

Recycled Fiber Opportunities

A Background Paper for a Generic Environmental Impact Statement on Timber Harvesting and Forest Management in Minnesota

Prepared for:

**Minnesota Environmental Quality Board
658 Cedar Street
St. Paul, Minnesota 55155**

November 1992

Prepared by:

**Jaakko Pöyry Consulting
560 White Plains Road
Tarrytown, NY 10591
TEL: 914-332-4000
FAX: 914-332-4411**

November 20, 1992

Dr. Michael Kilgore
GEIS Project Manager
Minnesota Planning Office
300 Centennial Office Building
658 Cedar Street
St. Paul, MN 55155

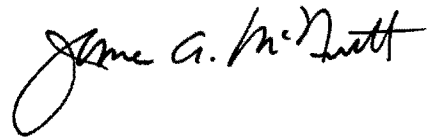
Dear Dr. Kilgore:

Pursuant to the State of Minnesota's GEIS contract (No. 30000-18408-01) with Jaakko Pöyry Consulting, Inc., as formally executed on May 15, 1991, and amended with Supplement No. 1 on July 10, 1991, and Supplement No. 2 on July 27, 1992, the sixth task included preparation of background papers. One of these papers, Recycled Fiber Opportunities, is hereby submitted for review and approval.

The material contained in this document is presented in accordance with the terms outlined in Attachment A to the base contract, Section III, Subsection F.

We look forward to a favorable review and approval of this work product in due course.

Respectfully yours,



James A. McNutt
Executive Vice President
and GEIS Project Manager

cc: Art Veverka
Bob Dunn
Doug Parsonson
Alan Ek

SUMMARY

This paper is one of five background papers to be completed as part of the Generic Environmental Impact Statement (GEIS) on Timber Harvesting in Minnesota (GEIS) as specified in the contract between the state of Minnesota and Jaakko Pöyry Consulting, Inc. As described in the document *Feasibility Study for a Generic Environmental Impact Statement: Timber Harvesting and Management in Minnesota* (Jaakko Pöyry Consulting, Inc. 1991), the paper describes existing and potential opportunities for utilizing recovered fiber in paper and allied products manufacturing in Minnesota.

Approximately 1.7 million tons of various grades of paper were generated and 0.6 million tons were recovered in Minnesota in 1990, yielding an overall recovery rate of 36 percent. This was slightly higher than the average for the Midwest for most grades.

- Approximately 115 thousand tons of old newspaper (ONP) was recovered in 1990 in Minnesota. This is expected to rise to 140 thousand tons by 1995, and 160 thousand tons (or 72 percent of the ONP available) by the end of the decade. High recovery of ONP will mainly be due to good access to markets in Canada, and by mandatory recycling which is monitored and enforced.

Most of the ONP collected in Minnesota in 1990 was used by Minnesota mills, the net surplus demand totaled only 20 thousand tons. The net state surplus is expected to rise to 40 thousand tons by 2000.

- About 30 thousand tons of old magazines (OMG) was collected in Minnesota in 1990. The majority of the OMG collected in Minnesota was overissue or newsstand returns. Recovery is expected to rise 40 thousand tons by 1995 and 55 thousand tons by 2000.

None of the OMG collected in Minnesota is used in Minnesota. This is not expected to change throughout the decade.

- An estimated 50 thousand tons of office wastepaper (OWP) in Minnesota were recovered in 1990. By 1995, recovery is expected to rise to 100 thousand tons and to 120 thousand tons by 2000.

Overall, mills in Minnesota consumed 15 thousand tons more OWP than was collected in the state in 1990. Because of the various subgrades (i.e., computer printout, white grades, mixed), it is likely that some grades are shipped out of Minnesota, while other grades are imported. The net deficit, however, is expected to increase as two large new deinked pulp mills come online in the 1990s. By 2000, mill consumption will likely exceed collection by about 130 thousand tons.

Increased collection and use of recovered paper in Minnesota and surrounding states could reduce demand for wood by the state's forest products industry, but supplies of some grades are limited.

- The state's paper industry is mainly comprised of printing and writing paper mills. Most of the pulp consumed is bleached kraft (chemical) and groundwood pulps.
- The alternative recovered papers for bleached virgin kraft pulp include high-grade deinking, pulp substitutes, or office wastepaper (OWP). Planned use of OWP by two new market deinked pulp mills in Minnesota would yield a net shortfall of this grade within the state.
- The alternative recovered papers for bleached virgin groundwood pulp are old newspapers (ONP) and old magazines (OMG). Users of these grades compete with Canadian newsprint mills for limited supplies. Canadian mills have already established long-term contracts for ONP collected in Minnesota. Supply contracts for these grades from Canadian newsprint mills would limit the availability of ONP and OMG to new users.
- The inconsistent quality of mixed paper currently precludes its use in significant quantities to make printing and writing papers.

The effect that increased collection and use of recovered paper pulp will have on the wood products industry will depend on the type of pulp it replaces.

- Economics favor the substitution of recovered paper for purchased pulp rather than integrated pulp, if substitution for integrated pulp means idling existing facilities.
- If recycled pulp replaces purchased pulp, there would be little or no effect on the wood harvest in the state since the purchased pulp being replaced is not a product of the Minnesota's forests.
- Recycled pulp could replace planned virgin pulp capacity. Planned increases in virgin pulping capacity at Minnesota paper mills by 1995 total almost 600 thousand tons which will require an additional 1.1 million cords/year.
- Some Minnesota paper mills purchase kraft pulps to augment integrated kraft pulp production or as the exclusive kraft source. All groundwood consuming mills in the state are integrated to groundwood pulp.

Under the following specific conditions, use of market deinked pulp produced in Minnesota could replace up to 400 thousand cords of wood harvested in the state annually:

- if the recycled pulp produced by Superior Recycled Fiber offsets planned virgin chemical pulp capacity, it could reduce demand for wood by up to 150 to 200 thousand cords per year; and
- if the recycled pulp produced by Western Pacific offsets planned chemical pulp capacity, it could reduce annual demand for wood by up to 150 to 200 thousand cords.

It is unlikely that market deinked pulp will replace *existing* virgin pulp production in Minnesota. The factors supporting this conclusion are presented in the overall conclusions in section 6. They include the composition of the state's paper industry, the economics of replacing existing pulp production, the physical characteristics of deinked pulp versus currently used pulps, and the supply and demand for OWP. The most likely scenario is for market deinked pulp to substitute for additional virgin pulp capacity first, and then replace purchased kraft pulp. However, these two scenarios are not exclusive of each other. A combination of the two could exist simultaneously.

TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES	iii
LIST OF PREPARERS	iv
1 INTRODUCTION	1
2 CHARACTERIZATION OF MINNESOTA	2
2.1 Minnesota	2
2.2 Midwest	5
2.2.1 Integrated Pulp Production	6
2.3 Canada	9
3 SUPPLY OF RECOVERED PAPER	10
3.1 Approach	10
3.1.1 Point of Collection	11
3.1.2 Per Capita Generation of Paper	12
3.1.3 Per Office Worker Generation of Paper	15
3.1.4 Scrap Generation From Converting Operations	15
3.1.5 Disposal of Paper by Channel	16
3.1.6 Recovery of Paper by Channel	18
3.2 Recovery Rates in Minnesota and the Midwest	20
3.2.1 1990 Recovery Rates	20
3.2.2 Forecast Recovery of Paper in Minnesota in 1995	22
3.2.3 Forecast Recovery of Paper in Minnesota in 2000	24
3.3 Canada	24
4 DEMAND FOR RECOVERED PAPER AND TRADE FLOWS	26
4.1 Minnesota	26
4.1.1 Current (1990) Demand	26
4.1.2 Forecast Demand	28
4.1.3 Trade Flows	31
4.2 Midwest	32
4.2.1 Current (1990) Demand	32
4.2.2 Forecast Demand	33
4.2.3 Trade Flows	33
4.3 Canada	33
4.3.1 Mill Demand	34
4.3.2 Trade Flows	34

TABLE OF CONTENTS (continued)

	<u>Page</u>
5 IMPACT OF SUPPLY/DEMAND ON VIRGIN FIBER	
SOURCES	35
5.1 Direct Entry Use of Recovered Paper	35
5.2 Market Deinked Pulp	35
5.2.1 Printing and Writing	36
5.3 Integrated Deinked Pulp Capacity	37
6 CONCLUSIONS AND RECOMMENDATIONS FOR	
FURTHER STUDY	37
6.1 Overall Conclusion	37
6.2 Recommendation for Further Study: The Impact of Incineration	39
APPENDIXES	
A. RECYCLING OVERVIEW	A-1
B. SCOPE OF <i>RECYCLED FIBER IN NORTH AMERICA</i>	B-1
C. ACRONYMS AND ABBREVIATIONS USED IN THIS PAPER	C-1
D. DEFINITIONS	D-1
E. FEDERAL, STATE, AND LEGISLATIVE TRENDS IN RECYCLING	E-1

LIST OF TABLES

	<u>Page</u>
Table 2.1. Paper and paperboard mills in Minnesota	3
Table 2.2. Paper and paperboard capacity, Minnesota vs. Midwest and total U.S., 1990	6
Table 2.3. Percent of integrated pulp capacity by grade segment, Minnesota vs. Midwest and total U.S., 1990	8
Table 3.1. Points of collection by grade of recovered paper	11
Table 3.2. Disposal of paper by channel	16
Table 3.3. Mandatory and voluntary recycling in Minnesota	19
Table 3.4. Generation and recovery of paper in Minnesota vs. the Midwest (1990)	21
Table 3.5. Generation and recovery of paper in Minnesota vs. the Midwest (1995 forecast)	23
Table 3.6. Generation and recovery of paper in Minnesota vs. the Midwest (2000 forecast)	25
Table 4.1. Current (1990) utilization of recovered paper in Minnesota (000 tons per year)	27
Table 4.2. Current and planned virgin pulp capacity at Minnesota mills (000 tons per year)	29
Table 4.3. 1995 utilization of recovered paper in Minnesota (000 tons per year)	30
Table 4.4. 2000 utilization of recovered paper in Minnesota (000 tons per year)	31

LIST OF PREPARERS

This paper was prepared by Mary Cesar, Jaakko Pöyry Consulting, Tarrytown, New York.

1 INTRODUCTION

This paper is one of five background papers to be completed as part of the Generic Environmental Impact Statement (GEIS) on Timber Harvesting in Minnesota (GEIS) as specified in the contract between the state of Minnesota and Jaakko Pöyry Consulting, Inc. As described in the document *Feasibility Study for a Generic Environmental Impact Statement: Timber Harvesting and Management in Minnesota* (Jaakko Pöyry Consulting, Inc. 1991), the paper describes existing and potential opportunities for utilizing recovered fiber in paper and allied products manufacturing in Minnesota. Specific topics include:

1. specific types of paper and allied products currently produced in Minnesota including their uses;
2. current technology available for using recovered fiber in paper and allied products production;
3. types of recovered fiber available (physically and economically) for Minnesota paper and allied products manufacturing facilities;
4. opportunities for using current process technology to substitute recovered fiber for virgin wood fiber in papermaking in Minnesota;
5. possibilities for future (short-term and long-term) use of recovered fiber by Minnesota's wood products manufacturing industries; and
6. potential forest resource economic and environmental impacts of using recycled fiber in the production of paper and allied products by Minnesota's wood fiber industries.

Most of these topics are covered in sections 1 to 6. Appendixes A to E have been included to assist readers in gaining an understanding of industry terminology, paper making processes and recycling issues. Appendix A provides an overview of the various grades of recovered paper, definitions, and a description of their physical properties (from both a raw material and end-product perspective). It also describes the various deinking and pulping processes. As such, topics 2 and 4 above are discussed in appendix A.

The paper draws heavily on a wider study "Recycled Fiber in North America" (RFNA) that was recently completed (February 1992) by Jaakko Pöyry Consulting, Inc. and Franklin Associates. The scope of this study is outlined in appendix B.

Minnesota was sampled intensively as part of the RFNA study to provide the detailed information needed for this paper.

Appendixes C and D define the acronyms and abbreviations used in this paper. Federal and state legislation impacting recycling in Minnesota and the Midwest region is summarized in appendix E.

The conclusions drawn in this paper will assist in formulating mitigation strategies as part of the GEIS process. The main objective of this paper is to determine if substitution of recycled fiber for virgin fiber may allow existing or expanded levels of industrial activity to occur at comparatively lower levels of harvesting.

2

CHARACTERIZATION OF MINNESOTA

The primary area covered by this paper is the state of Minnesota. However, because of the state's proximity to other significant fiber consuming states, two additional general regions will be addressed (one which includes Minnesota).

- The U.S. Midwest—North Dakota, South Dakota, Nebraska, Kansas, Iowa, Missouri, Minnesota, Wisconsin, Illinois, Michigan, Indiana, and Ohio.
- Canada, with particular emphasis on the provinces of Ontario and Quebec.

2.1

Minnesota

There are nine paper and paperboard mills located in Minnesota, representing approximately 2.2 million tons of end product capacity. The paper mills were operating at 87 percent of capacity in 1990; according to API statistics the average operating rate for all U.S. paper mills was 90 percent. Seven of the nine mills make some type of printing and writing paper, one makes recycled boxboard and corrugating medium; one makes roofing felts. The paperboard operating rates for Minnesota were withheld to avoid disclosure; the average operating rate for U.S. paperboard mills was 90 percent.

The six major printing and writing mills (Potlatch Brainerd, Potlatch Cloquet, Lake Superior, Blandin, Boise Cascade, and Champion) are vertically integrated to 82 percent of their pulp requirements. This integrated pulp is produced from Minnesota's wood resources. These mills purchase 16 percent of their pulp needs on the open markets. There are no market pulp mills in Minnesota; purchased pulp is sourced from mills outside the state. Recovered paper accounts for their remaining 2 percent fiber use.

Table 2.1 summarizes the pulp and end product capacities of each mill. (Acronyms and abbreviations can be found in appendix C.)

Table 2.1. Paper and paperboard mills in Minnesota.

Manufacturer (mill location)	1990 Capacity/Use (000 tons/year)			
	Pulp	End-Product		
Potlatch (Cloquet)	NBSK	35	Coated Freesheet	185
	NBHK	150		
Potlatch (Brainerd)	NBSK*	30	Coated Freesheet	120
Lake Superior (Duluth)	PGW	150	Supercalendered	250
	NBSK*	50		
Blandin (Grand Rapids)	PGW	190	Lightweight Coated	500
	NBSK*	150		
	PS*	20		
Boise Cascade (Int'l. Falls)	NBHK	325	Uncoated Freesheet	465
	NBSK	100	Coated Freesheet	45
Champion (Sartell)	TMP	135	Lightweight Coated	200
	NBSK*	85	Supercalendered	85
Hennepin (Little Falls)	SGW	25	Groundwood Speciality	35
	WP (varies*)	35		
Certainteed (Shakopee)	DWP	30	Roofing Felt	50
	ONP*	10		
	MP*	20		
Waldorf (St. Paul)	ONP*	70	Boxboard	140
	OCC*	150	Corrugating Medium	140
	MP*	20		
	OWP*	50		

*Estimated purchases.

