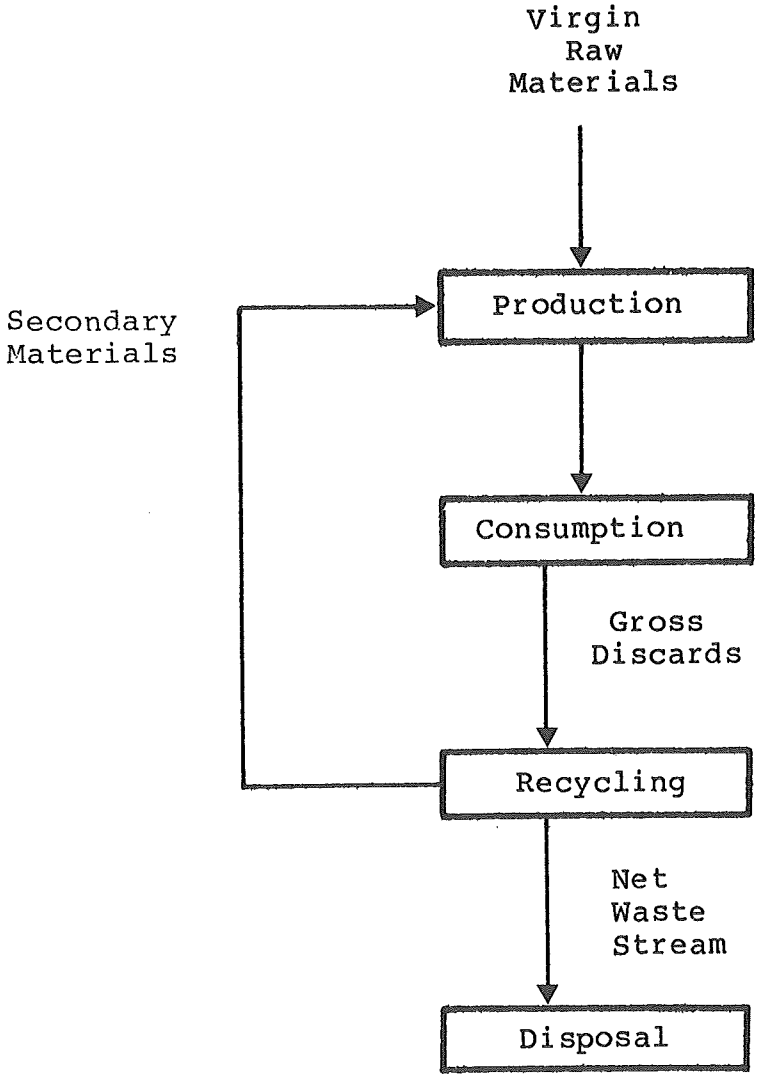


Table 4
COMPOSITION OF RESIDENTIAL AND COMMERCIAL SOLID WASTE
AND RELATIVE AMOUNTS RECYCLED, 1980
(Percent by Weight)

	Percent of Net Waste Stream*		Percent of Gross Discards Currently Recycled**	
Combustibles				
All Paper	33.0%		11.2%	
Newspaper		6.0		1.7
Books, Magazines		3.0		0.2
Office Paper		4.0		0.7
Corrugated		9.0		7.4
Other		11.0		1.2
Plastics	3.7		0.0	
Rubber	1.9		0.1	
Leather	0.7		0.0	
Textiles	1.4		0.0	
Wood	3.6		0.1	
Food Wastes	16.6		0.0	
Residential/Commercial		13.8		0.0
Manufacturing		2.8		0.0
Yard Wastes	18.5		0.2	
Combustibles Subtotal	79.4		11.6	
Noncombustibles				
All Metals	9.3		2.2	
Ferrous Appliances		4.0		1.9
Ferrous Cans		4.2		0.1
Aluminum Scrap		0.3		0.1
Aluminum Cans		0.4		0.1
Other Nonferrous		0.4		0.1
Glass	9.9		0.2	
Misc. Inorganics	1.4		0.0	
Noncombustibles Subtotal	20.6		2.4	
TOTAL	100.0%		14.0%	

* Waste stream as disposed after material recycling.
** Gross discards includes total materials generated before recycling or disposal.

Source: U. S. Environmental Protection Agency, Third Report to Congress, 1975; Fred C. Hart Associates, 1980; Metropolitan Council

the City of St. Paul and the Metropolitan Inter-County Association was reviewed to assess their progress toward implementing recycling and resource recovery systems. Finally, based on this information and advice from the Council's Solid and Hazardous Waste Management Advisory Committtee as well as affected industries, objectives were proposed as goals for the Region's land disposal abatement plans for the next 20 years.

Table 4 lists the various materials found in residential and commercial solid waste based on national averages. The first column describes the percent composition by weight of the total discards as generated before any recycling or recovery. The second column describes the percent of the total waste stream recycled due to source separation of each individual material. Although this may not exactly represent the composition of the solid waste in the Twin Cities Metropolitan Area, several important facts are derived from this table:

- As a major category, combustibles represent about 80 percent of the total waste stream.

- The greatest single contributors to the disposal problems are, in order of importance, paper (about 37 percent), yard waste (about 17 percent), and food waste (about 16 percent).

- Noncombustibles, mainly glass and metals, contribute the remaining 20 percent.

- Our current recycling system is probably recovering about 14 percent of the total materials discarded.

- Currently, the greatest impact on the total waste stream comes from recycling paper products, which acounts for over 90 percent of the materials recycled.

- Currently neglible amounts of food and yard waste are being recycled.

- Only a small portion of the glass and metals available is currently being recycled.

Based on this data, information in the preceding sections, and consultations with government, industry and citizen representatives, objectives were proposed for each of the specific materials using five-year target dates. Tables 5 and 6 display the proposed regional objectives for "low-technology" recycling and "high-technology" resource recovery systems. For purposes of these objectives, "low-

Table 5
REGIONAL RECYCLING OBJECTIVES: "LOW-TECHNOLOGY" SYSTEMS*
(Percent by Weight of Net Waste Stream)

Material	Estimated 1980 Recycling Rate (Percent of Each Material Available)	Regional Source Separation Objectives (Net Increase in Percent of Each Material Recovered) 1985	1990	1995	2000	Net Increase in Waste Stream Impact by 2000 (Percent of Net Waste Stream)
Combustibles:						
Newspaper	24%	4-6%	10-16%	20-26%	20-26%	1.2- 1.6%
Books, Magazines	9	0-1	1-3	3-5	5-7	0.2- 0.2
Office paper	15	3-5	20-25	40-45	55-70	2.2- 2.8
Corrugated	70	0-0	0-0	0-0	0-0	0.0- 0.0
Other Paper	12	0-1	1-2	1-2	1-2	0.1- 0.2
Plastic	1	0-1	1-3	3-5	5-7	0.2- 0.3
Rubber	8	0-2	5-7	10-12	15-17	0.3- 0.3
Leather	0	0-1	1-2	2-3	3-4	**- **
Textiles	0	0-1	1-2	2-3	3-4	**- 0.1
Wood	2	1-3	3-5	5-8	5-10	0.2- 0.4
Residential/Commercial Food Waste	0	0-0	0-0	0-0	0-0	0.0- 0.0
Manufacturing Food Waste	0	5-10	10-20	20-30	30-40	0.8- 1.1
Yard Waste	1	15-20	15-20	15-20	15-20	2.8- 3.7
Combustibles Subtotal						8.0-10.7
Noncombustibles:						
Ferrous Appliances	50	5-10	15-20	25-30	35-40	1.4- 1.6
Ferrous Cans	2	1-3	6-8	6-8	6-8	0.3- 0.3
Aluminum Scrap	30	25-30	40-50	40-50	40-50	0.1- 0.2
Aluminum Cans	20	30-40	50-60	50-60	50-60	0.2- 0.2
Other Nonferrous Metals	5	3-5	10-15	20-25	30-35	0.1- 0.1
Glass	2	6-8	10-13	15-18	20-23	2.0- 2.3
Misc. Inorganics	1	0-1	1-3	3-5	5-7	0.1- 0.1
Noncombustibles Subtotal						4.2- 4.8
TOTAL						12.2-15.5%

* "Low-technology" systems include all forms of source separation such as office paper recovery programs, recycling centers, scrap dealers, backyard and centralized open composting and metals salvaging.