Source: Jaakko Pöyry Consulting, Inc. 1992.

Potlatch Corporation Northwest Paper Division (Cloquet)

Facilities for both wood pulping and paper making. Currently developing plans for an expansion of their kraft pulp mill and a new paper machine.

Potlatch Corporation, Northwest Paper Division (Brainerd)

Paper machine only, no pulping capacity.

Lake Superior Paper Industries (Duluth)

Joint venture of Pentair, Inc. and Minnesota Power in operation for two years. Facilities for both wood pulping and paper making. Currently evaluating the possibility of adding a second paper machine.

Blandin Paper Company (Grand Rapids)

Facilities for both wood pulping and paper making. Recently completed construction of a new wood room, additional pulping capacity and a new paper machine. Plans for another paper machine are currently on hold.

Boise Cascade Corporation (International Falls)

Facilities for both pulping and paper making. A new 850 tpd paper machine, and an expansion and modernization of pulping operations has been recently completed.

Champion International (Sartell)

Facilities for both wood pulping and paper making. Completed construction of a new paper machine and associated facilities recently. Currently developing plans for a new paper machine to replace two older machines.

Hennepin Paper Company (Little Falls)

Facilities for both wood pulping and paper making. Currently use 30 to 35 percent wastepaper in their fiber mix. This percentage is expected to increase.

CertainTeed Corporation (Shakopee)

Manufacture roofing felt from wood chips and recovered paper.

Waldorf Corporation (St. Paul)

No wood pulping capacity. Minnesota's only paper maker using wastepaper for 100 percent of their fiber needs. New sources of wastepaper (such as residential mixed paper) are currently being explored to substitute for office wastepaper currently used in the manufacture of boxboard.

Other manufacturers that produce wood fiber products are:

Superwood Corporation (Duluth)

Produce pulp from roundwood and full tree chips to make hardboard. Have experimented with using ONP in their fiber mix.

Superwood Corporation (Bemidji)

Produce pulp from roundwood and full tree chips to make hardboard.

International Biltrite (International Falls)

Produce pulp from roundwood and full tree chips to make construction sheathing. Can use up to 20 percent recycled mixed paper waste. Negotiating with Koochiching County for wastepaper to be diverted from county landfills.

2.2

Midwest

The Midwest is the second largest paper and paperboard producing region and paperboard in the United States, with a capacity of approximately 15.2 million tons. About 18 percent of the total U.S. paper and paperboard capacity is shared by 148 regional mills.

Forty mills have the capacity to produce approximately 6.4 million tons of printing and writing papers (including SC and directory), making it the largest grade segment in the Midwest (42 percent of regional paper and board capacity).

Containerboard mills in the Midwest form the second largest segment of capacity. There are 23 linerboard, corrugating medium, and/or kraft paper mills representing 3.4 million tons, or 22 percent of total regional capacity.

Boxboard mills account for 12 percent of regional capacity. Miscellaneous and specialty mills make up about 10 percent, while tissue and towel, building materials and newsprint mills comprise the balance.

Compared to the total U.S., the Midwest ranks second in total boxboard capacity and has the second highest concentration of boxboard mills in the U.S. The boxboard mills in the region were established to serve the large local packaged goods industry.

The high concentration of printing and writing paper capacity in the Midwest is attributed to the conversion of many older newsprint machines to printing and writing grades.

There is also a high concentration of miscellaneous and specialty paper mills in the Midwest. Specialty mills in the region include producers of molded pulp, school construction paper, pattern tissue, and specialty packaging or technical papers. Like the boxboard manufacturers, many of the specialty paper mills supply the local packaged goods industry.

The Midwest has the smallest newsprint capacity of the four U.S. regions, accounting for only 3 percent of the total U.S. newsprint capacity in 1990. Many of the older Midwest newsprint mills were converted to printing and writing grades because they were unable to compete with the newer and larger newsprint mills built in the South and in Canada. Demand for newsprint in the Midwest is primarily supplied by Canadian mills.

Containerboard is not a major grade produced in the Midwest, accounting for only 10 percent of the total U.S. capacity in 1990. While six machines have been built in the region since 1970, most of the newer and larger

containerboard mills are in the South where inexpensive softwood fiber is more readily available.

Table 2.2 compares Minnesota paper and paperboard capacity by grade with the Midwest and total U.S.

Table 2.2. Paper and paperboard capacity, Minnesota vs. Midwest and total U.S., 1990.

	Minnesota		Midwest		Total U.S.	
	(000 tpy)	% Total	(MM tpy)	% Total	(MM tpy)	% Total
Boxboard	140	6	1.9	12	7.1	9
Containerboard	140	6	3.4	22	33.0	40
Building Materials	50	2	0.5	3	2.2	3
Newsprint	0	0	0.2	1	6.5	8
Printing & Writing	1,850	84	6.4	42	23.6	29
Tissue & Towel	0	0	1.4	9	6.0	7
Miscellaneous	30	1	1.5	10	4.1	5
Total	2,210	100	15.3	100	82.5	100

Source: Jaakko Pöyry Consulting, Inc. 1992.

2.2.1

Integrated Pulp Production

The raw fiber materials needed to produce paper and paperboard can be acquired in a variety of ways. Each source has advantages and disadvantages with regard to quality, pulp cost the initial capital investment required, flexibility to use varied raw materials. The fiber options include:

- *Integrated pulp producers*—where the paper mill has a pulp mill on site. The pulp manufactured can be either virgin or deinked. Integrated pulp producers generally have a high initial capital investment, and limited flexibility to vary or substitute raw materials. An average size deinked pulp mill is generally smaller (500 to 600 tpd), requiring a smaller capital investment (\$200 to \$250 thousand per daily ton) than an average size virgin pulp mill (1,200 tpd at \$650 to \$700 thousand per daily ton).
- *Captive pulp*—where the mill has a captive offsite pulp mill and delivers slush pulp via pipeline or truck to the paper mill. The fiber and cost options available to the paper mill are limited by the capabilities of the associated pulp mill. The Potlatch mill at Brainerd is a good example of this.
- *Purchased dry or wet lap pulp or pulp substitutes*—either captive (paper mill owns pulp mill or source) or on the open market. The pulp purchased can

be either virgin or deinked. Purchased pulp offers the most flexibility for substitution to a paper mill. The cost, consistency, and associated supply risks are also higher than for pulp manufactured onsite. There are *no* market pulp mills in Minnesota. All purchased pulp is produced at mills outside the state, from trees grown outside the state.

- *Recycled pulp*—where the recovered paper is cleaned, but not deinked (as in the case of Waldorf). Almost all boxboard and containerboard mills that use recovered paper have this ability. This process is sometimes called direct entry of recovered paper, and the facility is generally not considered integrated.

For printing and writing, containerboard, and boxboard mills, the level of integrated pulp production in the Midwest is lower than for the U.S. as a whole. On the other hand, the levels of integration in tissue and newsprint are comparable to national averages.

Tissue mills tend to be highly integrated since many use recovered paper, and the recovered paper needs to be deinked. It is usually more economical to deink recovered paper on site than to purchase market deinked pulp. The two newsprint mills in the Midwest are recovered fiber based and have integrated deinking facilities.

Midwestern printing and writing mills are generally smaller than the national average. The average capacity at uncoated printing and writing mills, which represents the majority of the printing and writing capacity in the region, is about 80,000 tpy, versus 160,000 tpy nationwide. Because of the limited size, it is more cost effective for some mills to purchase pulp rather than build small capacity pulping facilities. In Minnesota, however, paper making capacity at printing and writing mills averages over 300,000 tpy, almost twice the nationwide average. Minnesota's printing and writing mills produce approximately 75 percent of their own pulp requirements. All mills purchase at least some pulp to supplement their own production. The specific purchased pulps are selected to enhance or add specific properties their own pulp does not provide.

Table 2.3 compares the percent of pulp integration in Minnesota to the Midwest region and the total U.S. The percentage of integrated pulp shown in this table was calculated by simply dividing the total pulp capacity in the region by the total end-product capacity at the same mills. The pulp capacity represents virgin pulp capacity and deinked pulp capacity. Since these pulps do not represent 100 percent of all end-products (recovered fiber used without deinking, fillers, coatings and moisture may also be present), 100 percent integration would be impossible to calculate using this method.

Table 2.3. Percent of integrated pulp capacity by grade segment*, Minnesota vs. Midwest and total U.S., 1990.

	Percent of Integration*		
	Minnesota	Midwest	Total U.S.
Boxboard	0	1	25
Containerboard	0	52	82
Newsprint	n.a.	91	93
Printing & Writing	56	53	78
Tissue & Towel	n.a.	61	60

*Total pulp capacity divided by end-product capacity (does not include use of recovered paper without deinking).

Source: Jaakko Pöyry Consulting, Inc. 1992.

Boxboard and Containerboard

Most boxboard mills and many containerboard mills use recovered paper directly without deinking. While cleaning and repulping equipment is necessary to process the fiber, it is not considered integrated pulp. The integrated pulp capacity shown in the Midwest and total U.S. is virgin pulp used to make solid bleached or kraft board products.

Newsprint

Newsprint contains a very small percentage of nonfiber materials, and most mills are fully integrated to the groundwood portion of their fiber needs. The nonintegrated segment represents purchased kraft pulp which is used to add strength to some groundwood furnishes.

Printing and Writing

The percentage of integration in printing and writing mills can be very misleading. Uncoated papers have a much higher ratio of fiber to end product (85:15) than coated papers (65:35). Dividing the pulp capacity by the end product capacity does not account for nonfiber components, and quotients of 65 or 85 percent could represent fully integrated mills. On the other hand, if a printing and writing mill also makes market pulp, the calculated percentage of integration could even be high. Minnesota and the Midwest have a higher ratio of coated to uncoated papers than average. The calculated integration of 56 percent for Minnesota's printing and writing mills represents approximately 75 percent of total pulp requirements.

Tissue and Towel

Tissue and towel products contain very little nonfiber additives. Therefore, the percentage of integration calculated in table 2.3 is a fairly true representation.

2.3

Canada

Canada plays an important role in the supply and demand of recovered paper in Minnesota because of its proximity to the state, and dominant position as a supplier of newsprint. Canadian mills have already begun contracting with private haulers in Minnesota for long-term supplies of newsprint. Most of the newsprint produced in Canada is exported to the United States. In fact, Canadian newsprint represents over half of the newsprint consumed in the U.S. Therefore, Canadian producers are especially sensitive to the recycled content goals of U.S. newsprint publishers, and look to the U.S. as a major source of supply of ONP.

In 1990, 121 Canadian paper and board mills were in operation. Most of the production was (and continues to be) based on virgin fiber supplies. Overall capacity was 19.4 million metric (21.4 million short) tons.

Newsprint is the major paper product produced in Canada. There are over ten million tons of production capacity, representing over 50 percent of all paper and board production. Printing and writing grades represent slightly less than four million tons (25 percent) of total production capacity, while containerboard accounts for about two million tons (12 percent). The remaining grades—boxboard, building boards, tissue and kraft paper— represent less than 5 percent of total Canadian paper industry capacity.

The three largest grade segments utilize recovered fiber in reverse order from their overall capacity. About 50 percent of the containerboard mills use some recovered fiber, and approximately 15 percent of the printing and writing mills use some recovered fiber. Less than 5 percent of the mills used recovered fibers for newsprint in 1990.

Total production of paper has increased at an average annual rate of slightly more than 2 percent during the past ten years. All grades except for kraft papers increased production tonnage during this period. As a percentage of the total production, newsprint remains the dominant grade, even though its share of total capacity has decreased from about 65 percent in 1980 to slightly more than 50 percent in 1990. Printing and writing grades have almost doubled their share of production. In 1990 they represented slightly more than 20 percent. Other grades remained fairly constant in terms of production percentages between 1980 and 1990.

Over 20 capacity expansion projects have been announced in Canada. Most of these are for increasing the use of recovered fiber at existing newsprint mills.

Currently there are no federal or provincial laws/regulations in Canada pertaining to the use of recovered fiber. Use of recycled content products is voluntary. However, several municipalities have proposed minimum recycled content

requirements for newspapers. Several of the larger municipal areas in Eastern Canada have also begun paper recovery/collection programs.

Environment Canada (equivalent to the U.S. Environmental Protection Agency) created the Environmental Choice program to help consumers identify products which are better for the environment. Criteria have been established for some printing and writing grades and newsprint. Products which meet the criteria can use the EcoLogo. Another identification mark used is the Mobius Loop, which identifies products which are suitable for recycling.

The Free Trade Agreement will have very little impact on the Canadian market. This is because both newsprint (Canada's major export commodity) and recovered paper (50 percent imported) have historically crossed the U.S.—Canadian border duty free.

3 SUPPLY OF RECOVERED PAPER

3.1 Approach

The purpose of this section is to document the generation of the various grades of recovered paper, the actual recovery of each grade, and to forecast potential recovery for 1995 and 2000.

A distinction between recovery and collection is important because the term *recycling* is used very loosely, especially in the context of municipal programs and citizen perception. By definition, recovery (or supply) is paper that finds a useful application. In contrast, paper that is collected but landfilled or incinerated because there is no other market is not recovered, but only collected. At the local level, the word recycling is sometimes a misnomer for collection.

For each grade of recovered paper, generation and recovery were calculated by point of collection (i.e., residences, offices, food stores, etc.). In general, per capita generation, based on overall generation for the Midwest region and total U.S., was the starting point for ONP, OCC, OMG, and mixed paper. Generation per office worker was the starting point for OWP. Allocation of total statewide generation for HGD was based on printing industry sales, while allocation of pulp substitutes was based on printing and writing paper production. The percentage of paper discarded through each channel was then estimated to yield a per capita or per office worker amount. Per capita and per worker generation in the Midwest were used as proxies for per capita generation in Minnesota. The per capita or per office worker generation was multiplied by the population or number of office workers in Minnesota to yield statewide generation of grades available through each channel.

The amount of paper recovered was based on interviews with major collectors and users of recovered paper in Minnesota and compared to the Midwest region and overall U.S. The total amount of paper recovered was then accounted for through mill use in Minnesota, shipments to other states within the Midwest region, and shipments outside the Midwest (to Canada and elsewhere).

3.1.1 Point of Collection

The point of collection (or discard) is an important consideration in determining the recovery potential of a particular grade. The general points of collection for each major grade discussed are summarized in table 3.1.

Table 3.1. Points of collection by grade of recovered paper.

	Points of Collection of Recovered Paper			
	Residences	Offices	Food Stores	Other
Old Newspapers	yes	yes	no	yes
Old Magazines	yes	yes	no	yes
Old Corrugated Containers	yes	yes	yes	yes
Mixed Paper	yes	no*	no	yes
Office Wastepaper	no	yes	no	no
High-grade Deinking	no	no	no	yes
Pulp Substitutes	no	no	no	yes

*Included in OWP.

Source: Jaakko Pöyry Consulting, Inc. 1992.