**Less than 0.05 percent.

Note: The term "net waste stream" does not include materials currently being recycled, and therefore represents only that portion of all material generated that is now disposed of. Estimates of current recycling in the Region range from eight to 14 percent of total materials generated.

Source: Metropolitan Council

Table 6
REGIONAL RESOURCE RECOVERY OBJECTIVES: "HIGH-TECHNOLOGY" SYSTEMS*
(Percent by Weight of Net Waste Stream)

Material	Present Resource Recovery Rate (Percent of Each Material Available)	Regional Resource Recovery Objectives (Net Increase in Percent of Each Material Recovered) 1985	1990	1995	2000	Net Increase in Waste Stream Impact by 2000 (Percent of New Waste Stream)
Combustibles:						
Newspaper	0%	0-5 %	25-45%	45-70%	64-70%	3.8- 4.2%
Books, Magazines	0	5-10	25-50	50-85	75-85	2.3- 2.6
Office Paper	0	0-5	10-15	15-35	20-35	0.8- 1.4
Corrugated	0	0-2	30-50	50-90	70-90	6.3- 8.1
Other aper	0	5-10	30-50	50-89	70-89	7.7- 9.8
Plastics	0	5-10	30-50	50-85	75-85	2.8- 3.1
Rubber	0	5-10	25-45	45-75	60-75	1.1- 1.4
Leather	0	5-10	30-50	50-87	70-87	0.5- 0.6
Textiles	0	5-10	30-50	50-87	70-87	1.0- 1.2
Wood	0	5-10	30-50	50-85	70-85	2.5- 3.1
Residential/Commercial Food Waste	0	5-10	30-50	50-90	70-90	9.7-12.4
Manufacturing Food Waste	0	5-10	20-30	30-50	40-50	1.1- 1.4
Yard Waste	0	5-10	25-45	45-75	60-75	11.1-13.9
Combustibles Subtotal						50.6-63.2
Noncombustibles:						
Ferrous Appliances	0	0-5	20-40	40-55	50-55	2.0- 3.2
Ferrous Cans	0	5-10	30-50	50-84	70-84	2.9- 3.5
Aluminum Scrap	0	5-10	5-25	5-50	5-50	**- 0.2
Aluminum Cans	0	5-10	5-20	5-40	5-40	**- 0.2
Other Nonferrous Metals	0	0-1	1-2	2-15	2-60	**- 0.2
Glass	0	0-0	1-50	1-50	1-50	0.1- 5.0
Misc. Inorganics	0	0-0	0-1	1-3	3-4	**- 0.1
Noncombustibles Subtotal						5.0-11.4
TOTAL						55.6-74.6%

* Resource recovery "high-technology" includes all centralized facilities which process mixed waste such as energy and biological recovery systems including mechanical separation of marketable materials and shredding equipment.

**Less than 0.05 percent.

Note: The term "net waste stream" does not include materials currently being recycled, and therefore represents only that portion of all material generated that is now disposed of. Estimates of current recycling in the Region range from eight to 14 percent of total materials generated.

Source: Metropolitan Council

technology" systems include all forms of source separation such as office paper recovery programs, recycling centers, scrap dealers, backyard and centralized composting, and salvaging. "High-technology" resource recovery systems, on the other hand, include all centralized facilities that process mixed waste such as energy and biological recovery systems and may employ mechanical separation of marketable items or shredding equipment. The two tables are designed to complement each other so that the combined objectives for the year 2000 will never add up to more than 90 percent of each material available.

These objectives were calculated in the following manner. First, the current recycling rate was identified for each specific material. Second, an additional potential degree of recovery was estimated for the year 2000. These estimates for potential increase in recovery rates were based on market conditions for that specific material and general strategy effectiveness as defined by experience with past and current projects in the country. Third, reasonable projections were estimated for the years 1985, 1990 and 1995, based on the same considerations in addition to estimated implementation periods. Finally, the objectives for each material, in each target year were multiplied by the corresponding percent of total discards from Table 4 to summarize the impact of each line item objective on the total waste stream. The results of this final step, estimation of total waste stream impact, are summarized in the far right column of Tables 5 and 6.

When evaluating these objectives, please note that the recycling objectives listed under each target year in Table 5 are in addition to the current recycling rates. All the objectives listed in Tables 5 and 6 are based on the "net waste stream" as defined above (see Figure 1). Therefore, the source separation objectives from Table 5 must be added to the current recycling rates to obtain the total percent of each material potentially recovered. It is also very important to keep in mind that these objectives for "low-technology" materials recovery through source separation shown in Table 5 represent the Council's "best guess" estimates of additional levels of recycling that are realistically achievable. These objectives are purposely optimistic to indicate what potentials exist for materials recovery from voluntary source separation programs implemented by private organizations, counties, municipalities and neighborhood groups. Although mandatory source separation programs are recognized to be more effective and are certainly feasible on a local scale, because of the diversity of our present disposal and recovery systems, and because of the fragmentation of solid waste authorities in the Region, it was assumed for purposes of these objectives that there would not be a mandatory region-wide source separation system.

Comparing Tables 5 and 6 reveals that regional objectives for land disposal abatement are very material-specific, even down to the subcategories such as paper grades, metal types and colors of glass. This is not surprising since the viability of the specific strategies listed in Section 3 are inherently dependent on the regional materials and energy markets. The two tables also reveal that the Region must rely on both low- and high-technology systems to reduce future landfill needs. Table 5 indicates that source separation systems should account for the vast majority of the Region's recovery for the next five years, similar to the present system, only larger. Then, by 1990, high-technology systems should be on line to recover the fuel and organic value of solid waste that cannot be obtained by low-technology systems. Once both systems are fully operational, they will complement each other. For instance, it is not now technically possible to recover high-quality, "clean" glass through mechanical separation. Therefore, the Region should depend on source separation to chieve maximum glass recovery and improve the energy value of the remaining mixed waste. Similar objectives are proposed for the other noncumbustibles, except for ferrous cans, since current magnetic separation technology permits high-volume recovery of ferrous from mixed waste.

The current recycling rates and objectives for paper indicate that the Region is already near the optimum recycling rate for corrugated and about half of the "market saturation point" for newspaper. The 70-percent recovery rate for corrugated is projected to continue over the long run. If a stable supply of newspaper can be established, new markets will more likely develop in the Region. Current market conditions for office paper are excellent with essentially unlimited potential for increased recovery. The other grades of paper are less valuable and therefore the objectives show that these will most likely stay in the mixed waste stream and be made available for energy or biological recovery systems.

The source separation objectives for rubber and wood indicate that because of their fuel value, they may be removed before the mixed waste stream is disposed. Wood-burning boilers and household stoves may increase the demand for waste wood. Experiments are currently being conducted on the feasibility of tire shredders and boilers that can process separated waste rubber as a supplemental fuel. The metropolitan counties should investigate alternative uses for tires and consider the option of a ban on all tires from landfills.

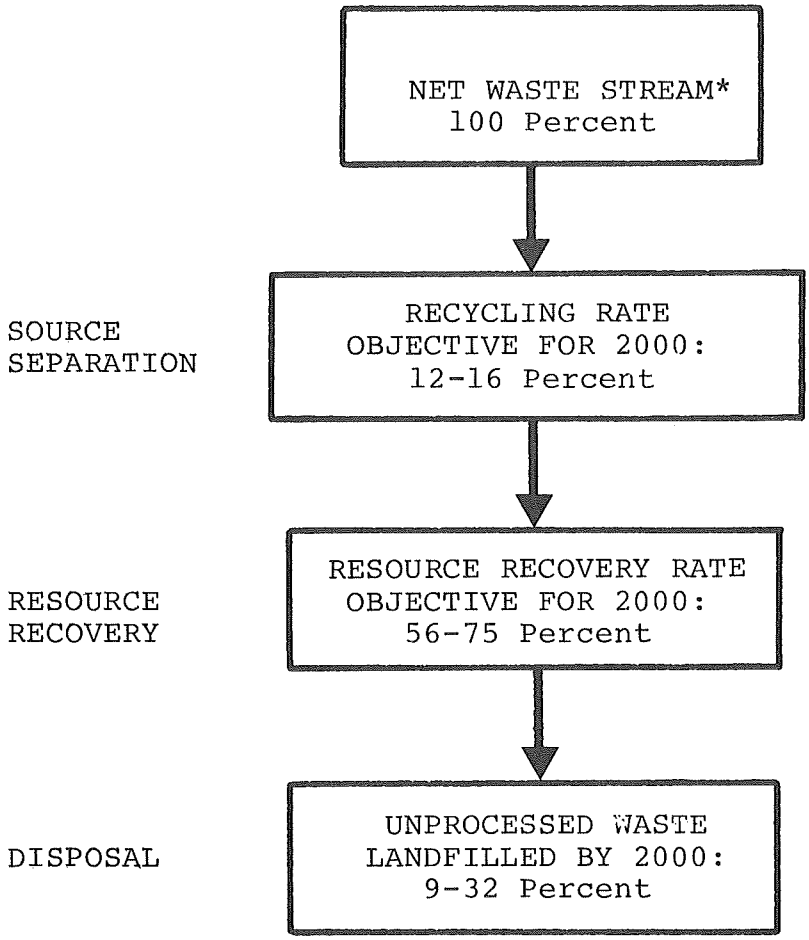
Table 4 indicates that about 2.6 percent of the waste stream is manufacturing food waste produced from food processors and canners. This is a presorted organic feedstock, which is readily available for composting, methane, or alcohol recovery systems. Therefore, the manufacturing food waste objectives reflect an immediate dependence on source separation of this material. Residential and commercial food waste, however, is not ordinarily separated from other materials and would be difficult to recover through recycling techniques. However, the high energy content of this significant portion of the waste stream lends itself to high-technology mixed waste recovery.

Table 6 indicates that about 56 to 75 percent of the Region's waste should be handled by high-technology systems by the year 2000. Most of the significant facilities should be on line and fully operational by 1990. Figure 2 summarizes waste separation and resource recovery objectives. Although the values were based on objectives for specific materials, as shown in Tables 5 and 6, the total waste stream impact of these two strategy categories is summarized in Figure 2 to illustrate the priority of abatment strategies. The objectives for waste separation, 12 to 16 percent, were established first and then the balance (up to about 90 percent) was allocated to resource recovery systems (56 to 75 percent). This results in a range of about nine to 32 percent of the net waste stream being landfilled as unprocessed waste by the year 2000.

Table 7 summarizes the results of this type of projection along with the other two strategy categories: waste reduction and source separation. It is evident that at this time, without any new legislative actions, waste reduction will play only a minor role in the total regional waste management system. Nonetheless, mulching of grass clippings and public education strategies are still important and deserve careful consideration and planning. Public participation and awareness will be essential for many of the source separation strategies and important for the general acceptance of high-technology system costs.

Waste processing (shredding and baling) may play a significant role during the interim period before high-technology development. If 30 percent of the Region's landfill capacity were used in combination with shredding and baling equipment, it would reduce total wastes by 18 percent by the year 1985, assuming a 60-percent volume reduction. It may be possible that these landfill shredders could be replaced by shredding equipment at the centralized resource recovery facilities by the year 1990.

Figure 2
SUMMARY OF LAND DISPOSAL ABATEMENT OBJECTIVES
(Percent by Weight of Net Waste Stream)



Note

The term "net waste stream" does not include materials currently being recycled, and therefore represents only that portion of all material generated that is now disposed of. Estimates of current recycling in the Region range from 8 to 14 percent of total materials generated.

Table 7
SUMMARY OF REGIONAL LAND DISPOSAL ABATEMENT OBJECTIVES
(Percent by Weight of Net Waste Stream)

	REGIONAL OBJECTIVES			
	Percent of Total Wastes Generated			
	1985	1990	1995	2000
Waste Reduction				
Office Paper Reduction	0.1-0.2%	0.2-0.3%	0.3-0.4%	0.4-0.5%
Newsprint Conservation	0.1-0.2	0.2-0.3	0.3-0.4	0.4-0.5
Mulching Grass Clippings	0.1-0.5	0.5-1.0	1.0-1.5	1.5-2.0
Public Education and Awareness	--------- As much as possible ----------			
	Percent of Total Wastes After Reduction			
	1985	1990	1995	2000
Waste Separation (Low-Technology Systems Only)				
Combustibles	14.2-16.2%	16.4-18.7%	18.8-20.8%	19.6-22.3%
Noncombustibles	3.4- 4.0	4.4- 5.2	5.4- 6.1	6.3- 7.0
Total	17.6-20.2	20.8-23.9	24.2-26.9	25.9-29.3
Resource Recovery (High-Technology Systems Only)				
Combustibles	2.8-6.6	27.5-34.2	34.1-40.1	41.2-51.0
Noncombustibles	0.2-0.6	2.5- 3.3	5.9- 7.0	6.8- 8.4
Total	3.0-7.2	30.0-37.5	40.0-47.1	48.0-59.4
TOTAL WASTE SEPARATION AND RESOURCE RECOVERY	20.6-27.4	50.8-61.4	64.2-74.0	73.9-88.7
Waste Processing (Shredding and Baling)				
Total Waste Processed Without Recovery	15.0-18.0	3.0- 6.0	0.0- 3.0	0.0- 0.0
TOTAL WASTE SEPARATION, RESOURCE RECOVERY, AND WASTE PROCESSING	35.6-46.4%	53.4-67.4%	64.2-76.9%	73.9-88.7%

An ideal, comprehensive system for solid waste management should include elements of all four abatement categories. However, even under an ideal system, there will always be some remaining residue that cannot be recovered and must be landfilled. In addition, although these systems can complement each other, they may sometimes compete for the same materials. For instance, paper can either be recycled into new paper, burned for its energy content, or shredded and composted with other organics. Therefore, management decisions concerning these various strategies should certainly consider the best use of the materials and efficiencies of the entire system. If facility planning includes careful examination of alternative recovery systems, over-design and cost overruns can be avoided through comprehensive management plans that include all feasible strategies.

The Council has determined that the objectives proposed within this section are realistically achievable for the Seven-County Area. The degree to which these objectives are achieved will depend on the level of commitment of the counties, cities and townships as well as the private sector. Specific actions for each are recommended in the following section. Since authority for implementation of reduction and recovery programs rests with counties, municipalities and private enterprises, these decision-making bodies must choose their own appropriate mix of strategies to help the Region realize these objectives.

6. RECOMMENDATIONS

The Waste Management Act of 1980 states that the Council's land disposal abatement report shall recommend priorities and objectives for abating, immediately and over specified time periods, the disposal of mixed municipal solid waste in the Metropolitan Area. The 1980 act also requires the report to contain development schedules for implementation of the various strategies recommended. The recommended development schedules are contained in Section 7.

The following recommendations are intended for use primarily by the counties for guidance in developing specific abatement proposals called for in the 1980 act. However, success in meeting the regional abatement objectives will depend on cooperative efforts of all levels of government and the private sector. The recommendations may be carried out in accordance with the timing and sequence of events as set forth in the development schedules (see Section 7).

ACTIONS BY GOVERNMENTAL UNITS

In order to achieve the regional goals in the previous section, the following recommendations are proposed for action by counties, cities, townships and school districts. The recommendations call for government to undertake various reduction and waste recovery strategies, including support of private sector efforts. All of the recommendations may not necessarily be carried out by any one unit of government. In fact, some of the recommendations best apply to the urbanized portion of the Region and may not be appropriate for rural areas, and vice versa. Actions that the Council considers to have the highest priority at this time are indicated by an asterisk (*). Each county, in consultation with its municipalities, must decide on the best mix of these various strategies depending on local conditions.

1. WASTE REDUCTION

1.a. General Evaluation

The metropolitan counties should evaluate, and where feasible, implement waste reduction strategies as part of the land disposal abatement planning process. The Council should expand its evaluation of specific waste reduction strategies to prepare for the solid waste policy plan amendments on land disposal abatement.

1.b. Office Paper Reduction

All units of government, including school districts, should support office paper reduction through adoption of specific administrative policies for procurement, paper use and in-office recycling.

1.c. Procurement Policies

All units of government, including school districts, should adopt procurement policies that favor the purchase of materials with the longest warranties.

1.d. Public Education and Awareness*

The MPCA and the Council, in coordination with the solid waste industry, should develop state and regional public education and awareness programs on waste reduction and resource recovery. The Minnesota Environmental Education Board, Department of Education and school districts should be encouraged to participate in the development and operation of this public education program. The metropolitan counties should allocate solid waste and/or public affairs staff to help the MPCA and Council disseminate waste reduction information.