Various collection points are controlled by different entities. Collection from residences, for example, usually falls under the jurisdiction of the municipality, while collection from food stores, offices, and other commercial sources is often the responsibility of individual private haulers. The motivation to recycle will be different for each channel. In general, municipalities are motivated by cost avoidance while private haulers are encouraged by profitability. In Minnesota, municipalities are also motivated by state laws and recycling goals, the need to develop an integrated waste management system that utilizes land disposal as a last resort, and pressure from counties which have responsibility for solid waste management.

3.1.2

Per Capita Generation of Paper

Newspapers

Old newspapers are the focal point for most community collection programs, and are perhaps the most important grade driving changes in recycling practices. Publishers have responded to legislation and threats of legislation by adopting voluntary goals for recycled content newsprint. In turn, newsprint producers have begun adding deinking capacity.

Generation of ONP is a combination of the new supply (consumption) of newsprint in the region, plus the coated and uncoated groundwood and supercalendered inserts in newspapers. ONP also includes pressroom scrap and overissue newspapers.

For the Midwest, ONP generation is estimated at three million tons for 1990, or 21 percent of the national total. This includes newsprint consumed by daily newspapers published within the region; advertising inserts and supplements printed on papers other than newsprint; newsprint consumed by other users of newsprint such as weekly papers, free distribution publications, shoppers, etc.; and newsprint generated as scrap during printing and publication. Overall and per capita ONP generation in the Midwest and Minnesota for 1990 are summarized below:

	<u>000 Tons</u>
Newsprint Consumed by Daily Newspapers	1,840
Advertising Inserts	470
Weekly Papers	570
Newsprint Scrap	<u>200</u>
Total ONP Generation	3,080
Midwest Population (thousands)	÷ 60,265
Pounds per Ton	<u>x 2000</u>
Pounds Per Capita (Midwest)	102
ONP Generation in Minnesota (000 tons)	220

Corrugated Containers

OCC is the largest single recyclable paper grade generated and recovered. Excluding HGD and PS, which come from converting scrap sources, OCC is presently recovered at the highest percentage and highest tonnage of any other grade of paper. OCC is derived almost exclusively from industrial and commercial/retail (e.g. food store) sources because goods are usually unpacked where they are sold or used.

OCC generation is based on the total quantity of corrugated (linerboard and medium) consumed by box plant manufacturers plus 5 percent to account for net

foreign imports of products packaged in corrugated. Generation is allocated on a state-by-state basis based on the shipments of boxes to industry by Standard Industrial Classification (SIC) codes, and estimates of shipments by these industries to the point of unpacking and discard of the corrugated container. Profiles of industries discarding OCC were obtained from *County Business Patterns*. Converting scrap (estimated at 8 percent) is subtracted from the quantities consumed by box plant manufacturers and allocated by region based on box plant activity (shipments) within the region.

For the Midwest, OCC generation is estimated at 6.3 million tons for 1990, or 25 percent of the national total. This includes OCC from residences, offices, grocery and other food stores, printing and publishing operations, general merchandise stores, other commercial sources, and scrap from box plant converters in the region. Overall and per capita OCC generation in the Midwest and Minnesota for 1990 are summarized below:

	<u>000 Tons</u>
Grocery and Food Stores	2,470
Printing and Publishing Operations	280
General Merchandise Stores	620
Offices, Residences, Other Commercial Sources	2,340
Box Plant Scrap	<u>610</u>
Total ONP Generation	6,320
Midwest Population (thousands)	÷ 60,456
Pounds per Ton	<u>x 2000</u>
Pounds Per Capita (Midwest)	210
OCC Generation in Minnesota (000 tons)	460

Magazines

OMG is a specialty grade in the paperstock trade and is not an officially recognized grade by the Paper Stock Institute or the American Paper Institute. Nevertheless, one mill in the Midwest has used OMG almost exclusively for years as a raw material.

Because magazines typically contain a number of potential contaminants to deinking systems, some mills are experimenting with purchase specifications. For the purposes of estimating the generation of old magazines, papers identified by the American Paper Institute as being shipped to magazine publishers or printers for the production of magazines and related publications such as catalogs and some direct mail have been included. Imports of these grades are also included. For the U.S., Midwest and Minnesota the following overall and per capita consumption of papers in the production of magazines and related publications in 1990 is estimated:

	<u>000 Tons</u>
Uncoated Paper	380
Coated Paper	<u>2,960</u>
Total	3,340
U.S. Population (thousands)	÷ 249,203
Pounds per Ton	<u>x 2000</u>
Pounds Per Capita (Midwest)	27
OMG Generated in Minnesota (000 tons)	50

Mixed Paper

The mixed paper category is a catchall which includes all papers which do not fall into one of the other six categories. As such, these sources of paper are highly variable and, at best, are sought only when very low cost fiber sources are needed. Some of the types of paper included as mixed paper would not be sought for recycling. Tissue products (toweling, napkins, facial tissues), most food and drug packaging, plastic coated paper and composites, microwavable paperboard, molded pulp, and a host of other paper products are not generally recovered for recycling.

Examples of mixed waste that might be sought for recycling are various printing and writing and selected packaging products including: telephone directories, direct mail, forms, some dry food packaging, grocery sacks, and carrier board.

For the Midwest, mixed paper generation is estimated at 8.8 million tons for 1990, or 28 percent of the national total. This includes residential mixed paper (26 percent of U.S.), commercial mixed paper and scrap (31 percent of U.S.), and nonrecyclable paper (28 percent of U.S.). The Midwest has a higher percentage of boxboard mills than any other region, and therefore a higher percentage of boxboard scrap. Overall and per capita mixed paper generation in the Midwest and Minnesota for 1990 are summarized below:

	<u>000 Tons</u>
Residential Mixed Paper	2,220
Commercial/Industrial Mixed Paper/Scrap	<u>620</u>
Subtotal	2,840
Nonrecyclable Mixed Paper	<u>5,950</u>
Total	8,790
Midwest Population (thousands)	÷ 60,265
Pounds per ton	<u>x 2,000</u>
Pounds per capita	292
Mixed Paper Generated in Minnesota (000 tons)	640

3.1.3

Per Office Worker Generation of Paper

Office Waste Paper

OWP consists of printing and writing papers of high quality (computer printout, white ledger), medium quality (laser printed papers), and mixed paper (commingled with groundwood, coated, or contaminated paper). Similar types of paper found in residences, retail and wholesale outlets, and other locations would be classified as mixed papers; similar papers from printing and converting operations would be called HGD or PS.

The methodology for determining quantities of OWP involves a three step process:

1. Estimate the amounts of paper generated per office worker in various industry segments.
2. Estimate the number of office workers in each industry segment.
3. Determine the annual generation of OWP by industry segment.

The methodology was developed from work Franklin Associates carried out for the National Office Paper Recycling Project (NOPRP) and Jaakko Pöyry Consulting carried out for the Northeast Recycling Council (NERC). Based on the two approaches, the following per worker estimates of generation were used:

<u>Type of Office</u>	<u>pounds per day</u>	<u>pounds per year</u>
Finance and Insurance	1.83	439
Government	.83	199
General Office	1.11	266

Generation in 1990 is estimated to be two million tons in the Midwest region, and 160,000 tons in Minnesota,

3.1.4

Scrap Generated from Converting Operations

High-Grade Deinking

Generation of high-grade deinking (scrap coming from printing and converting operations) was largely based on an estimate of printing and converting activity in the region. Generation in 1990 is estimated at 670,000 tons in the Midwest, and 50,000 tons in Minnesota.

Pulp Substitutes

By definition, pulp substitutes are the unprinted or lightly printed scrap and obsolete inventory resulting from converting operations that can be used without deinking. Generation of pulp substitutes in 1990 was estimated to be 500,000 tons in the Midwest, and 110,000 tons in Minnesota. The estimate of generation was based on converting activity in the region.

3.1.5

Disposal of Paper by Channel

Once per capita generation has been calculated, the place where the paper enters the waste stream and become available for recovery must be determined. The potential for recovery will depend on where the paper becomes available since certain collection methods are more successful than others. For example, OCC which is discarded in high density bales at food stores is more easily and efficiently recovered than OCC left curbside and commingled with newspapers and magazines.

Table 3.2 summarizes the points of discard and collection for the major categories of recoverable paper. Each grade is then discussed in greater detail.

Table 3.2. Disposal of paper by channel.

	Points of Collection of Recovered Paper			
	Residences	Offices	Food Stores	Other
Old Newspapers	75 %	10 %	0 %	15 %
Old Magazines	50 %	14 %	0 %	36 %
Old Corrugated Containers	23 %	4 %	39 %	34 %
Mixed Paper	27 %	0 %	0 %	6 %
Office Wastepaper	0 %	100 %	0 %	0 %
High-grade Deinking	0 %	0 %	0 %	100 %
Pulp Substitutes	0 %	0 %	0 %	100 %

Source: Jaakko Pöyry Consulting, Inc. 1992.

Newspapers

Residences.—The exact percentage of newspapers discarded in homes is unknown; newspapers delivered to homes can be discarded in office buildings, train stations, airports, and other public areas. Minnesota currently has over 600 operating curbside programs serving over three million residents statewide. It is estimated that 75 percent of the regional ONP in the Midwest is discarded from homes and apartment buildings.

Offices.—Approximately 51 pounds of newspapers per office worker (10 percent of the ONP in the Midwest) is discarded in offices annually, based on waste composition audits conducted by Jaakko Pöyry Consulting for the Northeast Recycling Council, and estimates from Franklin Associates, Ltd. for the National Office Paper Recycling Program.

Other (newsroom scrap).—Publisher scrap for newspapers is estimated at 8 percent of total consumption of newsprint and accounts for pressroom waste and overissue. The scrap rate for other uses of newsprint is estimated at 4.5 percent. In the Midwest, this accounts for about 7 percent of the total regional ONP.

Other (commercial/industrial).—Including public areas, libraries, hotels, and other retail and commercial locations. In the Midwest, an estimated 8 percent of the total regional ONP discarded is believed to be disposed at these locations.

Magazines

Other (scrap).—Approximately 12 percent of the total is estimated to be generated as converting scrap during the printing and publishing of magazines.

Other (newsstands).—About two-thirds of the magazines produced are delivered to homes, offices or institutions through second-class mail with the remaining third sold through newsstands. Half of those delivered to newsstands are returned unsold, entering the waste stream or becoming available for recovery as newsstand returns. Newsstand returns represent approximately 14 percent of OMG in the Midwest.

Offices.—Approximately 20 pounds of magazines and other coated papers per office worker (14 percent of the total regional OMG) is discarded in offices annually, based on waste composition audits conducted by Jaakko Pöyry Consulting for the Northeast Recycling Council, and estimates from Franklin Associates, Ltd. for the National Office Paper Recycling Program.

Residences.—Approximately 50 percent of the total regional OMG is discarded in homes and apartment buildings.

Other (commercial/industrial).—In addition to homes and offices, magazines are found at institutions such as libraries and schools, hotels, airports, and other commercial and retail establishments. Approximately 10 percent of the total regional OMG is discarded through these channels.

Corrugated

Food Stores.—Approximately 39 percent of the OCC in the Midwest is consumed and discarded at food stores.

Residences.—Approximately 23 percent of the total regional OCC is consumed and discarded at homes and apartment buildings.

Offices.—Approximately 41 pounds of corrugated containers per office worker (4 percent of the total regional OCC) is discarded in offices annually, based on waste composition audits conducted by Jaakko Pöyry Consulting for the Northeast Recycling Council, and estimates from Franklin Associates, Ltd. for the National Office Paper Recycling Program.

Other.—Approximately 34 percent of the total regional OCC is consumed and discarded at other commercial/industrial locations, including printing plants, retail stores, other commercial/industrial locations, and as scrap at corrugated box plants.

Mixed Paper

Residences.—Approximately 27 percent of the mixed paper in the Midwest is discarded and collectible from homes and apartment buildings as residential mixed paper.

Other.—Approximately 6 percent of total regional mixed paper is discarded and collectible from other commercial/industrial locations and converting plants.

Noncollectible.—Approximately 67 percent of total regional mixed paper is not considered collectible. This subcategory consists mainly of tissue, building papers, cigarette papers, etc.

Office Wastepaper

Offices.—By definition, 100 percent of the OWP generated is discarded in offices. Similar types of paper found in residences, retail and wholesale outlets, and other locations would be classified as mixed papers; similar papers from printing and converting operations would be called HGD or PS.

High-Grade Deinking

Other (scrap).—100 percent of high-grade deinking is discarded by printing and converting plants.

Pulp Substitutes

Other (scrap).—100 percent of pulp substitutes are discarded by paper mills converting plants and printers.

3.1.6

Recovery of Paper by Channel

The amount of each grade paper recovered will vary by point of discard, depending on the motivation for recovery. An understanding of the specific factors driving recovery rates in each channel is necessary to estimate current and potential recovery of paper in a given region.

Residences

State mandated and community based recycling is relatively new in the Midwest. Many municipalities are either currently starting recycling programs or are in a transitional stage between voluntary drop-off of recyclables and curbside collection. Minnesota has a very aggressive solid waste management program and curbside recycling, especially in the Twin Cities area.

Municipal recycling coordinators from Minnesota were surveyed to determine the types of material collected in municipal recycling programs, who is responsible for collection, and how collection is accomplished. A large portion of the respondents were from towns with populations of less than 10,000.

As seen in table 3.3, ONP and OCC are the two grades of recovered paper most often collected, either through voluntary or mandatory programs. The responses suggest that 99 percent of the municipalities collect ONP and OCC. These two grades have traditionally been collected and recycled, and have established markets and collection systems. In the rural areas of this region, respondents indicated that most of the ONP collected is used by local farmers for animal bedding.

Table 3.3. Mandatory and voluntary recycling in Minnesota.

	ONP	OCC	OMG	OWP	RMP*
Mandatory	21%	18%	3%	9%	3%
Voluntary	74%	79%	26%	85%	55%
Not Collected	2%	0%	47%	3%	21%
Did Not Answer	3%	3%	24%	3%	21%
Total	100%	100%	100%	100%	100%

*Residential mixed paper.

Source: Jaakko Pöyry Consulting, Inc. 1991.

Offices

Voluntary and mandatory office collection programs for OCC, ONP and OWP generally rely on the private sector. However, in cases where the local government is the main employer, collection of these grades would fall under their jurisdiction.

For the most part, collection of OWP is not mandatory in the Midwest, although the majority of the respondents (90 percent) indicated that voluntary collection is very common. Collection of OWP is mandatory in only 7 percent of the municipalities, suggesting that collection does not fall under their jurisdiction. OWP collection is likely to increase in the future. Even where office recycling

is not mandated by legislation, many large and small companies are apt to start recycling programs in order to be considered good corporate citizens, if they haven't done so already.

Food Stores

The largest concentration of postconsumer OCC is available from food stores. According to the Grocery Manufacturers of America, over 90 percent of food stores already collect and market their OCC.

Other Channels

Recovered paper is also collected from general commercial and industrial businesses, retail stores, magazine and catalog distributors, and as scrap from box plants, printers, converters, and paper mills. Almost 100 percent of the preconsumer grades (double lined kraft or DLK, high-grade deinking, pulp substitutes) are recovered and recycled. Postconsumer grades are not uniformly collected from other channels.