2. WASTE SEPARATION

2.a. Technical Assistance and Publicity*

The MPCA, Council and metropolitan counties should support existing and new recycling centers through technical assistance and publicity, distributed on an equitable and fair basis. This technical assistance and publicity program should include the following tasks:

- The MPCA, Council and metropolitacounties, in cooperation with the solid waste industry, should establish an intergovernmental publicity program to promote and foster recycling in the Region. An intergovernmental recycling committee should be established to promote existing programs and advise local units of government on the need for new programs. Such a committee should be made up of both public and private officials.

- The MPCA and Council should develop recycling management and training programs. Such programs should be developed cooperatively with

the private sector. These management and training programs should be made available to communities and individuals interested in developing recycling programs.

- Municipalities and townships should publicize the location and hours of operation of local recycling centers.

2.b. School District Source Separation

School districts should examine the feasibility of developing source separation programs as a revenue-raising measure. Counties and municipalities should provide assistance to school districts to develop such programs.

2.c. Collection Points and Cooperatives

The metropolitan counties and municipalities should foster and promote recycling collection points and cooperatives.

2.d. Collection Points*

Local units of government should examine the feasibility of providing sites and facilities for collection points for recyclable materials unless this service is reasonably available by private or volunteer groups. Local units of government should first promote private recycling programs.

2.e. Subsidizing Collection Centers*

Local units of government should examine the feasibility of subsidizing collection centers.

2.f. Curb-side Source Separation*

The metropolitan counties should consult with each municipality to examine the feasibility of curb-side source separation programs. The first phase of any examination study should include a market analysis. Counties should also examine strategies for small municipalities and rural areas to encourage increased materials recovery.

2.g. Model Source Separation Ordinances*

The MPCA and Council should develop model source separation ordinances. The metropolitan counties should work with municipalities and townships to examine the feasibility of implementing these ordinances.

2.h. Yard Waste*

The metropolitan counties should examine the economic feasibility, efficiencies, and methods for increasing separate yard waste pickup and processing. Specific equipment and land that the county and its municipalities intend to allocate for composting operations should be identified.

2.i. In-Office Paper Recycling*

All units of government should implement, if feasible, in-office paper recycling programs to recover the high-quality bond paper through employee source separation programs. Technical assistance for implementation and procurement should be provided by the State Resource Recovery Office within the State Department of Administration. If feasible, local units of government should "piggyback" on other procurement and recycling programs to gain efficiencies of scale.

2.j. Procurement

The following procurement recommendations should be considered by all local units of government, including school districts, to increase market demand of recycled products:

- All local units of government should establish a policy to increase proportionately purchases of recycled products by 10 percent by 1990 and 20 percent by 2000.

- The Council should complete a legal and feasibility analysis to determine if all local units of government should establish a 10-percent preference for recycled products. This analysis should include, but not be limited to, the following considerations: suitability of product to meet function intended, cost competitiveness of recycled products, minimum performance standards and availability.

- All local units of government should eliminate specifications and guidelines for soliciting bids that require virgin materials exclusively, where practical.

- Specifications for all office papers should not require a minimum brightness factor of greater than 55.

- All local units of government should procure, to the extent possible, materials that can be recycled.

- All local units of government should establish performance standards on motor oil so that re-refined oil can compete on motor oil bids.

- All local units of government should establish specifications so that recapped tires can be used on vehicles.

2.k. Salvaging

Local units of government should encourage landfill and transfer station operators to implement separation and salvaging methods, where possible.

2.l. Mechanical Separation

Metropolitan counties should investigate the potential for mechanical separation at existing and future transfer stations and landfills.

3. WASTE PROCESSING

Shredding and Baling*

Metropolitan counties, in consultation with each other, should propose a regional system of transfer stations, with the renovation of existing facilities and development of new ones, where necessary. Within the proposed regional transfer station system and landfill system, the counties should investigate the cost-effectiveness of shredding and baling to reduce landfill volume and cover requirements.

4. RESOURCE RECOVERY

4.a. Energy Recovery*

Metropolitan counties should continue energy recovery facility planning to meet the Region's long-range

disposal and recovery requirements. The metropolitan counties should develop other management techniques, such as waste reduction, waste separation and waste processing, while energy recovery systems are being developed. Any specific project proposal should contain an analysis of the impacts on existing recovery systems.

4.b. Modular Combustion Units*

The solid waste energy market analyses of the metropolitan counties should include the feasibility of using small, modular combustion units.

4.c. Composting, Methane Digesters and Alcohol Production

The MPCA, Council and metropolitan counties should initiate or continue investigations of the feasibility of composting, methane digester and alcohol production alternatives. The counties should coordinate compost market analysis with MPCA, the Minnesota Department of Agriculture, the Metropolitan Waste Control Commission, the Metropolitan Council and the University of Minnesota Extension Service.

4.d. Backyard and Centralized Composting*

Local units of government should develop programs, including public education, to increase backyard and centralized, community composting by citizens, cities and townships.

4.e. Innovative Research

The MPCA, Council and metropolitan counties should investigate innovative research and development by other agencies and firms of other solid waste management alternatives.

4.f. Wood Fiber Processing

The metropolitan counties, through the coordination of the Council and the Department of Agriculture's shade tree program, should investigate the possibility of increasing the Region's processing capacity to handle both diseased wood and storm-damaged material to reduce the need for open burning and landfilling of wood fiber resources.

5. ORGANIZED COLLECTION

5.a. Organized Collection Task Force*

The Council should establish an advisory task force to include representatives from private hauling firms, owners of transfer stations and landfills, metropolitan counties, municipalities, townships, MPCA, generators (citizens and industry) and recycling industries, to evaluate the feasibility of an organized collection system in the Region. This task force should outline the need and purpose of such an organized collection system--for example, to make refuse collection more efficient, promote recycling and resource recovery programs, and allow more local control over collection service.

5.b. Economic Impacts and Mechanisms

The task force should examine the economic feasibility and impacts of an organized collection system and examine the mechanisms for implementing an organized collection system, such as county and municipal ordinances and licenses controlling collection and disposal services, and city and township contracts with haulers.

5.c. Model Ordinances

The Council, with assistance from the already-mentioned advisory task force, should develop model ordinances and contracts for counties and other local units of government that could be used to establish community-based organized collection.

5.d. Mandatory Collection

The Council, with assistance from the above-mentioned advisory task force, should examine the need for mandatory collection ordinances that could be adopted by counties and other local units of government.

6. FINANCING MECHANISMS

6.a. Comprehensive Billing*

The Council (in coordination with all local units of government, MPCA, private haulers, and owners of transfer stations and landfills, and recycling industry representatives) should evaluate the feasibility of a comprehensive billing system that would identify and return the actual costs of waste collection, disposal

and overall management back to the original generators. This should be coupled with the evaluation of an organized collection system.

6.b. Variable Collection Rates*

The Council (in coordination with all local units of government, MPCA, private haulers, and owners of transfer stations and landfills) should investigate the feasibility of collection rates that vary according to the quantity generated (that is, a user-based rate).

6.c. Tax Incentives

Local units of government should assist and encourage recycling and recovery industries to determine if they can qualify for state and federal tax incentives for recycling programs (such as the 10-percent federal tax credit for new recycling equipment and the five-percent state tax credit for pollution control facilities).

6.d. Grants

Local units of government, with assistance from the Council, should determine if they can qualify for state, federal and other grants for collection and recovery programs.

6.e. Loans and Rebates

Metropolitan counties should design their own incentives to encourage recovery programs through tax-free loans and fee rebates.

6.f. County Funds

Metropolitan counties should examine the feasibility of establishing their own funds from various local sources (such as local waste surcharges on disposal facilities and general tax revenues).

7. DEMONSTRATION AND ANALYSIS

7.a. Waste Stream Analysis*

The metropolitan counties and the Council, through the continuing land disposal abatement planning process, should initiate a scientifically controlled analysis of the specific composition and amount of the local solid waste stream, using standardized solid waste sampling techniques.

7.b. Composting Demonstration

The MPCA and the Council should initiate a composting demonstration project to determine the feasibility of using food and other scrap wastes as a bulking agent for sludge composting.

7.c. Compost Market Study*

The MPCA, Metropolitan Waste Control Commission, Minnesota Department of Agriculture, the Council and the University of Minnesota Extension Service should conduct an in-depth market study to assess the demand for compost products made from solid waste and sewage sludge.

ACTIONS BY PRIVATE INDUSTRY

The 1980 Waste Management Act requires the Council's land disposal abatement report to include recommendations for private sector actions and levels of expenditure necessary to achieve the report's goals and objectives. The following recommendations suggest a high level of involvement by the private sector in developing waste reduction and recovery programs. All of these recommendations are voluntary and carry no legal authority. Nonetheless, private sector cooperation and involvement will continue to be essential if the best abatement strategies are to be successfully implemented.

1. WASTE REDUCTION

1.a. Conservation and Recycling

All commercial and industrial enterprises should examine the materials balance (that is, the amount of raw material purchased as it relates to the amount of solid waste produced) of their processes to determine if conservation and recycling techniques could reduce waste generated.

1.b. State Packaging Program

The packaging industry should continue to work with the MPCA during the evaluation of the state packaging program.

1.c. Office Paper Reduction

All business, commercial and industrial establishments should support office paper reduction through adoption of specific administrative policies for procurement, paper use and in-office recycling.

1.d. Warranty Policies

All private companies should adopt procurement policies, where feasible, that favor the purchase of materials with the longest warranties.

1.e. Newspaper Conservation

Newspaper companies should examine newspaper conservation policies to determine their feasibility and impact.

1.f. Public Education and Awareness*

Private industry should work with the public sector in developing public education and awareness programs (see recommendations for governmental actions under "Waste Reduction").

2. WASTE SEPARATION

2.a. Increasing the Capacity of Markets*

Private industry should develop recommendations to be submitted to local, regional and state units of government detailing potential methods of governmental assistance to help increase the capacity of current materials markets in the Region.

2.b. New Materials Markets*

Private industry should assist local, regional and state units of government in investigating methods of developing new materials markets in the Region.

2.c. Public Education and Awareness*

All recycling centers and parent companies should cooperate with government agencies to develop the most efficient public education campaign possible.

2.d. In-Office Paper Recycling

All private companies should implement in-office paper recycling programs to reduce waste generated and related disposal charges.

2.e. Procurement

All private companies should consider the same procurement recommendations listed for local units of government (see governmental actions under "Waste Separation") to increase market demand of recycled products and to facilitate recycling.

2.f. Building Designs

In the design of all buildings, waste separation procedures should be considered to allow adequate storage space for recyclable materials.

2.g. Demolition of Buildings

In plans for demolition of buildings, salvaging operations should be considered and separate containers provided for marketable items, when feasible.

2.h. Upgrading Transfer Stations

Transfer station operators and owners should consider upgrading existing facilities to include separation methods.

3. WASTE PROCESSING

All transfer station and landfill owners should examine the feasibility and costs of shredding and baling operations. Study of environmental impacts of these strategies should be coordinated with the MPCA.

4. RESOURCE RECOVERY: ENERGY RECOVERY COORDINATION AND PUBLIC INFORMATION*

Private waste management firms involved with energy recovery facility planning should continue to coordinate their efforts with the metropolitan counties and develop an efficient system of public information relating to specific projects.

5. ORGANIZED COLLECTION: ORGANIZED COLLECTION TASK FORCE*

The refuse collection industry should select representatives to serve on the Council's advisory task force proposed to examine the feasibility of an organized collection system in the Region. All private hauling firms should be given an opportunity to comment on any proposal developed by the task force.

6. FINANCING MECHANISMS

6.a. Tax Incentives

All private recycling and recovery establishments should determine if they can qualify for state and federal tax incentives for recycling programs (such as the 10-percent federal tax credit for new recycling equipment and the five-percent state tax credit for pollution control facilities).

6.b. Federal Grants

All private recycling and recovery establishments should determine if they can qualify for federal grants from the U.S. Environmental Protection Agency, Department of Housing and Urban Development, and the Small Business Administration for recovery programs.

6.c. Cooperative Financing Options

Private industry, with local governmental units, should investigate various cooperative financing options.

6.d. Information Service

The Waste Management Board, MPCA and the Council should coordinate an information service that identifies and describes current financial assistance and arrangements for recycling and recovery programs.

POTENTIAL LEGISLATIVE AND OTHER ACTIONS

Although the 1980 act did not require the Council's land disposal abatement report to recommend actions by the State Legislature and U.S. Congress, the greatest potential for improving the current recovery system lies with these higher levels of government. The following recommendations call for continued evaluation of various legislative issues dealing with waste reduction and recovery. Both government and the private sector should work together in support of new legislation that will most effectively and efficiently reduce the Region's dependence on land disposal to handle solid wastes.

1. WASTE REDUCTION

1.a. Container Deposits

The Council, MPCA and metropolitan counties should evaluate the container deposit issue, including an analysis of the costs and benefits of other states' programs and develop recommendations as may be necessary for the Legislative Commission on Waste Management.

The Minnesota Legislature should consider container deposit legislation at a time when the costs and benefits of other states' programs are known and objectively analyzed.

1.b. Packaging Rules

The Council and the metropolitan counties should assist the MPCA in its continuing evaluation of the state packaging rules.

1.c. Product Charges

The Council and affected industries should assist the MPCA in evaluating the costs and benefits of product charges.

1.d. Bans

The Council, the metropolitan counties and affected industries should assist the MPCA in evaluating the costs and benefits of bans of certain products and materials from landfills.

1.e. Newspaper Conservation

The MPCA should continue to examine the value of newspaper conservation policies, such as printing format changes, and attempt to work with newspaper companies in developing voluntary conservation programs before mandatory programs are considered.

1.f. Waste Surcharges

The Council, in cooperation with the metropolitan counties, should continue to evaluate the waste stream impacts of local waste surcharges on disposal facilities to be used only within the solid waste management system.

1.g. Labeling System

The Minnesota Legislature should examine the feasibility of a packaging and product labeling system to help the consumer determine the composition of the item, and whether it is made from recycled materials and whether it can be recycled.

2. FINANCING MECHANISMS

2.a. MPCA Demonstration Program

The State Legislature should extend the time period for projects funded under the 1980 Waste Management Act's demonstration program administered by the MPCA.

2.b. State Department of Administration Resource Recovery Program

The State Legislature should consider providing a second legislative appropriation to ensure the state resource recovery program's continuation until the program can be sustained by revenues derived from the sale of recovered waste materials.

2.c. Freight Taxes

The State Legislature and U.S. Congress should examine the possibilities of removing freight taxes on scrap metal and other secondary materials.

2.d. Virgin Materials Tax Preference

The U.S. Congress should continue to examine removing the preferential tax treatment of virgin materials.

2.e. Investment Tax Credit

The State Legislature should consider the proposal of the MPCA to establish a state 10-percent investment tax credit on the purchase of new recycling equipment, similar to the federal credit now in existence.

2.f. Tax Incentives

The Council and MPCA should continue to investigate innovative tax incentives including, but not limited to, real estate tax reductions and modifications, sales tax modifications, income tax modifications, tax exempt mortagage options, state income materials credits, and possibilities of reinstating the new jobs

credit. These should be looked at to determine their possible legislation as encouragement of recycling and recovery activities.

2.g. Product Charges

The Council and affected industries should assist the MPCA in evaluating the use of a product charge to establish funds for recovery programs.

2.h. Pollution Fines

The metropolitan counties and MPCA should consider using pollution fines to establish a fund for recovery programs.

2.i. Technical Assistance Funds

The Minnesota Legislature should consider the need for additional appropriations to the Council and counties to complete the actual abatement tasks beyond the existing planning funds.

7. REGIONAL DEVELOPMENT SCHEDULES

The Waste Management Act of 1980 requires that the land disposal abatement report include schedules for developing abatement programs. Table 8 shows recommended regional development schedules for programs to be carried out by local government and private industry, as discussed in Section 6, "Recommendations." The development schedules are intended to show the approximate timing and sequence of events that could occur, assuming full governmental and private industry participation in recommended land disposal abatement activities. The development schedules are merely guides for action, and will have to be refined as specific project proposals are developed. Development schedules specific to each county will have to be developed as part of the Council's regional land disposal abatement plan due by 1983.

The development schedules show the target year (T) when programs should be in full operation if the project receives favorable evaluations based on economic, technical and institutional criteria. Also shown are the projected dates for evaluation reports (X) for specific aspects of each strategy. Many of the strategies will require a "go" or "no-go" decision at these points.

Table 8 shows that waste reduction and source separation programs could generally be implemented much sooner than the higher-technology options. In most instances, waste reduction and source separation do not require the extensive amount of project planning, design, siting and financing that is normally associated with the high-technology resource recovery projects. Waste reduction and source separation programs could greatly contribute to the abatement of future landfill needs by serving the Region's solid waste management system as both short-term, interim measures and long-term ongoing programs.