3.2

Recovery Rates in Minnesota and the Midwest

In general, paper is assumed to be recovered at a higher rate in Minnesota than in other states in the Midwest because of the well-established collection and processing infrastructure, the presence of the Waldorf Corporation, and the strong environmental ethic prevailing in the state. The current and forecast generation and recovery were based on the assumptions presented earlier in this section.

3.2.1

1990 Recovery Rates

Approximately 1.7 million tons of various grades of paper were generated and 0.6 million tons were recovered in Minnesota in 1990, yielding a recovery rate of 36 percent. This was slightly higher than the average for the Midwest for all grades except pulp substitutes. In the Midwest, the majority of pulp substitutes are generated in Wisconsin and Ohio where uncoated freesheet represents a higher percentage of overall printing and writing paper production. Uncoated freesheet is the main paper grade included in pulp substitutes.

The 1990 generation and estimated recovery in Minnesota for each paper grade and channel are compared to the Midwest region totals in table 3.4.

Residences

The recovery rate of 29 percent for all paper grades discarded in residences reflects fledgling curbside recycling programs in most areas. As public awareness and participation grow, recovery will increase. Many programs have only recently expanded to include mixed paper, magazines, and corrugated.

Table 3.4. Generation and recovery of paper in Minnesota vs. the Midwest (1990) (000 tons/year).

	Minnesota - 1990			Midwest - 1990		
	Gen.	Rec.	Recovery Rate	Gen.	Rec.	Recovery Rate
From residences	170	100	59%	2,300	1,000	45%
From offices	20	5	25%	300	0	10%
From food stores	0	0	NA	0	0	NA
From other sources	30	10	33%	500	400	75%
Total ONP	220	115	52%	3,100	1,400	45%
From residences	20	5	25%	300	0	5%
From offices	10	0	0%	100	0	NA
From food stores	0	0	NA	0	0	NA
From other sources	20	25	125%	200	100	45%
Total OMG	50	30	60%	600	100	17%
From residences	0	0	NA	0	0	NA
From offices	160	50	31%	2,000	600	31%
From food stores	0	0	NA	0	0	NA
From other sources	0	0	NA	0	0	NA
Total OWP	160	50	31%	2,000	600	30%
From residences	90	15	17%	1,300	0	2%
From offices	50	5	10%	600	0	2%
From food stores	270	200	74%	3,800	2,900	75%
From other sources	50	30	60%	600	300	55%
Total OCC	460	250	54%	6,300	3,200	51%
From residences	0	0	NA	0	0	NA
From offices	0	0	NA	0	0	NA
From food stores	0	0	NA	0	0	NA
From other sources	50	45	90%	700	700	97%
Total HGD	50	45	90%	700	700	100%
From residences	170	10	6%	2,400	200	8%
From offices	0	0	NA	0	0	NA
From food stores	0	0	NA	0	0	NA
From other sources	40	10	25%	500	300	50%
Total Recoverable MP	210	20	10%	2,900	500	17%
Nonrecoverable MP	430	0	NA	5,900	0	NA
From residences	0	0	NA	0	0	NA
From offices	0	0	NA	0	0	NA
From food stores	0	0	NA	0	0	NA
From other sources	110	100	91%	500	500	100%
Total PS	110	100	91%	500	500	100%
From residences	450	130	29%	6,300	1,200	19%
From offices	240	60	25%	3,000	600	20%
From food stores	270	200	74%	3,800	2,900	76%
From other sources	300	220	73%	3,000	2,300	77%
Recoverable Wastepaper	1,260	610	48%	16,100	7,000	43%
Nonrecoverable MP	430	0	0%	5,900	0	0%
Total Wastepaper	1,690	610	36%	22,000	7,000	32%

Source: Jaakko Pöyry Consulting, Inc. 1992.

Offices

Office collection programs were also relatively new in many areas in 1990. Two new OWP-consuming market deinked pulp mills are planned for the Duluth area in the near future. These mills will play a major role in increasing awareness and participation in office paper recycling as local markets for the product grow.

Food Stores and Other Channels

Recovery is already high at food stores and other commercial locations such as magazine distribution centers, printers, and converting plants. The infrastructure for collection from these locations is well-established and recovery is assumed to be approaching maximum levels.

3.2.2

Forecast Recovery of Paper in Minnesota in 1995

By 1995, the recovery rate of paper in Minnesota is expected to rise to 45 percent. The majority of the growth will come from curbside and office collection programs as public awareness and experience increases. About 800,000 tons of various grades of recovered paper will be available for use in recycling in Minnesota by 1995.

Residences

By 1995, recovery of paper from residences is expected to rise to 38 percent (from 29 percent in 1990). Growth will be mainly due to increased public awareness of state and local recycling goals. Since newspapers are already collected at a relatively high rate; most of the growth is expected to come from better recovery of magazines, corrugated and mixed paper from residences.

Offices

Recovery of paper from offices is expected to double by 1995 as more and more paper recycling programs are started, and recycling of office papers becomes second nature. The main new grades targeted for collection will be newspapers and corrugated.

Food Stores and Other Channels

Recovery is already high at food stores, but more and more corrugated will be recovered from other retail outlets and restaurants.

The 1995 forecast generation and recovery in Minnesota for each paper grade and channel are compared to the Midwest region totals in table 3.5.

Table 3.5. Generation and recovery of paper in Minnesota vs. the Midwest (1995 forecast) (000 tons/year).

	Minnesota - 1995			Midwest - 1995		
	Gen.	Rec.	Recovery Rate	Gen.	Rec.	Recovery Rate
From residences	180	110	61%	2,500	1,600	65%
From offices	30	20	67%	500	200	30%
From food stores	0	0	NA	0	0	NA
From other sources	10	10	100%	200	200	90%
Total ONP	220	140	64%	3,200	2,000	63%
From residences	20	10	50%	300	100	20%
From offices	0	0	NA	0	0	NA
From food stores	0	0	NA	0	0	NA
From other sources	30	30	100%	500	300	52%
Total OMG	50	40	80%	800	400	50%
From residences	0	0	NA	0	0	NA
From offices	180	100	56%	2,300	1,200	50%
From food stores	0	0	NA	0	0	NA
From other sources	0	0	NA	0	0	NA
Total OWP	180	100	56%	2,300	1,200	52%
From residences	100	30	30%	1,300	300	20%
From offices	50	10	20%	700	100	15%
From food stores	290	230	79%	4,000	3,000	75%
From other sources	50	30	60%	700	600	85%
Total OCC	490	300	61%	6,700	4,000	60%
From residences	0	0	NA	0	0	NA
From offices	0	0	NA	0	0	NA
From food stores	0	0	NA	0	0	NA
From other sources	50	50	100%	700	700	100%
Total HGD	50	50	100%	700	700	100%
From residences	180	30	17%	2,500	200	9%
From offices	0	0	NA	0	0	NA
From food stores	0	0	NA	0	0	NA
From other sources	40	20	50%	600	300	50%
Total Recoverable MP	220	50	23%	3,100	500	16%
Nonrecoverable MP	450	0	NA	6,300	0	NA
From residences	0	0	NA	0	0	NA
From offices	0	0	NA	0	0	NA
From food stores	0	0	NA	0	0	NA
From other sources	110	110	100%	600	600	100%
Total PS	110	110	100%	600	600	100%
From residences	480	180	38%	6,600	2,200	33%
From offices	260	130	50%	3,500	1,500	43%
From food stores	290	230	79%	4,000	3,000	75%
From other sources	290	250	86%	3,300	2,700	82%
Recoverable Wastepaper	1,320	790	60%	17,400	9,400	54%
Nonrecoverable MP	450	0	0%	6,300	0	0%
Total Wastepaper	1,770	790	45%	23,700	9,400	40%

Source: Jaakko Pöyry Consulting, Inc. 1992,

3.2.3

Forecast Recovery of Paper in Minnesota in 2000

The recovery rate of paper in Minnesota is forecast to reach 47 percent by the end of the century as curbside and office programs become common in most areas. Some 900,000 tons of recovered paper will be available for market in 2000.

Residences

Recovery of paper from residences is expected to rise to 42 percent by 2000. Growth will be due to continued emphasis and enforcement of state and local recycling goals.

Offices

Collection of papers from offices will rise modestly between 1995–2000; most offices are expected to have programs in place by 1995.

Food Stores and Other Channels

Recovery will increase slightly due to collection from nontraditional channels such as airports, public places, small retail outlets, and restaurants.

The maintenance of high recovery rates in the above channels will be highly dependent on the continued success of local and state recycling coordinators in keeping the public focused on reducing the amount of solid waste being disposed of in landfills.

The forecast generation and recovery in Minnesota by 2000 for each paper grade and channel are compared to the Midwest region totals in table 3.6.

3.3

Canada

The domestic supply of recovered paper is highly dependent upon population density. With the majority of the Canadian population living within 100 miles of the U.S. border, and over 75 percent living in urban areas, Canada has an excellent opportunity to increase recovery and provide a fiber source. However, since its population is only about 10 percent of the U.S., Canadian mills will continue to rely on U.S. recovered paper as a major source of recovered paper. This presents a risk. Should regional U.S. needs increase beyond projected levels, shipments to Canada would be a likely target for increasing the U.S. supply. In this regard, ONP and OMG are the most vulnerable grades.

Table 3.6. Generation and recovery of paper in Minnesota vs. the Midwest (2000 forecast) (000 tons/year).

	Minnesota - 2000			Midwest - 2000		
	Gen.	Rec.	Recovery Rate	Gen.	Rec.	Recovery Rate
From residences	180	130	72%	2,400	1,400	60%
From offices	30	20	67%	500	300	65%
From food stores	0	0	NA	0	0	NA
From other sources	10	10	100%	200	200	95%
Total ONP	220	160	73%	3,100	1,900	61%
From residences	20	15	75%	300	100	33%
From offices	0	0	NA	0	0	NA
From food stores	0	0	NA	0	0	NA
From other sources	40	40	100%	500	400	75%
Total OMG	60	55	92%	800	500	63%
From residences	0	0	NA	0	0	NA
From offices	210	120	57%	2,600	1,500	58%
From food stores	0	0	NA	0	0	NA
From other sources	0	0	NA	0	0	NA
Total OWP	210	120	57%	2,600	1,500	58%
From residences	110	30	27%	1,400	400	25%
From offices	50	20	40%	700	200	25%
From food stores	320	250	78%	4,300	3,700	85%
From other sources	50	30	60%	700	600	85%
Total OCC	530	330	62%	7,100	4,900	69%
From residences	0	0	NA	0	0	NA
From offices	0	0	NA	0	0	NA
From food stores	0	0	NA	0	0	NA
From other sources	60	60	100%	800	800	100%
Total HGD	60	60	100%	800	800	100%
From residences	200	40	20%	2,600	300	10%
From offices	0	0	NA	0	0	NA
From food stores	0	0	NA	0	0	NA
From other sources	40	20	50%	600	300	50%
Total Recoverable MP	240	60	25%	3,200	600	19%
Nonrecoverable MP	490	0	NA	6,500	0	NA
From residences	0	0	NA	0	0	NA
From offices	0	0	NA	0	0	NA
From food stores	0	0	NA	0	0	NA
From other sources	110	110	100%	600	600	100%
Total PS	110	110	100%	600	600	100%
From residences	510	215	42%	6,700	2,200	33%
From offices	290	160	55%	3,800	2,000	53%
From food stores	320	250	78%	4,300	3,700	86%
From other sources	310	270	87%	3,400	2,900	85%
Recoverable Wastepaper	1,430	895	63%	18,200	10,800	59%
Nonrecoverable MP	490	0	0%	6,500	0	0%
Total Wastepaper	1,920	895	47%	24,700	10,800	44%

Source: Jaakko Pöyry Consulting, Inc. 1992.

4

DEMAND FOR RECOVERED PAPER AND TRADE FLOWS

Current and forecast demand for recovered paper from Minnesota paper and paperboard mills will play the greatest role in determining the impact of recycling on the state's wood products industry. In order to have a mitigating impact on Minnesota's forests, recovered paper must not only replace current or projected wood pulp demand, it must affect *Minnesota* wood demand. Replacement of market wood pulp (pulp produced for sale on the open market) made from trees grown outside the state will be assumed to have no impact on Minnesota's total timber harvest.

There is currently no market pulp production in Minnesota. All market wood pulp needs from paper and paperboard mills is sourced from outside the state. The Potlatch mill in Brainerd technically consumes market pulp, but this pulp would be considered a *transfer* since it comes from the company's Cloquet mill.

4.1

Minnesota

4.1.1

Current (1990) Demand

Four of Minnesota's nine paper and paperboard mills currently use recovered paper as all or part of their furnish. The utilization rate (amount of recovered paper used divided by total production) ranges from 7 percent to over 100 percent for individual mills; the average for the state is 22 percent. The maximum utilization rate for a specific mill varies by end product. In coated papers, for example, nonfiber additives such as clay coatings and fillers can represent one-third of the weight of the paper. Thus, for coated papers, the maximum possible utilization rate would be about 67 percent, even if 100 percent of the fiber used were recovered paper.

Utilization rates also depend on the grade of recovered paper used and the processing method. Not all grades of recovered paper have the same fiber content. Yields for specific grades of recovered paper vary depending on the paper type (i.e., coated or uncoated paper), amount of ink coverage, and amount of contaminants (i.e., staples, glues, etc.). Direct entry methods (use of recovered paper without deinking) produce higher yields since the ink is left in the paper. Deinking and cleaning processes will produce lower yields as more of the ink and other contaminants are removed. This accounts for utilization rates over 100 percent.

Estimated utilization of recovered paper in Minnesota is compared to supply in table 4.1.

Table 4.1. Current (1990) utilization of recovered paper in Minnesota (000 tons per year).

	ONP	OMG	OWP	OCC	MP	HGD	PS	TOT	PROD**	UTILIZ RATE
Potlatch Cloquet	0	0	0	0	0	0	0	0	190	0%
Potlatch Brainerd	0	0	0	0	0	0	0	0	140	0%
Lake Superior Duluth	0	0	0	0	0	0	0	0	210	0%
Blandin Grand Rapids	0	0	0	0	0	0	20	20	290	7%
Boise Cascade Int'l Falls	0	0	0	0	0	0	0	0	200	0%
Champion Sartell	0	0	0	0	0	0	0	0	250	0%
Hennepin Little Falls	0	0	10	5	5	0	15	35	33	105%
CertainTeed Shakopee	5	0	10	0	20	0	0	35	60	58%
Waldorf St. Paul	65	0	45	140	15	0	0	265	260	102%
Minnesota Pacific Pulp and Paper Corp (tba)	0	0	0	0	0	0	0	0	0	NA
Envirosys, Inc. (93)	0	0	0	0	0	0	0	0	0	NA
Superior Recycled Fiber Industries (93)	0	0	0	0	0	0	0	0	0	NA
Mill Demand	70	0	65	145	40	0	35	355	1,633	22%
Nonpaper Demand*	25	0	0	0	0	0	0	25		
Total Demand	95	0	65	145	40	0	35	380		
Supply	115	30	50	250	20	45	100	610		
Net (imports)/exports	20	30	(15)	105	(20)	45	65	230		

*Animal bedding and insulation.