The development schedules show that waste reduction and source separation programs should be in full operation within the next five to six years. At that point, these programs could continue to serve the Region's solid waste management needs on an ongoing basis as the more expensive, high-technology options become operational.

The development schedules show the maximum effectiveness of high-technology resource recovery to be achieved in the next five to 10 years. The smaller, less expensive modular combustion units could be developed and in full operation by 1986. The large, capital-intensive solid waste energy facilities could be developed and serving the Region's

waste management needs as early as 1987. These systems, coupled with the low-technology reduction and separation options, could, it seems, effectively replace the Region's solid waste landfill needs by as much as 68 to 90 percent. The development schedules show a number of abatement activities as ongoing, with no specific target dates or maximum effectiveness period. In particular, recommendations for increased public education and information activities might be developed over the next couple of years and then continued as ongoing programs. Other abatement activities and programs could be developed quickly and continued on an ongoing basis.

The development schedules give highest priority generally to those programs and activities that could be developed from current state-of-the-art techniques. These should be undertaken immediately without any further research and development. On the other hand, a number of the abatement recommendations involve unproven technologies and management methods, and these require further research and analysis. Study, research and demonstration of such methods should continue, but not at the expense of immediately implementable steps to abate landfill needs.

All of the abatement recommendations are important for abating landfill needs. The recommendations are not ranked, however, according to the priority they may have in achieving abatement objectives, except as they meet the guidelines of the Council's solid waste policy plan. The policy plan gives first preference to waste reduction, followed by, in order of priority, waste separation, waste processing and resource recovery. Notwithstanding, the Council's solid waste policy plan also recognizes that future solid waste management must be a comprehensive system that will include a combination of waste management strategies, including reduction, separation and resource recovery.

Table. 8
REGIONAL DEVELOPMENT SCHEDULE

GOVERNMENT ACTIONS

* = Highest priority.
T = Target year for full operation if project receives favorable evaluations.
X = Evaluation report.

Recommendation	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	//	2000
1. WASTE REDUCTION												
1.a. General Evaluation												
County Evaluation	-----X											
Council Evaluation	-X------X											
Education	----------											
Implementation	----------T----------											
1.b. Office Paper Reduction												
Planning	-----X---											
Education	---------											
Implementation	-----T-------X----------											
1.c. Procurement Policies												
Planning	-----X--											
Education	---------											
Implementation	-----T-------X----------											
1.d. Public Education and Awareness*												
Planning	-----X--											
Education	---------------X----------											
Implementation	----T----------X----------											
2. WASTE SEPARATION												
2.a. Technical Assistance and Publicity*												
Planning	---------											
Regional Publicity	---X---T----------X----------											
Management Program	-X---------T----X----------											
Local Publicity	-----X---T----------X----------											
2.b. School District Source Separation												
Planning	-----X--											
Education/Marketing	---X---											
Implementation	------------T----X----------											
2.c. Collection Points and Cooperatives												
Planning	-----X--											
Implementation	----------T------X----------											
2.d. Collection Points*												
Planning	-----X--											
Education/Marketing	----------											
Implementation	--------T------X											
2.e. Subsidizing Collection Centers*												
Planning	-----X--											
Education	--------------											
Implementation	---------T---X----------											

Table 8 (Cont.)
REGIONAL DEVELOPMENT SCHEDULE

GOVERNMENT ACTIONS (Cont.)

* = Highest priority.
T = Target year for full operation if project receives favorable evaluations.
X = Evaluation report.

Recommendation	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	//	2000
2.f. Curb-side Source Separation*												
Planning			X									
Market Analysis			X									
Pilot Tests					X							
Education												
Full Implementation												
2.g. Model Source Separation Ordinances*												
Planning			X									
Implementation					X					T		
2.h. Yard Waste*												
Planning			X									
Education												
Implementation				X		T		X				
2.i. In-Office Paper Recycling*												
Planning			X									
Education/Marketing												
Implementation					T			X				
2.j. Procurement												
Planning			X									
Implementation							T		X			
2.k. Salvaging												
Planning			X									
Education												
Implementation							T		X			
2.l. Mechanical Separation												
Planning			X									
Education/Marketing												
Implementation								T		X		
3. WASTE PROCESSING												
Shredding and Baling*												
Planning			X									
Siting & Design												
Construction & Start-up												
Operation								T		X		

Table 8 (Cont.)
REGIONAL DEVELOPMENT SCHEDULE

GOVERNMENT ACTIONS (Cont.)

* = Highest priority.
T = Target year for full operation if project receives favorable evaluations.
X = Evaluation report.

Recommendation	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990 // 2000
4. RESOURCE RECOVERY										
4.a. Energy Recovery*										
Planning			X							
Siting & Design										
Construction & Start-up										
Operation									T	X
4.b. Modular Combustion Units										
Planning			X							
Siting & Design										
Construction & Start-up										
Operation									T	X
4.c. Composting, Methane Digesters and Alcohol Production										
Feas. Analysis			X							
Planning			X							
Marketing			X							
Siting & Design										
Construction & Start-up										
Operation									T	
4.d. Backyard and Centralized Composting*										
Planning			X							
Education/Marketing										
Siting & Design										
Construction & Start-up										
Operation									T	
4.e. Innovative Research										
Information Collection and Analysis	ongoing									
Summary Reports	ongoing									
Develop Recommentation	ongoing									
4.f. Wood Fiber Processing										
Planning	ongoing									
Education	ongoing									
Implementation	ongoing									

Table 8 (Cont.)
REGIONAL DEVELOPMENT SCHEDULE

GOVERNMENT ACTIONS (Cont.)

* = Highest priority.
T = Target year for full operation if project receives favorable evaluations.
X = Evaluation report.

Recommendation	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	//	2000
5. ORGANIZED COLLECTION												
Organized Collection Task Force*												
Dev. Work Program	------											
Form Task Force		----										
Anal. Mechanisms			---X---									
Anal. Econ. Impacts			---X---									
Anal. Mandatory Coll.	---X---											
Recommendations & Public Review		--X------										
Implementation			--------T---X----------									
6. FINANCING MECHANISMS												
6.a. Comprehensive Billing*												
Feas. Analysis	-----X											
Planning		-----X----										
Education			----------									
Implementation			---------T---X----------									
6.b. Variable Collection Rates*												
Feas. Analysis	-----X											
Planning		-----X----										
Education			----------									
Implementation			---------T---X----------									
6.c. Tax Incentives												
Update Info. Dist.	-----X----------											
Develop Ref. Ser.	-----X---											
Implement Service		------T----------X----------										
6.d. Grants												
Update Info. Dist.	-----X----------											
Develop Ref. Ser.	-----X---											
Implement Service		------T----------										
6.e. Loans and Rebates												
Feas. Analysis	-----X---											
Planning	-----X---											
Education		----------										
Implementation		---------T-----X----------										

Table 8 (Cont.)
REGIONAL DEVELOPMENT SCHEDULE

GOVERNMENT ACTIONS (Cont.)

* = Highest priority.
T = Target year for full operation if project receives favorable evaluations.
X = Evaluation report.

Recommendation	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	//	2000
6.f. County Funds												
Feas. Analysis	-----X											
Planning	---X---											
Education	----------											
Implementation	----------T---X----------											
7. DEMONSTRATION AND ANALYSIS												
7.a. Waste Stream Analysis*												
Dev. Work. Prog.	-X--											
Dev. Fund. Agree.	--X											
Conduct Analysis	------											
Summarize Results	--X--X											
7.b. Composting Demonstration												
Dev. Work. Prog.	----X											
Dev. Fund. Agree.	-----X											
Site Selection	----											
Public Education	------X											
Conduct Demonstration	----X---											
Summarize Results	--X-------X											
7.c. Compost Market Study*												
Dev. Work Pro.	---X											
Dev. Fund. Agree.	----X											
Conduct Study	----X											
Summarize Results	----X											

ACTIONS BY PRIVATE INDUSTRY

1. WASTE REDUCTION												
1.a. Conservation and Recycling												
Materials Analysis	---X----------											
Dev. Recommendations	--X----------X											
Implement Programs	---------T-----X----------											
1.b. State Packaging Program												
Planning	(presently ongoing)											
Education	---X----------T----------											
Implementation	----------T-----X----------											

Table 8 (Cont.)
REGIONAL DEVELOPMENT SCHEDULE

ACTIONS BY PRIVATE INDUSTRY (Cont.)

* = Highest priority.
T = Target year for full operation if project receives favorable evaluations.
X = Evaluation report.

Recommendation	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990 // 2000
1.c. Office Paper Reduction										
Planning		X								
Education				T		X				
Implementation				T		X				
1.d. Warranty Policies										
Planning		X								
Education				T		X				
Implementation				T		X				
1.e. Newspaper Conservation										
Planning		X								
Education				T		X				
Implementation				T		X				
1.f. Public Education and Awareness*										
Planning		X								
Education						X				
Implementation			T			X				
2. WASTE SEPARATION										
2.a. Increasing the Capacity of Markets*										
Develop recommendations		X				X				
Education						X				
Implementation						X		T		
2.b. New Materials Markets*										
Planning		X				X				
Implementation						X			T	
2.c. Public Education and Awareness*										
Planning										
Regional Publicity		X		T			X			
Management Program		X				T		X		
Local Publicity		X		T			X			
2.d. In-Office Paper Recycling										
Planning		X								
Education/Marketing										
Implementation				T			X			

Table 8 (Cont.)
REGIONAL DEVELOPMENT SCHEDULE

ACTIONS BY PRIVATE INDUSTRY (Cont.)

* = Highest priority.
T = Target year for full operation if project receives favorable evaluations.
X = Evaluation report.

Recommendation	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990 // 2000
2.e. Procurement										
Planning	-----X--									
Implementation		----------T-X----------								
2.f. Building Designs										
Planning		--X-----								
Education		----------								
Implementation		---------T----X----------								
2.g. Demolition of Buildings										
Planning		--X-----								
Education		----------								
Implementation		---------T----X----------								
2.h. Upgrading Transfer Stations										
Planning	---X-------									
Implementation		----------T----X----------								
3. WASTE PROCESSING										
Planning	---X-------									
Education		----------								
Implementation		----------T----X----------								
4. RESOURCE RECOVERY*										
Planning	-----X----------									
Siting & Design		----------								
Construction & Start-up			----------							
Operation				----------T--X----------						
5. ORGANIZED COLLECTION										
Organized Collection Task Force*										
Dev. Work Program	------									
Form Task Force	----									
Anal. Mechanisms	---X---									
Anal. Econ. Impacts	---X---									
Anal. Mandatory Coll.	---X---									
Recommendations & Public Review	--X------									
Implementation		---------T---X----------								

Table 8 (Cont.)
REGIONAL DEVELOPMENT SCHEDULE

ACTIONS BY PRIVATE INDUSTRY (Cont.)

* = Highest priority.
T = Target year for full operation if project receives favorable evaluations.
X = Evaluation report.

Recommendation	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990 // 2000
6. FINANCING MECHANISMS										
6.a. Tax Incentives										
Qualification Analysis				ongoing						
6.b. Federal Grants										
Qualification Analysis				ongoing						
6.c. Cooperative Financing Options										
Planning		---X								
Implementation				----------T-----X----------						
6.d. Information Service										
Planning		---X								
Implementation			----T----------X----------							

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APPENDIX

EXCERPTS FROM THE 1980 WASTE MANAGEMENT ACT

ARTICLE X
SOLID WASTE AND SEWAGE SLUDGE MANAGEMENT, METROPOLITAN AREA

INTRODUCTION

The 1980 Waste Management Act, signed into law April 14, 1980, deals with hazardous waste, municipal solid waste and sewage sludge disposal. Only those parts of Article X that deal with the planning process of land disposal abatement and sanitary landfill siting in the Metropolitan Area are reprinted here, in the order the planning steps are to take place.

Complete copies of the 1980 Waste Management Act are available from: Chief Clerk of the House of Representatives, Room 211 State Capitol, St. Paul, Minnesota 55155; telephone: 296-2314. A summary of the 1980 Waste Management Act is available from: Legislative Commission on Waste Management, B-46 State Capitol, St. Paul, Minnesota 55155; telephone: 297-3604.

LAND DISPOSAL ABATEMENT PLANNING

Planning Step Number 1: Metropolitan Council Abatement Report

Sec. 473.149, Subd. 2a. By January 1, 1981, the Council shall prepare and submit a report to metropolitan counties on potentials for abating the need for and practice of land disposal of mixed municipal solid waste in the MetropolitaArea, for use by the counties in developing land disposal abatement plans pursuant to Section 473.803, Subdivision 1b. The report shall contain an analysis of abatement achievable through waste reduction, separation, waste processing, and resource recovery. The report shall contain specific and quantifiable alternative abatement objectives and degrees of abatement, along with solid waste management methods and technologies, private and government actions, facilities and services, development schedules, revenue-raising measures, and levels of public and private expenditure and effort necessary to the achievement of those alternative objectives and degrees of abatement. The report shall recommend priorities and objectives for abating, immediately and over specified time periods, the disposal of mixed municipal solid waste in the Metropolitan Area. During the preparation of the report, the

Council shall encourage public debate and discussion of the issues relating to land disposal abatement and shall hold a public meeting on the issues in each metropolitan county.

Planning Step Number 2: Counties' Abatement Proposals

Sec. 473.803, Subd. 1b. By April 1, 1982, after considering the Council's disposal abatement report submitted to the counties pursuant to Section 473.149, Subdivision 2a, each county shall submit to the Council a proposal to reduce to the greatest feasible and prudent extent the need for and practice of land disposal of mixed municipal solid waste. The proposal shall address at least waste reduction, separation, and resource recovery. The proposal shall include objectives, immediately and over specified time periods, for reducing the land disposal of mixed municipal solid waste generated within the county. The proposal shall describe specific functions to be performed and activities to be undertaken by the county and cities and towns within the county to achieve the objectives and shall describe the estimated cost, proposed manner of financing, and timing of the functins and activities. The proposal shall include alternatives which could be used to achieve the objectives if the proposed functions and activities are not established.

Planning Step Number 3: Metropolitan Council Amends Solid Waste Policy Plan

Sec. 473.149, Subd. 2d. By January 1, 1983, after considering county land disposal abatement proposals submitted pursuant to Section 473.803, Subdivision 1b, the Council shall amend its policy plan to include specific and quantifiable objectives for abating the land disposal of mixed municipal solid waste. The plan shall include a reduced estimate, based on the Council's abatement objectives, of the added solid waste disposal capacity needed in appropriate sectors of the Metropolitan Area, stated in annual increments through the year 1990 and thereafter in five year increments through the year 2000. The objectives in the plan shall be based upon standards for county resource recovery and waste reduction and separation programs and activities. The plan shall include standards and procedures to be used by the Council in determining that metropolitan counties have not implemented the Council's land disposal abatement plan and have not met the standards for county abatement programs and activities. The Council shall report to the Legislative Commission on its abatement plan and on legislation that may be required to implement the plan.

Planning Step Number 4: Counties Revise Solid Waste Master Plan

Sec. 473.803, Subd. 1b (continued). By June 1, 1983, each county shall revise its master plan to include a land disposal abatement element to implement the Council's land disposal abatement plan adopted under Section 473.149, Subdivision 2d, and shall submit the revised plan to the Council for review under Subdivision 2. The proposal and master plan revision required by this subdivision shall be prepared in consultation with cities and towns within the county, particularly the cities and towns in which a solid waste disposal facility is or may be located pursuant to the county master plan.

SANITARY AND DEMOLITION LANDFILL SITING PROCESS

Planning Step Number 1: Metropolitan Council Report on Additional Landfill Needs

Sec. 473.149, Subd. 2. By July 1, 1980, the Council shall adopt by resolution an estimate of the added solid waste disposal capacity needed in appropriate sectors of the Metropolitan Area in annual increments through the year 1990 and thereafter in five-year increments through the year 2000. The Council's estimate shall be based upon existing and projected solid waste generation rates without regard to potential waste reduction, separation, and recovery activity except that provided by services and facilities in operation or under construction.