**Paper and paperboard production only (does not include pulp).

Note: Data in this table represent direct use of recovered paper only (do not include market deinked pulp).

Source: Jaakko Pöyry Consulting, Inc. 1992.

The 1990 average utilization rate of recovered paper in Minnesota is estimated to be 22 percent, compared to 39 percent for the Midwest region, and 26 percent overall. The Minnesota rate is low due to the high concentration of printing and writing paper mills compared to the region and rest of the country (see table 2.2).

Assuming that Minnesota mills recovered paper from within the state, local mills consume over 60 percent of the paper recovered in Minnesota. On a net basis, there are excess supplies of all grades of recovered paper except OWP and mixed paper. Paper not consumed in Minnesota is available for export to other states and to Canada.

4.1.2

Forecast Demand

Demand for recovered paper from mills in Minnesota is expected to increase 56 percent to 555,000 tons by 1995, due mainly to two greenfield mills: Superior Recycled Fiber Industries and Envirosys, Inc. Production of market deinked pulp is planned to begin in 1993 at Superior Recycled Fiber Industries in Duluth. The mill is expected to supply Potlatch and Lake Superior with about 90,000 tons per year of 67 percent postconsumer deinked pulp made from OWP and high grade deinking. The effect that use of this recycled pulp will have on the wood products industry will depend on the type of pulp it replaces. Three basic options exist:

1. *Recycled pulp replaces purchased pulp.* If recycled pulp replaces purchased pulp, there would be little or no effect on the level of wood harvest in the state since the purchased pulp being replaced is not a product of the Minnesota timber industry.
2. *Recycled pulp replaces planned virgin pulp capacity.* Recycled pulp could replace planned additional virgin pulp capacity. Planned annual increases in pulping capacity at Minnesota paper mills by 1995 total almost 600 thousand tons. About half of this incremental tonnage will be chemical pulps. The other half will be a combination of groundwood and chemical pulps. If the recycled pulp produced by Superior Recycled Fiber offsets planned virgin chemical pulp capacity, it could reduce demand for wood by up to 125 to 175 thousand cords. Current and planned virgin pulp capacity at Minnesota mills are summarized in table 4.2.
3. *Recycled pulp replaces existing virgin pulp capacity.* It is unlikely that recycled pulp will replace existing virgin pulp capacity because of the cost of idling existing facilities. This option was not considered.

Utilization rates are traditionally based on the direct use of recovered paper. In the case of market deinked pulp, the direct use of recovered paper takes place at the pulp mill, not at the end user mill. Therefore, individual mill utilization rates will not change (tables 4.1 and 4.3) even though they might indeed be consuming market deinked pulp. If all of the market deinked pulp is consumed at Minnesota mills, the overall utilization rate for the state in 1995 could be as high as 23 percent.

Envirosys, Inc. will produce approximately 10,000 tons per year of molded pulp products from recovered paper. Production is scheduled to begin in 1993. Since this is a greenfield mill and molded pulp products historically consume recovered paper, Envirosys, Inc.'s consumption of recovered paper is expected to have no impact on the Minnesota Wood Products industry.

Table 4.2. Current and planned virgin pulp capacity at Minnesota mills (000 tons per year).

Manufacturer (mill location)	Type Pulp	Virgin Pulp Capacity (000 tpy)		
		1990	1995 +	Increase
Potlatch (Cloquet)	NBSK, NBHK	185	490	305
Potlatch (Brainerd)	none	0	0	0
Lake Superior (Duluth)	PGW	160	285	125
Blandin (Grand Rapids)	PGW	190	310	120
Boise Cascade (Int'l.Falls)	NBHK	325	325	0
Champion (Sartell)	SGW, TMP	180	225	45
Hennepin (Little Falls)	SGW	25	25	0
Certainteed (Shakopee)	DWP	30	30	0
Waldorf (St. Paul)	none	0	0	0
Total Minnesota Mills		1,095	1,690	595

Source: Jaakko Pöyry Consulting, Inc. 1992.

Recovered paper is not always consumed in the same state (or even the same region) where it is generated, but shipments from one state to another would be almost impossible to track. Assuming that Minnesota mills use recovered paper collected from within the state, local mills would consume almost three-fourths of the paper recovered in Minnesota. On a net basis, there would be excess supplies of all grades of recovered paper except OWP.

OWP will be needed from other states, and possibly Canada, to satisfy the anticipated demand from Minnesota deinked pulp mills. There are also three new (1992 start up) OWP consuming market pulp mills in the region; two in Wisconsin, and one in Indiana. It is likely that some mills will substitute high-grade deinking for OWP. Recovered paper not consumed in Minnesota (mainly ONP, OCC and pulp substitutes) will be available for export to other states and to Canada.

Forecast utilization of recovered paper in Minnesota in 1995 is compared to supply in table 4.3.

A third greenfield mill may come online by the end of the decade. Minnesota Pacific Pulp and Paper Corp plans to make market deinked pulp from OWP in Duluth. Since a firm start date had not been set at the time of writing this paper, start-up has been assumed to take place after 1995. The mill would be slightly smaller than the Superior Recycled Fiber Industries mill, producing approximately 70,000 tons per year of market deinked pulp. Again, since there is currently no market pulp production in Minnesota, the establishment of a new recycled mill is not expected to affect the state's

wood products industry. If anything, the two planned mills will reduce Minnesota paper mills' dependence on market pulp from other regions.

Table 4.3. 1995 utilization of recovered paper in Minnesota (000 tons per year).

	ONP	OMG	OWP	OCC	MP	HGD	PS	TOT	PROD**	UTILIZ RATE
Potlatch Cloquet	0	0	0	0	0	0	0	0	500	0%
Potlatch Brainerd	0	0	0	0	0	0	0	0	150	0%
Lake Superior Duluth	0	0	0	0	0	0	0	0	390	0%
Blandin Grand Rapids	0	0	0	0	0	0	20	20	300	7%
Boise Cascade Int'l Falls	0	0	0	0	0	0	0	0	210	0%
Champion Sartell	0	0	0	0	0	0	0	0	310	0%
Hennepin Little Falls	0	0	10	5	5	0	15	35	33	106%
CertainTeed Shakopee	10	0	10	0	20	0	0	40	65	62%
Waldorf St. Paul	70	0	50	150	20	0	0	290	270	107%
Minnesota Pacific Pulp and Paper Corp (tba)	0	0	0	0	0	0	0	0	0	NA
Envirosys, Inc. (93)	10	0	0	0	0	0	0	10	10	100%
Superior Recycled Fiber Industries (93)	0	0	20	0	0	40	0	120	0	NA
Mill Demand	90	0	155	155	45	40	35	515	2,238	23%
Nonpaper Demand*	30	0	0	0	0	0	0	30		
Total Demand	120	0	155	155	45	40	35	545		
Supply	140	40	100	300	50	50	110	790		
Net (imports)/exports	20	40	(50)	145	10	50	75	245		

*Animal bedding and insulation.

**Paper and paperboard production only (does not include pulp).

Note: Data in this table represent direct use of recovered paper only (do not include market deinked pulp).

Source: Jaakko Pöyry Consulting, Inc. 1992.

On the other hand, recycled pulp could replace planned virgin pulp capacity. If the recycled pulp produced by Minnesota Pacific Pulp and Paper Corp offsets planned virgin chemical pulp capacity, it could reduce demand for wood by up to 120 to 150 thousand cords.

The overall utilization rate in Minnesota could be as high as 26 percent by 2000, assuming no significant increase in paper production in the state, *and assuming that all of the market deinked pulp produced in Minnesota is consumed in Minnesota.* Should Potlatch or Lake Superior expand their papermaking capacity, the utilization rate would surely go down. There will

be little room for increased use of the *white* grades of recovered paper (OWP, HGD, PS) once the two new pulp mills are fully operational.

Forecast utilization of recovered paper in Minnesota in 2000 is compared to supply in table 4.4.

Table 4.4. 2000 utilization of recovered paper in Minnesota (000 tons per year).

	ONP	OMG	OWP	OCC	MP	HGD	PS	TOT	PROD**	UTILIZ RATE
Potlatch Cloquet	0	0	0	0	0	0	0	0	530	0%
Potlatch Brainerd	0	0	0	0	0	0	0	0	160	0%
Lake Superior Duluth	0	0	0	0	0	0	0	0	410	0%
Blandin Grand Rapids	0	0	0	0	0	0	20	20	315	6%
Boise Cascade Int'l Falls	0	0	0	0	0	0	0	0	220	0%
Champion Sartell	0	0	0	0	0	0	0	0	330	0%
Hennepin Little Falls	0	0	10	5	5	0	15	35	33	106%
CertainTeed Shakopee	10	0	10	0	20	0	0	40	70	57%
Waldorf St. Paul	70	0	50	160	20	0	0	300	280	107%
Minnesota Pacific Pulp and Paper Corp (tba)	0	0	90	0	0	0	0	90	0	NA
Envirosys, Inc. (93)	10	0	5	0	0	0	0	15	15	100%
Superior Recycled Fibre Industries (93)	0	0	85	0	0	40	0	125	0	NA
Mill Demand	90	0	255	165	45	0	35	625	2,360	26%
Nonpaper Demand*	30	0	0	0	0	0	0	30		
Total Demand	120	0	250	165	45	40	35	655		
Supply	160	55	120	330	60	60	110	895		
Net (imports)/exports	40	55	(130)	165	15	20	75	240		

*Animal bedding and insulation.

**Paper and paperboard production only (does not include pulp).

Note: Data in this table represent direct use of recovered paper only (do not include market deinked pulp).

Source: Jaakko Pöyry Consulting, Inc. 1992.

4.1.3

Trade Flows

Recovered paper is becoming less and less of a regional commodity. In areas such as Minnesota, where the supply (and potential supply) of most grades surpasses demand, excess supplies are shipped to neighboring states

where the demand is greater. Pulp substitutes and high-grade deinking flow from Minnesota to Wisconsin where several mills use these grades to make uncoated freesheet. More recently, OCC from Minnesota is being shipped to Stone Container's mill in Missoula, Montana and even to the West Coast ports for export to the Pacific Rim. ONP from Minneapolis and the seven county area is beginning to flow to Canada to supply new deinking mills in Thunder Bay and elsewhere.

4.2

Midwest

The Midwest is a macrocosm of Minnesota. Demand for recovered paper and trade flows in the Midwest region follow a pattern similar to that of Minnesota.

4.2.1

Current (1990) Demand

Paper and paperboard mills in the Midwest used approximately 5.8 million tons of recovered paper in 1990, representing 94 percent of the total regional demand. An additional 250,000 tons (4 percent) was consumed for nonpaper uses such as animal bedding, mulch, and insulation. Exports to Canada totaled only 130,000 tons, representing 2 percent of total demand.

Recovered paper is consumed, in varying amounts, in all end product categories in the region. Boxboard and containerboard represent the largest regional end uses for recovered paper. There are only two newsprint mills in the region and both use recovered paper as their sole furnish. A substantial amount of recovered paper is also used in the manufacture of tissue products and uncoated printing and writing paper. Recovered paper is used in smaller quantities in coated and specialty papers.

The type or mix of recovered paper varies from grade to grade and from mill to mill. The grades and amounts of recovered paper an individual mill can handle depends on specific mill processing and cleaning capabilities, as well as fiber availability and pricing. In general, the types of recovered paper used will be similar within like end product categories.

The current overall recovered paper utilization rate in the Midwest is 38 percent, but the rate of recovered paper utilization in individual end products ranges from 13 percent to over 100 percent. There are two market deinked pulp mills in the region which provide recovered fiber pulp to various end products and it would be impossible to accurately track the use of this fiber to specific end uses or regions. The regional utilization rate of 38 percent assumes that all of (and only) the market deinked pulp produced in the Midwest is consumed by regional mills.

4.2.2

Forecast Demand

Regional demand for recovered paper is projected to increase by 41 percent between 1990–95, to 8.4 million tons. Growth will be due mainly to exports as planned new deinking capacity at nearby Canadian mills comes on line. Forecast demand from Canadian mills would raise exports to 17 percent of the total regional demand, in contrast to just 2 percent in 1990. Demand for recovered paper due to expansions at regional domestic paper and paperboard mills is expected to increase approximately 15 percent to 6.7 million tons by 1996, while demand from nonpaper products is projected to increase 10 percent to 270,000 tons.

Boxboard producers will continue to be the largest consumers of recovered paper. Containerboard mills, however, will improve their position due to increased utilization. Market deinked pulp will become a desired commodity with the potential to increase the use of recovered paper indirectly in the printing and writing and tissue segments.

By the end of the decade, total regional demand for recovered paper is forecast to be 10.1 million tons, assuming all current planned and announced capacity increases take place. Announced planned expansions and new mills would represent almost one million tons of new demand between 1995-2000. Growth of exports during the same period is expected to increase only 21 percent, while growth in nonpaper uses of recovered paper is projected to increase 10 percent.

4.2.3

Trade Flows

OCC and ONP flow north to Canada and west to the Coast from as far east as Illinois and Indiana. One example is Stone container, working through Burlington Northern Railroad, who is finding that OCC can be economically sourced for its Missoula, Montana, mill from the Midwest because of attractive backhaul rates. The train has even been dubbed the "Recycling Express." Laidlaw, the contract supplier for Canadian Pacific Forest Products in Thunder Bay, Ontario, is writing ten year contracts directly with municipalities for ONP and OMG.

4.3

Canada

Demand for recovered paper in Canada is partly driven in by U.S. newspaper publishers' goals for increased recycled content in newsprint. The U.S. is the major consumer of paper produced in Canada. Because of the proximity of several large Canadian newsprint mills, this increased demand

will impact strongly on the supply/demand balance of recovered paper in Minnesota.

4.3.1 Mill Demand

The demand for recovered fiber in Canada has shown a steady increase since the mid-1960s. For most of the last decade, the average annual increase was 7 percent for all grades. The largest growth area was the use of recovered fiber in tissue. In the early 1980s, less than 25 percent of the tissue produced contained recovered fiber, whereas in 1990 the figure was over 50 percent. The recovered fiber used in tissue primarily replaced market pulp as a cost competitive move.

OCC is the major grade of recovered paper used by Canadian mills and accounts for about half of the recovered fiber demand. Other significant grades are pulp substitutes and ONP. The other three grades of recovered paper account for less than 10 percent each.

Overall demand for recovered fiber is expected to increase at an annual rate of about 7 percent for the next decade, with a slightly higher growth rate in the first five years. The driving force behind this growth is the projected increased demand for recovered fiber content in newsprint in both the U.S. and Canada.

Canadian utilization rates for recovered fiber used in all grades is expected to double between 1990 and 2000, reaching a level of 20 percent.

Prices for recovered fiber in Canada are essentially the same as paid by U.S. mills, but vary across Canada depending on the regional supply source. Many of these are in the U.S.

4.3.2 Trade Flows

Current and future supply/demand balance for recovered fiber depends on OCC and ONP fiber imported from the U.S. Because of the size of the newsprint capacity and the export of some 80 percent to the U.S., the U.S. will remain the primary source of recovered ONP. As noted earlier, reliance on the U.S. for supplies of recovered paper is not without risk.

5

IMPACT OF SUPPLY/DEMAND ON VIRGIN FIBER SOURCES

Recovered paper can be used at new or existing mills in Minnesota. A new (greenfield) recycled paper or paperboard mill would impact the wood products industry if it displaces a virgin product. In addition, demand from a greenfield recycled mill would affect the amount and grades of recovered paper available for substitution at existing virgin mills.

At existing mills, recovered paper can substitute for virgin fiber in the manufacture of paper and paperboard in three main ways:

1. substitution of direct entry recovered paper for purchased or integrated virgin pulp;
2. substitution of market deinked pulp for purchased or integrated virgin pulp; and
3. substitution of integrated deinked pulp for purchased or integrated virgin pulp.

5.1

Direct Entry Use of Recovered Paper

Some grades of recovered paper are used directly in the manufacture of paper and paperboard—without deinking. A typical example would be the use of OCC and other grades to make paperboard at Waldorf Corporation in St. Paul. Lightly printed computer printout is used to make high-grade products such as tissue and printing and writing paper without deinking. Small amounts of old newspapers can also be used without deinking in the production of newsprint or directory paper. The advantages are high yield and low cost; the tradeoff is lower brightness since the ink and other contaminants are retained in the paper.

5.2

Market Deinked Pulp

Market deinked pulp is a rapidly evolving product. On the one hand, it seems ideally suited to nonintegrated mill use—providing the ability to participate in an attractive recycled market without investing in a deinking facility. Deinked pulp mills can be cost effective at 500 to 600 tons per day, unlike virgin pulp mills, which must usually be 1200 tons per day or larger.

The substitution ability of market deinked pulp will have the greatest impact on the printing and writing and tissue segments of the wood products industry. Since there are no tissue mills in Minnesota, the discussion of substitution will focus on the printing and writing segment.

5.2.1

Printing and Writing

Almost 60 percent of the pulp used in the printing and writing segment in the Midwest is integrated virgin pulp. Recycled pulp (including pulp substitutes) provides about 15 percent of the region's fiber needs; the rest (some 1.5 million tons) is market pulp (including captive pulp transfers). The market pulp segment includes both virgin and deinked pulp, with virgin pulp comprising over 90 percent. Market deinked pulp could displace some or all of the virgin market pulp used in this segment.

A small increase in mill capacity has been announced for the printing and writing segment between 1990-95. By mid-decade, this segment will still require some 1.5 million tons of purchased pulp. However, market deinked pulp could play a big role in the fiber supply scenario. Over 300,000 tons of new market deinked pulp capacity is expected to come on line in the Midwest by 1995. While market deinked pulp can be used in many end products, the current trend is for increased use in printing and writing papers. Regionally produced market deinked pulp could displace up to 400,000 tons of virgin market pulp demand in the Midwest by 1995.

Plans to install recovered paper pulping operations at three existing mills could further erode virgin pulp consumption by 2000. Since these plans are preliminary, and a firm start-up date has not been set, they are not expected to be fully operational before 1995. Even with these expansions, the printing and writing segment will require about 1.5 million tons of purchased pulp in 2000. Market deinked pulp will continue to make inroads in the fiber supply picture. About 700,000 tons of market deinked pulp is expected to be available in the region by 2000, and could displace a sizeable portion of the virgin pulp purchased by printing and writing mills in the area.

Minnesota

In Minnesota, about 75 percent (one million tons) of the pulp used in the printing and writing segment is integrated virgin pulp (66 percent kraft, 34 percent groundwood). Recovered paper (pulp substitutes) provided less than one percent of the fiber needs; market pulp, including pulp transfers represent the balance (about 330,000 tons or 25 percent of the total). All of the purchased virgin pulp is softwood kraft pulp (see table 2.1). If market deinked pulp replaced the purchased softwood kraft pulp, adjustments would have to be made since market deinked pulp generally has a high hardwood content. The specific paper properties provided by various pulps and substitution options are discussed in appendix A.

Pulp expansion plans at four Minnesota mills total almost 600,000 tons by 1995 (detail on table 4.2):

- Potlatch (Cloquet, Brainerd);
- Lake Superior (Duluth);
- Blandin (Grand Rapids); and
- Champion (Sartell).

Depending on the specific products made at these mills, some purchased pulp may also be required. Lake Superior, Blandin, and Champion, for example, are integrated to groundwood pulp but purchase the kraft pulp portion of the furnished needed for their coated groundwood and supercalendered papers. Deinked pulp could account for some or all of the incremental purchased pulp.

5.3

Integrated Deinked Pulp Capacity

The addition of integrated deinked pulp capacity in the regional printing and writing industry could displace almost any type or combination of fibers. The impact on the wood products industry would depend on the specific mill configuration. There are no current plans to add integrated deinked pulp capacity at any of the mills in Minnesota.

6

CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER STUDY

6.1

Overall Conclusion

Increased collection and use of recovered paper in Minnesota could reduce future demand for wood by the state's forest products industry by as much as 400,000 cords. The most likely range will be 150,000 to 300,000 thousand cords due to several factors:

1. The composition of the state's paper industry (over 80 percent printing and writing paper) requires the use of bleached kraft (chemical) and groundwood pulps. The printing and writing mills in Minnesota currently consume approximately 0.9 million tons per year of chemical pulp and 0.5 million tons per year of groundwood pulp. For recovered paper, chemical pulp means high-grade deinking, pulp substitutes, or OWP. End user demand presently favors postconsumer recycled content in printing and writing grades, especially for publication papers. OWP is the only postconsumer source of bleached chemical fibers.

ONP and OMG are the main sources of postconsumer bleached groundwood fibers. The inconsistent quality of mixed paper currently precludes its use in significant quantities to make printing and writing papers. Therefore, OWP (or market pulp made from OWP) is the most

likely substitute for virgin kraft pulp to make printing and writing paper in Minnesota.

2. Economics favor the substitution of recovered paper or market deinked pulp for purchased pulp rather than integrated pulp. This is especially true if substitution for integrated pulp means idling existing facilities. Minnesota paper mills purchase half of their kraft pulp needs; the coated and uncoated groundwood mills in the state are fully integrated to the groundwood portion of their pulp furnish. Therefore, ONP and OMG are unlikely substitutes for purchased pulp or existing integrated virgin pulp production in Minnesota.
3. Because of its fiber composition, market deinked pulp will not be a major substitute for virgin groundwood pulp. Its hardwood content and reduced strength and brightness properties also make it a questionable replacement for virgin softwood kraft pulp in premium coated freesheet products. Deinked pulp is most likely to replace hardwood kraft pulp, but could replace *some* softwood kraft pulp in coated and uncoated products.
4. There are already plans to consume more OWP than is or will be collected within the state. Neighboring states also consume large amounts of OWP. Therefore, sufficient amounts of OWP will not be available for new integrated deinked pulping capacity at existing mills. It is more likely that mills will use market deinked pulp as an optional source of chemical fiber.
5. Paper mills in Minnesota currently purchase over 400,000 tons of virgin kraft market pulp annually. Since a small amount of chemical pulp is mixed with groundwood pulp to make coated and uncoated groundwood products, purchases of virgin kraft market pulp are expected to increase in tandem with planned new groundwood pulp capacity.

High demand for market pulp in the state makes it possible that one or more current virgin kraft pulp producers could make or purchase deinked pulp and sell or trade their unneeded virgin pulp to another mill. Another possibility would be for a mill to use deinked pulp to increase production of finished product. In either case, the net result would be reduced or zero-growth demand for virgin pulp.

If 20 percent of the current market pulp needs were met by deinked pulp, mills in Minnesota could reduce demand for virgin kraft market pulp by about 100,000 tons. Virgin market pulp is not currently produced in Minnesota (or from wood grown in Minnesota), so there would be no impact on Minnesota's total timber harvest levels. On the other hand, if half of the planned *new* virgin kraft pulp capacity in the state were

replaced with recycled pulp, mills in Minnesota could reduce future demand for virgin kraft pulp by approximately 150,000 tons (or 300,000 cords of wood).

6. By 1995, almost 100,000 tons of deinked pulp made in Minnesota will be available annually, growing to 175,000 tons before the year 2000. Another 200,000 tons will be available from other market deinked pulp mills in the Midwest by 1995; rising to over 400,000 tons by the year 2000. Therefore, the amount of virgin pulp that could be replaced with market deinked pulp in Minnesota could be as high as 300,000 tons in 1995, and 600,000 tons in 2000, *assuming that mills in Minnesota consumed 100 percent of the pulp produced by market deinked pulp mills in the entire Midwest region.* This is highly unlikely as there are obviously many other mills that will use portions of this pulp.

Market deinked pulp is used mainly at printing and writing and tissue mills. Minnesota mills represent approximately 24 percent of the printing and writing and tissue capacity in the Midwest. If the market deinked pulp produced in the Midwest were distributed proportionately throughout the region, Minnesota mills could consume 75,000 tons annually in 1995, and 150,000 tons by 2000. Using this as a minimum, the likely consumption of market deinked pulp by Minnesota mills could range from 75 to 150,000 tons, equivalent to 150,000 to 300,000 cords of wood.

6.2

Recommendation For Further Study: The Impact of Incineration

Incineration competes with the forest products industry for supplies of recovered paper in Minnesota. Incinerators burn some of the same grades of paper targeted for recovery from the municipal solid waste stream. Access to incineration as a disposal option is fairly common in Minnesota which has, by far, the largest number of burn plants (13) in the Midwest. When burn capacity is translated to the basis of pounds of all types of waste (not just paper) per person per year, Minnesota also leads the other states in the region, at 584 pounds per person. (The next highest state is Indiana at 246 pounds per person.)

The feed stock for incineration is sometimes guaranteed through flow control legislation. Thus, for existing incinerators the advent of aggressive paper collection efforts may be a threat to economic efficiency of burn plants. While recyclable paper products will be banned at landfills in Minnesota by 1995, fiber is needed in municipal solid waste to maintain high British Thermal Units (BTU) necessary for efficient incineration. As more paper is recovered from the solid waste stream for recycling, the total BTU content of the remaining waste will decrease.

In 1991, the EPA withdrew a proposed "25% materials separation" rule from the 1990 Clean Air Act Amendments. This action effectively removes one of the motivations for municipalities to collect and separate recyclables from the solid waste stream. Municipalities with access to incinerators can reduce the amount of waste ending up in the landfill simply by burning it instead of recycling it. This is a sensitive issue in states like Minnesota where incinerators are numerous. The end result of this competition for fiber could be a change in the structure of the paper collection and processing industry. Burn plants might begin to recover some valuable paper grades in exchange for mixed paper and residue from a Materials Recovery Facility (MRF) or paper stock dealer.

Incineration could essentially compete with existing or planned mills in the region for the lower grades of recovered paper, such as mixed OWP and residential mixed paper. This could affect future price levels for these grades as demand increases.

APPENDIX A: RECYCLING OVERVIEW

1 DEFINITIONS

Solid waste management began to take a multidimensional role around 1986 when recycling became a goal of public institutions, environmental activists, private citizens, and industrial/business organizations. What was historically an integral part of the paper industry — recycling and recycled content products — was thrust into the public arena. As a result, many traditional terms of paper recycling are taking on new or altered meanings, and new terms are coming into use. Thus, it is important that these terms be defined as carefully as possible, as many of them are now embodied in laws, regulations, and public policy statements, as well as the everyday world of paper recycling. Even sectors of the paper industry that have traditionally depended almost solely on virgin fiber are adapting to terms and definitions that bridge traditional and current use.

Many definitions are in a state of transition. Some terms, while heavily ingrained in daily use, are likely to be phased out; others will be adopted. This paper has tried to accommodate this dynamic state in the definitions that follow, in order to make them working definitions. A complete list of definitions used is provided in Appendix IV.

It should be noted that the term paper is used in the generic sense to include both paper and paperboard.

One group of definitions requires special attention — Recovered Paper, Waste Paper, and Secondary Fiber. These terms, particularly the latter two, are often used interchangeably. All three terms refer to paper and paperboard (including converted products) which have been diverted from the solid waste stream for potential reuse and recycling. Recovered paper is currently the term of choice within the paper industry.

1.1 Recovered Paper

Recovered paper is considered to be paper materials and paper by-products which have known recycling potential, and which have been removed or diverted from the solid waste stream. This includes paper which has never been discarded as solid waste and is intended for sale, use, reuse, or recycling, whether or not such materials or by-products require subsequent separation and processing. Mill broke is excluded.

1.2

Waste Paper (or Wastepaper)

Waste paper is paper that has served its original purpose. It is either discarded or recovered for recycling. The term waste paper has been used for decades to designate secondary fiber or paper stock used for recycling. The term is commonly used both inside and outside the paper industry. There is, however, a growing movement to use the term only for discarded paper and to substitute the term recovered paper for paper destined for recycling. The continued use of the term waste paper is significant for three reasons:

1. If recovered paper is classified as waste, exports of recovered paper could fall under the regulations of the Basel Convention regarding transfrontier shipments of waste. Originally introduced in 1989 as a mechanism for protecting third world countries from becoming hazardous waste dumping grounds, it could affect the U.S. paper stock industry in unanticipated ways. Representatives of the Netherlands government recently introduced a proposal to ban trade of materials with a negative impact on the domestic recycling structure. If this policy is adopted, the repercussions could stop paper stock from being exported to any country signing the Basel Convention.
2. Some paper recycling companies are concerned that using the term waste paper will associate the transport of recovered paper with the interstate transportation of solid waste. Recovered paper sorting facilities could be inadvertently associated with solid waste processing facilities.
3. Many in the paper industry object to the term "waste paper" because it does not convey the fact that recovered paper is a valuable raw material.

1.3

Secondary Fiber

Historically, this term has been used to describe recovered paper. Terms used interchangeably have been waste paper, paper stock, and more recently, recovered paper. The term is commonly used to describe fiber derived from discarded paper. However, secondary fiber may also refer to wood pulp derived from residuals of manufacturing (e.g. lumber mills) and forestry operations. Since secondary fiber could refer to recovered paper or wood pulp from residues, the use of this term has been avoided.

2

DESCRIPTION OF RECOVERED PAPER GRADES

Throughout this paper, reference will be made to various grades of recovered paper. These are referred to by the Paper Stock Institute (PSI) as paper stock grades. The definitions generally follow those of the Paper Stock Institute with some notable exceptions — Old Magazines (OMG), Office Waste Paper (OWP) and High Grade Deinking (HGD). These terms have been defined according to current usage and understanding.

2.1

Old Newspapers (ONP)

There are several grades of ONP. These are based on the presence of contaminants (glossy, rotogravure, or colored sections, magazines or paper other than news), the condition (sunburned or wet) and age of the bales. Nevertheless, the Paper Stock Institute generally defines ONP as "baled newspapers." ONP enters the waste stream from residences, offices, printing plants, or as overissue newspapers.