Planning Step Number 2: Counties' Inventories of Proposed Landfill Sites

Sec. 473.803, Subd. 1a. By June 1, 1981, each county shall adopt, by resolution of its governing body, an inventory of four proposed sites in the county suitable for mixed municipal solid waste disposal facilities and one proposed site in the county suitable for the disposal of demolition debris and shall submit the inventory to the Council for approval or disapproval. The Council shall evaluate and approve or disapprove each proposed site in accordance with the standard set out in this subdivision. Except as otherwise provided in this subdivision, each site shall satisfy the standards and criteria in federal and state regulations and the Council's policy plan for solid waste management. In proposing the approving sites for the inventory, the counties and the Council shall prefer land which is capable of being returned to its existing use or the use anticipated in a plan of a metropolitan agency, county or local unit of government use after closure of a

disposal facility. Each site shall contain no less than 80 acres and no more than 250 acres. Each proposed site shall be surrounded by a buffer area at least equal to the area of the site. No site shall be proposed by the county or approved by the Council unless the agency certifies its intrinsic suitability for the use intended, based on preliminary environmental analysis and on-site surveys and investigations conducted by the county or agency. Notwithstanding any plan, charter provision, law, ordinance, regulation, or other requirement of any state agency or political subdivision, no land shall be excluded from consideration for inclusion in the inventory except land determined by the agency to be intrinsically unsuitable. The Council shall evaluate each site with respect to local land-use and land use controls, the protection of agriculture and natural resources, existing and future development patterns, transportation facilities and other services and facilities appropriate to land disposal facilities, the quality of other potential sites, and patterns of generation of solid waste. The Council shall notify a county of any site proposed by the county 60 days to propose an alternative site. If the county fails to propose an alternative acceptable to the Council in the time allowed, the Council shall propose a site acceptable to it for inclusion in the inventory of sites in that county. If in the Council's judgment a county does not contain the requisite number of satisfactory sites, the Council may reduce the number of sites required of that county. A moratorium is hereby imposed on development within the area of each site and buffer area proposed by a county, pending the Council's adoption of an inventory pursuant to Section 473.149, Subdivision 2b. For sites and buffer areas included in the Council's inventory, the moratorium shall extend until October 1, 1983. No development shall be allowed to occur within the area of a site or buffer area during the period of the moratorium. No county, city, or town land-use control shall permit such development, nor shall any county, city, or town sanction or approve any subdivison, permit license, or other authorization which would allow such development to occur.

Planning Step Number 3: Metropolitan Council Inventory of Proposed Landfill Sites

Sec. 473.149, Subd. 2b. By October 1, 1981, the Council shall adopt by resolution an inventory of eligible solid waste disposal sites and buffer areas within the Metropolitan Area. The Council's inventory shall be composed of the sites and buffer areas proposed by the counties and reviewed and approved by the Council pursuant to Section 473.803, Subdivision 1a. If a county does not have an approved inventory, the Council shall adopt the

required inventory for the county, following investigations by the Council and public hearings as the Council deems appropriate. The Council's inventory shall satisfy all requirements and standards described in Section 473.303, Subdivision 1a, for sites and buffer areas proposed by counties. For sites and buffer areas included in the Council's inventory, the moratorium imposed under Section 473.303, Subdivision 1a, shall extend until October 1, 1983.

Planning Step Number 4: Metropolitan Council Report to Legislature on Mitigation and Compensation for Adverse Local Effects

Sec. 473.149, Subd. 2c. By January 1, 1982, the Council shall report to the legislative commission on methods of mitigating and compensating for the local risks, costs, and other adverse effects of solid waste disposal facilities and on methods of financing mitigation and compensation measures. The methods of mitigating and compensating to be considered shall include but not be limited to the following: payment outside of levy limitations in lieu of taxes for all property taken off the tax rolls; preference for the city or town containing a facility in federal A-95 reviews conducted by the Council; payment of all costs to service the facilities including the costs of roads, monitoring, inspection, enforcement, police and fire, and litter clean-up costs; payment for buffer zone amenities and improvements; city or town control over buffer zone design; elimination of the tipping charge for solid waste collected in the city or town; a guarantee against any and all liability that may occur; payment for reclamation of closed sites to locate design specifications.

Planning Step Number 5: Reduction of Metropolitan Council Estimate of Additional Landfills Needed; Allocation of Needed Capacity Among Counties; and Adoption of Disposal Facility Development Schedule

Sec. 473.149, Subd. 2d. By January 1, 1983, after considering county land disposal abatement proposals submitted pursuant to Section 473.803, Subdivision 1b, the Council shall amend its policy plan to include specific and quantifiable objectives for abating the land disposal of mixed municipal solid waste. The plan shall include a reduced estimate, based on the Council's abatement objectives, of the added solid waste disposal capacity needed in appropriate sectors of the Metropolitan Area, stated in annual increments through the year 1990 and thereafter in five-year increments through the year 2000. The objectives in the plan shall be based upon standards for county resource recovery and waste reduction and separation programs and activities. The plan shall include

standards and procedures to be used by the Council in determining that Metropolitan counties have not implemented the Council's land disposal abatement plan and have not met the standards for county abatement programs and activities. The Council shall report to the legislative commission on its abatement plan and on legislation that may be required to implement the plan.

Sec. 473.149, Subd. 2e. By January 1, 1983, after requesting and considering recommendations from the counties, cities, and towns, the Council as part of its policy plan shall determine the number of sites to be acquired within each metropolitan county for solid waste disposal facilities in accordance with Section 16. The Council shall adopt a schedule for development of disposal facilities by each such county through the year 2000. The schedule shall be based upon the Council's reduced estimate of the disposal capacity needed because of the Council's land disposal abatement plan. The schedule may include procedures to be used by counties in selecting sites for acquisition pursuant to Section 16. The schedule shall include standards and procedures for Council certification of need pursuant to Section 473.823. The schedule shall include a facility closure schedule and plans for post-closure management and disposition, for the use of property after acquisition and before facility development, and for the disposition of property and development rights, as defined in Section 16, no longer needed for disposal facilities.

Planning Step Number 6: County/City Site Selection of Disposal Sites

Sec. 473.833, Subd. 2. Each metropolitan county shall select and acquire sites and buffer areas for solid waste disposal facilities in accordance with this section and the Council's policy plan and development schedule adopted pursuant to Section 473.149, Subdivision 2e.

Sec. 473.833, Subd. 3. Each metropolitan county shall establish a site selection authority. By June 1, 1983, each site selection authority shall select specific sites within the county from the Council's disposal site inventory, in accordance with the procedures established by the Council under Section 473.149, Subdivision 2e, and in a number equal to that required by the Council to be acquired by the county. Each site selection authority shall be composed of the county board, plus one member appointed by the governing body of each city or town within the county containing a site in the Councils' disposal site inventory or the majority of the land containing within such a site. If the number of members on the site selection authority who reside in a city or town contain all or part of a site

or buffer area is equal to or greater than the number of members who do not, the chairman of the county board shall appoint to the authority an additional member or members, residing within the county but not in a city or town containing all or part of a site or buffer area, sufficient to assure a majority of one on the authority of members residing in cities and towns not containing all or any part of a site of buffer area. The chairman of the county board shall be the chairman of the site selection authority. If a site selection authority has not selected the requisite number of sites in accordance with the Council's standards, criteria, and procedures by June 1, 1983, the Council shall make the selection.

Planning Step Number 7: County Acquisition of Disposal Sites

Sec. 473.833, Subd. 4. In order to prevent the development of conflicting land uses at and around future solid waste disposal facility sites, the Council shall provide for the acquisition by a metropolitan county of property and rights in property at and around each solid waste disposal site selected pursuant to Subdivision 3. Each site scheduled for development as a facility through the year 1990 shall be acquired in fee. Development rights shall be acquired for each site scheduled for development as a facility after the year 1990 through the year 2000. Development rights shall be acquired in a buffer area surrounding and at least equal to the area of each site scheduled for development as a facility through the year 2000. The owner of any property for which development rights are to be or have been acquired pursuant to this subdivision may elect by written notice at any time up to 90 days following the issuance of a permit by the agency for a facility to have the county acquire fee title to the property. Fee title shall be acquired by counties for buffer areas only at the election of the owner of the fee.

Planning Step Number 8: Metropolitan Council Report to Legislature on Authority Transfer if Counties Fail to Acquire Disposal Sites

Sec. 473.833, Subd. 7. If any county fails to identify property for acquisition or if any county refuses to proceed with acquisition, as required by this section and the Council's disposal facility development schedule adopted pursuant to Section 473.149, Subdivision 2e, the Council shall prepare and recommend to the Legislature, no later than January 1, 1984, legislation to transfer solid waste management authority and responsibility in the Metropolitan Area from the counties to the Waste Control Commission or a new metropolitan commission established for that purpose.