ONP is a relatively homogenous category of recovered paper, containing primarily mechanically pulped softwood fibers. It is particularly well suited for the production of groundwood grades such as newsprint and groundwood publication papers.

The Paper Stock Institute recognizes four distinct grades of ONP, according to the appearance and presence of various other papers as described below.

- #6 News — Consists of baled newspapers containing less than 5% of other papers.
- #7 Special News — Consists of baled, sorted, fresh dry newspapers (not sunburned), free from paper other than news, containing not more than the normal percentage of rotogravure and colored sections.
- #8 Special News Deink Quality — Consists of baled, sorted, fresh dry newspapers, not sunburned, free from magazines, white blanks, pressroom overissues, and paper other than news, containing not more than the normal percentage of rotogravure and colored section.
- #9 Overissue News — Consists of unused, overrun regular newspapers printed on newsprint, baled or securely tied in bundles, containing not more than the normal percentage of rotogravure and colored sections.

ONP is also used as the primary component in gypsum board liner and molded pulp products and in lesser amounts in the furnish of various grades

of paperboard. When ONP is used in a flotation deinking system, calcium carbonate or clay must be added in order to efficiently remove the inks. This is generally accomplished through the use of coated groundwood paper such as old magazines.

2.2

Old Magazines (OMG)

The Paper Stock Institute (PSI) has not established a definition for magazines, although a grade category — #27-S — exists. In practice, they are often reported as mixed paper. Most grade categories which could include magazines — Flyleaf Shavings (PSI grade #27), Publication Blanks (PSI grade #26), Mixed Groundwood Shavings (PSI grade #22), Coated Groundwood Sections (PSI grade #44) — refer to new (preconsumer) scrap from the production of magazines or other publications. These would generally be included in high-grade deinking paper.

OMG enters the waste stream from residences, magazine distribution centers, and printing plants. It primarily refers to magazines which have been used and discarded, newsstand returns, and misprinted magazines. Municipal recycling systems are starting to target OMG as a grade to be collected, either separately, mixed with ONP, or co-mingled with other papers in a category called residential mixed paper. When magazines are collected from offices, they are usually included in office waste paper (OWP).

2.3

Old Corrugated Containers (OCC)

The Paper Stock Institute defines Old Corrugated Containers (PSI grade #11) as "baled corrugated containers having liners of either test liner, jute or kraft." OCC provides strength and is best suited for recycling back into the components of a corrugated box — linerboard and medium — or into kraft paper grades or boxboard. Postconsumer OCC enters the waste stream primarily from food stores, but is also recovered from offices, residences, industrial plants, and other commercial or retail locations.

A sub-grade of OCC called Double Lined Kraft (DLK) results from corrugated box plant cuttings. It is a preconsumer grade and is much cleaner than postconsumer OCC. DLK is used almost exclusively in linerboard.

2.4

Office Waste Paper (OWP)

The Paper Stock Institute has not established a definition for OWP. OWP currently includes various grades of high-grade deinking, pulp substitutes, or mixed paper. The quality and consistency of OWP is highly dependent on

the specific grades targeted for collection in a given office. The scope of programs varies greatly from those programs that target only high-grade computer printout (CPO) to offices that collect "anything that tears". Paper generated in offices generally consists of uncoated, bleached freesheet papers. Business forms, computer printout paper, fine papers such as letterheads, and commodity papers such as multipurpose copy or bond papers fall in this category. OWP enters the waste stream from commercial and government offices.

OWP contains a mixture of chemically pulped hardwood and softwood fibers. As such, office papers are not suitable as the sole material in the manufacture of paper and paperboard products requiring high strength (e.g. containerboard) or large amounts of mechanical fiber (e.g. newsprint or coated groundwood paper). Uncoated freesheet grades (fine papers), white top paperboards, market pulp, and tissue are the preferred end-uses. Because office papers are generally uncoated, the yield is higher than for coated grades such as magazines and high quality printing papers. Deinking OWP can be difficult because of laser printing and other permanent forms of printing or copying. This can limit the recyclability of OWP, depending on the cleanliness requirements of the final product and the specific technology employed in the deinking system.

2.5

Mixed Paper (MP)

The Paper Stock Institute defines Mixed Paper (PSI grade #1) as "a mixture of various qualities of paper not limited as to type of printing or fiber content." Because of its heterogeneous nature, mixed paper usage is generally confined to the lower grades of paper and paperboard. MP enters the waste stream from residences and commercial locations, as scrap from converters, or as a byproduct from sorting other grades of recovered paper.

Many papers are classified as mixed paper if they are commingled and no longer fit the criteria for a single homogeneous grade. If a residential collection program does not require source separation of ONP, OMG, or OCC, these grades may be collected together as mixed paper. It is therefore possible for paper to be collected as mixed paper that was not included in the initial description.

On the other hand, the MP category also includes several paper and paperboard products that are not currently recovered, and some of these are generally considered unrecoverable. This category includes tissue & towel products, building papers such as gypsum liner or roofing felt, and packaging papers for wet products.

2.6

High-Grade Deinking (HGD)

There is no specific PSI definition for HGD. High-grade deinking is a general category used by the American Paper Institute. It includes various grades of printed, bleached or unbleached, coated or uncoated, freesheet or groundwood paper. HGD is not a precise descriptive term, except to denote relatively clean printed recovered paper. Some very clean OWP and sorted residential paper could potentially fall under this category. However, HGD generally enters the waste stream from printing and converting plants.

The HGD category includes a variety of fibers and fillers or coatings. However, because of the way in which it is collected (in large quantities from printers or converters), HGD is a relatively homogeneous material. This scrap from printers and converters generally does not have to be sorted prior to use. While deinking and pulping processes for various grades of HGD are similar, specific grades are not necessarily interchangeable.

Some grades of HGD are primarily uncoated and coated free sheet papers. These grades contain chemical fibers which are mostly hardwood based (plus additives and/or coatings). Other grades of HGD can be mixtures of coated and uncoated freesheet or coated and uncoated groundwood. HGD grades are primarily used in the manufacture of uncoated freesheet (fine papers), coated freesheet papers, market pulp, and tissue.

2.7

Pulp Substitutes (PS)

Pulp Substitutes normally consist of manila tab cards (PSI grade #37), white shavings (PSI grades #27, #28, #30), envelope cuttings (PSI grades #31, #33, #35), unprinted bleached sulfate board (PSI grade #47), side rolls and converted trim, unprinted news and groundwood (PSI grades #24, #26), and dark kraft grades (PSI grades #15-#21). The white or light-colored grades are used in high-grade paper production; the darker pulp substitutes are used in brown toweling and wipes. In general, white (or light colored) pulp substitute grades are recycled back into the grades from which they originated.

PS enters the waste stream from paper mills and printing or converting plants. Some types of PS (such as obsolete inventory, off-spec paper, and damaged or returned rolls) may never have entered the market place and therefore have not been included in the calculation of new supply.

3

DEINKING AND PULPING TECHNOLOGIES

Development of new technologies to use recovered fiber is driven in part by end-product market opportunities and fiber availability.

The recycling of paper fiber has three distinct phases: collection, pulp processing, and paper manufacture. Collection represents all the steps necessary to deliver recovered paper to the door of the pulp processing operation. Pulp processing represents all the steps necessary to transform the recovered paper to a clean slush or dried pulp. Paper manufacture is the process of blending and forming the pulp, removing the water, and making it into paper, paperboard, or molded products.

The recycling process starts with collection. The quality of recycled pulp is dependent on the source of recovered paper. Traditionally, this is broken down into various grade classifications. The Paper Stock Institute periodically publishes a list of Paper Stock Standards and Practices. In 1990, this list defines 43 different paper stock grades and mentions an additional 33 specialty grades. Within a grade classification there are local differences. Many special grade classifications are created by either the supplier or the user. The buyer and seller ultimately agree on what is acceptable for a specific waste paper grade. Many of the grades may, therefore, have very minor usage.

Future collection processes will produce large quantities of paper stock with a fairly consistent level of contamination. In general, the major grades will not be free from contaminants, and these will need to be removed in the pulping process. New collection techniques may create unique grades, which will be processed according to their fiber and contamination characteristics. Knowledge of the recovered fiber and potential contaminants should be communicated to the pulp processing facility by the collector.

3.1

Fiber Requirements

While paper stock is classified according to the source of paper, utilization is dependent only on the properties which can be obtained. Five major characteristics are important for fiber utilization:

- strength,
- optical properties,
- contaminants,
- production characteristics, and
- economics.

Chart 3-1 presents eight major uses of recovered fibers. Typical recovered paper used for these grades are shown.

CHART 3-1
Typical Relative Furnish Requirements by Grade

PAPER GRADE	Printing/ Writing	Tissue	News- print	Molded Fiber	Box- board	Liner	Medium	Building Tube
WASTE PAPER	Ledger Pulp Sub Mix Office	Ledger Pulp Sub Mix Office	ONP OMG	ONP Pulp Sub	all	OCC	OCC	Mixed OCC ONP
FURNISH								
Strength	70	70	30	20	50	90	70	50
Brightness	80	75	60	40	40	20	15	40
Contaminants	3	10	20	40	35	45	50	100
Drainage	60	60	30	30	40	60	60	40

Furnish values (1-100) are for simple comparison and will vary depending on grade.

The selection of specific grades of recovered paper depends on the actual grade being produced, the process equipment available, and the cost and supply of recovered paper. For example:

- A printing & writing mill with extensive deinking and contaminant removal equipment would be able to use assorted mixed office waste. With limited deinking and contaminant removal equipment, the mill is restricted to the ledger grades; and with no deinking or cleaning capabilities only pulp substitutes can be used.
- Tissue is similar to printing & writing paper, except more contaminant specks are acceptable in the lower grades. A low ash content is required. Stickies are the biggest problem and must be removed. Some tissue mills make a lower brightness product and might use newsprint, brown kraft, or ledger without deinking. A wide variety of recovered papers can be utilized, depending on the tissue quality desired.
- A recycled newsprint mill with only washing technology must use a high grade of sorted old newsprint (ONP) which is free of magazines (OMG) and many of the coated inserts. Newsprint made with flotation technology can use a lower grade of newsprint which contains up to 40% magazines and inserts.
- The recovered paper used for molded fiber products depends on the end-use. Gray egg cartons or apple trays are made from ONP; brighter products are made from a mixture of pulp substitutes and ledgers. Very

low-grade products such as flower pots may be made from low grade mixed paper and sludge.

- A typical clay-coated folding boxboard used for cereal or detergent will have three or four different layers with a total of three to ten different waste papers, depending on the grade and process.
- Linerboard uses corrugated waste. Depending on the process equipment, the mill may use OCC, a postconsumer waste, or new double-lined kraft lined cuttings (DLK). DLK is a cleaner scrap from the corrugating box manufacturing operation. In addition, some other fibers such as news of flyleaf shavings may be used in small amounts to lower the recovered paper cost, if sufficient strength is maintained. Some linerboard has a recycled white top, and can use any of the stocks suitable for newsprint or tissue.
- Corrugating medium is similar to linerboard, but has less demanding contaminant requirements. A furnish of only OCC is not unusual, but other fibers (e.g. OWP and MP) can be tolerated in a mixture with OCC.
- Building and tube papers cover a variety of papers, including those used for the construction industry, gypsum wallboard facing, and tube board. These grades use ONP, OCC, and mixed papers. Some of the lighter grades, such as the painted side of gypsum wallboard, may use ledgers and occasionally, deinked pulp.

As previously shown, chart 3-1 summarized these desired characteristics with four numbers for strength, brightness, contaminant tolerance, and drainage. The numbers are relative values with many exceptions. In general:

- Linerboard requires the most strength and molded fiber the least. Corrugating medium does not require high tensile strength but recovered fiber is added to improve the runnability of the product.
- The numbers shown for brightness are averages. Some tissue has a lower brightness; consequently, the average is lower than for printing & writing. Molded fiber and boxboard have a wide range of brightness requirements.
- The contaminant column is a very arbitrary scale. Higher numbers indicate more contaminants can be tolerated without causing product rejection.
- Drainage is an important production related item. The higher the number, the easier the drainage. (The number is approximately the

Canadian Standard Freeness (CSF) divided by 10). Substituting a slower draining pulp will often decrease the production.

3.2

Pulp Processing Technology

The processing of recovered paper to make pulp requires two steps:

- separation of fibers for reuse, and
- removal of contaminants.

3.2.1

Fiber Separation

Since paper is hydrogen bonded, it is only necessary to penetrate the hydrogen bond with water to separate the fibers. Fiber separation can use mechanical, chemical, and thermal energy.

Mechanical Separation

The pulper (also referred to as the repulper) is the primary unit for separation of individual fibers. In some very simple systems this is the only operation in the entire process. Recently, the pulper has been used to assist in contaminant removal and to help disperse deinking chemicals and/or pulping aids into the slush pulp. Pulpers are either continuous or batch operations, and operate at either low or high consistency.

In addition to the pulper, there are several other mechanical devices which separate individual fibers from flakes. These are:

- Secondary pulper, detrasher, or screen with wiping extraction plate
- Deflaker
- Refiner

Chemical Assistance

Many recycling processes do not use special chemicals. Sodium hydroxide is often added to aid in defibering. This may cause the fiber to change, although the concentration is too low to cause significant swelling. With mechanical pulps, the pH should not exceed ten to prevent yellowing. Sodium silicate is also used to aid in fiber separation.

Specialty chemicals are used for specific problems. Often these are proprietary chemicals and include a variety of surfactants and pulping aids. Also, nonproprietary special chemicals such as acid or alkali are used to repulp wet strength papers.

Thermal Assistance

With many older systems the old adage "the hotter the better" is applied. Some systems ran at temperatures close to 200°F. These high temperatures improved the fiber separation and assisted in the deinking chemistry. Today, systems are operating at 100-150°F since deinking chemicals have been designed to operate satisfactorily at lower temperatures. This reduces the heating load as well as costs. Some systems run at a lower process water temperature when repulping is easy and deinking is not required.

Special Processing

There is a unique pulping process which uses stem explosion pulping. This proprietary process uses steam pressure to discharge the recovered paper through a small orifice, which separates fibers and disperses contaminants. This process is not in commercial operations at this time, but is expected to enter the demonstration stage in 1992. Successful tests have been reported at the laboratory pilot plant level.

3.2.2

Contaminant Removal

The second and more difficult step of recycled pulp production is the removal of undesirable material. This is referred to as contaminant removal. Contaminants depend on both the source of paper stock and the final use of the product. For example, ink is a contaminant in some, but not all grades.

Each contaminant creates a set of problems. Some affect all grades; others affect only certain grades. For example:

- Stickies are a problem with all grades. Stickies may cause both operating and production problems, along with product quality problems.
- Not every operation has a significant stickie problem. Jaakko Pöyry has reviewed the operating efficiency of North American paper machines, and some of the most efficient paper machines use more than 50% recovered fiber. This is very dependent on the grade being produced and its tolerance for contaminants.
- Any nonfibrous material is a contaminant for printing & writing paper grades. Brown fibers are emphasized only because they cannot be bleached or removed and will show as brown fibers in the finished products. Fused ink from laser or xerographic printing can be a major problem, depending on the deinking technology. With washing deinking this type of ink will stay with the fibers and show up as a dirt speck in the finished product.

- Filler and coating pigments from recovered paper such as clay, calcium carbonate, and titanium dioxide may be retained or removed from the recycled pulp, depending on the process. When removed they result in a yield loss and increase the quantity of sludge for disposal. When retained they can cause problems from carbonate foaming (if introduced into an acid papermaking system), weaker pulp, and contaminants adsorbed on the filler.

In some cases the fillers and coatings may be desirable to improve the printability of a sheet. For example, newsprint having an ONP/OMG base can have better smoothness and brightness than a virgin sheet.

- Tissue is similar to printing & writing papers except filler is always considered a contaminant. Usually a slightly higher dirt count in the finished pulp can be tolerated. In some operations the recovered paper is more contaminated than in printing & writing grades.
- Newsprint has similar contaminants to printing & writing grades. Flexographic inks are often mentioned as a problem with newsprint, but only a small percentage of news is printed with flexo inks, primarily in New England.
- Plastic film is a serious problem for some linerboard operations because large quantities are present in some recovered papers, overloading the processing equipment in these operations.
- Hot melt glues are a major contaminant in telephone directories and some magazines. Their presence greatly hinders acceptable recycling.
- Hot melt glues and adhesives are also one of the major contaminants in board grades.
- Wax is also a problem in linerboard because residual wax carryover results in slippery board.

3.3

Environmental Concerns

All pulp & paper processes are areas of environmental concern relating to air pollution, water pollution, and solid waste disposal.

- Air emissions are generally not a problem with recovered fiber operations. This is not true with virgin pulping operations. Air emissions can become a problem if sludge from the recycled pulp process is burned as a means of disposal.

- Aqueous effluent can be treated with standard municipal waste technology. recycled pulping operations discharge directly to municipal sewers. Unlike municipal sewage, there are no pathogenic materials present in recycled pulping process. Heavy metals are often mentioned as an area of concern because of the possibility of accumulation from printing inks. Extensive testing of various recycled pulping plants shows heavy metal concentrations are lower than typical municipal sewage plants, and below the established maximum guidelines. Polychlorinated biphenyls (PCB) were a problem because of the extensive use of carbonless papers twenty years ago. This source of PCBs and the resulting problem has almost disappeared. Dioxin is a concern when ultra-stringent guidelines must be met. There is no known dioxin generation within a recovered fiber pulping operations unless chlorine bleaching is used.
- Solid waste has become a problem for some recycled pulping operations. Contaminants removed from the recovered paper must be disposed of as solid waste. Recovered fiber solid waste is often divided into trash and sludge. Trash is large material removed early in the process and heavy materials removed from heavy reject cleaners. Trash includes: wires, glass, sand, rocks, large pieces of wood, rags, plastic, and metal. Water is readily drained from trash, and it is usually disposed of by land filling. Sludge is the fine material removed from the deinking process and may include screen rejects. Sludge includes ink, filler, and fine fibers, and might include small pieces of plastic, adhesives, waxes, and fiber flakes. Sludge is difficult to dewater. A special sludge press is often used. Sludge can be disposed of by incineration, land filling, or land spreading. If incinerated, 30-50% of the dry material can be ash, which must be land filled.
- The paper stock pulping operation always has a loss of material. Typical dry basis yields of 90% are obtained with OCC. Deinking operations often have 75-88% yields, although some yields below 70% have been reported, particularly when processing mainly coated waste paper. The yield loss represents dissolved or very fine material which ends up in the aqueous effluent or solid waste. The aqueous stream also ends up as secondary waste water treatment sludge, which is combined with deink sludge for disposal. Usually 1-4% of the original paper stock weight ends up in the aqueous stream, and the rest becomes solid waste.
- Recovered paper pulping plants often are located in urban areas. The large number of trucks delivering recovered paper is occasionally a nuisance to the local neighborhood. With more industrial locations, and adequate truck storage facilities, this should not be a problem.

- Loose recovered paper can be blown around by the wind, creating a nuisance and litter problem. With properly designed operation and the use of closed trucks the problem can be eliminated or greatly curtailed.
- Pelletizing or briquetting has been suggested as a method of transporting recovered paper instead of baling. There is some concern that pelletizing might weaken the fibers or lower the brightness. It would, however, greatly enhance the handling of the material within the mill, making it more akin to chips. Storage silos could be used. Lower handling costs would likely be a benefit.

4

PROPERTIES OF VIRGIN FIBER AND RECOVERED FIBER

A basic understanding of the properties of various paper and paperboard products and how these properties are acquired is essential to assess the properties and substitution abilities of recovered paper. The varying fiber components and fiber recovery processes have a significant impact on the recyclability of paper and options for reuse.

4.1

Virgin Fiber Characteristics

Paper can be made from different fibrous materials. The suitability of a material as a source depends largely upon the characteristics (length, diameter, cell wall thickness, ease of pulping/processes, etc.) of its fibers. The raw materials for papermaking originate primarily from cellulose. The woody structure of trees consists of about 50% cellulose by weight with the remainder being lignin (the glue holding the fibers together). Wood deficient regions rely heavily on secondary fiber and nonwood plant fibers for papermaking, including crop plants such as: sugarcane, bamboo, jute, hemp, banana leaves, and cotton.

4.1.1

Hardwood and Softwood

Most virgin fiber paper is made from trees which can be divided into hardwoods and softwoods — the deciduous trees and the evergreens. Within hardwood and softwood classifications, the size and shape of fibers varies considerably from species to species and even within a given tree. On average, softwood trees have a fiber length of about 3.2mm (0.125 inch), whereas hardwood trees have a much shorter fiber length — about 1.0 mm (0.04 inch). In paper, short fibers give better smoothness and opacity, but they are much weaker than long fibers.

As the average fiber length increases, so do the strength properties of the paper. In general, runnability improves with increasing fiber length, while printability improves with decreasing fiber length. The detrimental effects of longer fiber length are a less uniform formation, a loss of opacity, and a reduction in surface smoothness. Again, this becomes a disadvantage from a printing standpoint because print uniformity is better on a smooth surface. Therefore, the demands for strength generally conflict with those for printability. Packaging grades generally emphasize strength.

4.1.2 Northern vs. Southern

In addition to the fiber differences between hardwoods and softwoods, there are also differences between tree growing regions of the continent. These differences can be primarily attributed to the length of the growing cycle — 18 to 25 years in the South vs. 30 to 80 years in the North for pulpwood trees.

As a result of growing cycle differences, southern fibers, particularly softwood, tend to be coarse and stiff while northern fibers are slender and flexible. Northern fibers are therefore better suited to high quality coated grades of paper (especially the lighter basis weights) since they provide a smoother surface for coating. Northern fibers are also superior to Southern fibers for highly filled grades of paper because they provide a denser sheet with a smoother surface.

4.2 Pulping Processes

The main raw material in the manufacture of pulp is wood. The main constituents of wood are:

- cellulose
- hemicellulose
- lignin
- extractives
- moisture

Cellulose and hemicellulose are desirable components for chemical pulp. Cellulose is the main constituent of fiber and gives the fiber its mechanical strength. Hemicellulose contributes decisively to the bonds between separate fibers in the network that are formed in the paper production process.

Lignin does not contribute to the mechanical strength of the fibers. Its presence in the pulp reduces the bonding ability of the fibers. The greater part of the lignin has to be removed in order to achieve sufficient strength

properties in the chemical pulp. As a result of the chemical delignification, chromophoric groups are formed in the residual lignin, thus causing the pulp to become dark in color.

Extractives are defined as wood components that can be removed with neutral solvents. The extractives form colored substances that contribute to yellowing of the pulp during the pulp cooking process. Furthermore, their presence may cause disturbances in the papermaking process.

There are three basic processes for producing virgin pulp — chemical, mechanical and combined chemi-mechanical systems. Because chemicals are used to separate most of the lignin and hemi-cellulose from the wood fiber, the yield of chemical pulp processes (kraft, sulfite) is about 50%. The yield of mechanical pulps (SGW, PGW, RMP, TMP) with no chemical treatment ranges from 93 to 97%, and that of the "alphabet" pulps (CTMP, BCTMP, APMP, HYS) produced in chemi-mechanical systems ranges from 80 to 93%.

In general, as pulp yield increases, strength properties decrease and opacity improves. For this reason, chemical pulps are used to strengthen and reinforce the paper web and mechanical pulps are used to opacify. Chemical pulps are strong due to their long, flexible fibers. Mechanical pulps improve sheet opacity because of their high fines content.

To achieve a chemical pulp with the required mechanical strength properties and brightness, the lignin and the extractives must be completely removed from the pulp. This is done through chemical extraction in two phases: delignification and bleaching.

The delignification reactions are not completely selective. They also cause hemicellulose degradation and, when continued beyond a certain limit, can even degrade cellulose. This can significantly decrease the strength properties of the pulp.

The dissolved substances from the delignification process can be recycled to the chemical recovery area. In the U.S., dissolved substances from the bleaching process are sent to a waste water treatment plant for treatment prior to discharge into receiving waters.

The kraft or sulfate process has emerged as the most dominant chemical pulp production method. The main reasons for this are:

- It accepts all tree species of economic significance as raw material.
- It yields a pulp with the best strength properties.

- It produces a pulp that, without loss in strength properties, can be bleached to full brightness.
- It facilitates complete recovery of the chemicals used.

The primary advantage of mechanical pulps is their low cost and high yield. The difficulty and cost of bleaching mechanical pulps and the occurrence of brightness reversion (yellowing) with ageing limit their use in high brightness papers.

Considerable research has been done to improve the strength properties of mechanical pulps, primarily by combining thermal and chemical treatments with traditional mechanical systems. In PGW (pressure groundwood) and TMP (thermomechanical) systems pressure and elevated temperature are used prior to defiberization to soften the lignin and maintain fiber length. Compared with traditional mechanical systems (SGW and RMP) the resulting pulps are stronger and energy requirements are lower. Chemical treatments are also used to soften and remove lignin, and to increase bonding between fiber walls. Compared with TMP, CTMP (chemi-thermomechanical pulp) has lower yield, higher strength, lower opacity, requires less energy and is easier to bleach. The properties of high brightness BCTMP (bleached chemi-thermomechanical pulp) can be tailored for a wide range of end-uses, from printing & writing paper to tissue and fluff market pulps.

4.3 Pulp Properties

Suitable uses for different papermaking fibers are determined by considerations of strength and appearance as well as production and economic factors. With recovered fibers a special consideration is the content of contaminants, which can affect all of the preceding criteria. These factors are the primary considerations in the selection of virgin fiber and recovered paper to be used for specific pulp and paper manufacturing end-uses.

4.3.1 Strength

Strength is based on both the fiber properties and the fiber bond strength. Fiber strength is a complex function of the intrinsic fiber strength, fiber length, and other fiber properties. Paper strength is often measured with a tensile test, but other strength tests such as out-of-plane internal tear, compressive strength, wet strength, stretch, or fold may be important. Pulps made from chemical pulping processes, especially the kraft pulping process, are much stronger than pulps made from semi-chemical or mechanical pulping processes. Softwood chemical pulps are stronger than hardwood chemical pulps.

The fiber bond strength is a function of the number of inter- and intra-fiber hydrogen bonds which can form. This is changed in the papermaking process by refining, along with fines retention and sometimes with chemical additives.

The reduction of bonding ability is due to an irreversible modification in the fiber structure. The fibers are stiffened and lose their flexibility, and the swelling capacity is also reduced. These all contribute to a lower bonding ability and lower strength. Generally, the greater the initial degree of beating or other severe treatment (like wet-pressing), the greater the loss of pulp quality upon recycling.

Paper produced from a recovered fiber has a lower maximum tensile strength than similar paper made from virgin fibers. It is not the recycling pulping process per se but the papermaking process of refining, pressing, and drying which lowers the fiber strength. Burst and fold are also lower with recovered fibers, but other strength tests such as tear and stiffness vary considerably.

Some of the strength limitations of recovered fiber can be compensated for by blending in strong fibers, additional refining, or incorporating chemical additives. Changes in pressing have also improved the final sheet strength. Nevertheless, there are limits. A strong paper could never be made from a furnish in which the majority of the furnish was a weak material, such as newsprint.

4.3.2 Optical

Optical characteristics include brightness, opacity, and shade. If high brightness is required, then substitution of a lower brightness pulp is not possible. Some recycled pulps will vary in brightness as the initial recovered paper brightness varies. It is technically possible to bleach a low brightness pulp to a higher brightness. However, it is usually not economically viable and contaminants are not bleached.

Opacity is an important papermaking property in newsprint and printing & writing paper grades. Greater opacity is normally obtained by adding filler, depending on the type of paper. The residual filler content in some recycled pulps can assist in obtaining more opacity. The increased fines content of recovered fiber pulps also contributes positively to opacity.

4.3.3 Printability

The effect of recovered fiber on printability has to be assessed separately for each grade. It also has to be known what kind of fibers are introduced into the furnish or if there is filler.

If the recycled content in newsprint is relatively low (less than 30%), it is scarcely noticeable. If the recycled content is significant (greater than 60%), there is a risk that print quality will deteriorate. Surface strength will be worse with lower bonding ability fibers. This can be compensated with wet-end chemicals or externally by surface sizing. The effect on optical properties depends on whether there are fillers in the recycled pulp. Filler generally increases brightness and opacity and also enhances paper smoothness. Multicolor print reproduction quality will definitely suffer with lower brightness paper. This is the most important quality requirement for papers used in four color advertising. If mechanical fibers are introduced in the recycled furnish the smoothness will decrease, causing dot gain in offset printing. Lower tack inks with higher viscosity have to be used. More pressing is required for rougher paper which further accentuates the dot gain. For rotogravure papers, smoothness and compressibility are the key requirements. Recovered fiber is a dead fiber and does not offer the same compressibility as a virgin fiber. Smoothness can be improved if there is a large fines content filling the voids in the fiber network. Lower absorption is beneficial for rotogravure paper and can thus be obtained.

Only newsprint has the potential for increased printability, comparable to that of virgin newsprint. When a modest amount of OMG is introduced to the furnish, overall lower strength in offset papers will be the key problem. Printers will need to learn how to handle recovered fibers properly.

The properties provided by the various virgin pulps are summarized in Chart 4-1. The properties are rated on a scale of 1 to 5 as follows:

<u>Scale</u>	<u>Properties Provided</u>
5	High
4	Medium
3	Neutral
2	Low
1	Very Low
0	Not Applicable

CHART 4-1
Virgin Pulp Fiber Characteristics — Relative Values

	BHK	BSK	UHK	USK	GWD	TMP
Brightness	5	5	1	1	3	3
Bulk	1	2	1	2	4	5
Cleanliness	5	5	3	3	4	4
Folding Endurance	4	5	4	5	1	1
Formation	3	2	3	2	4	4
Opacity	4	2	5	5	5	4
Printability	4	2	3	1	4	4
Smoothness	4	2	3	1	5	4
Stiffness	2	4	3	4	2	3
Tensile Strength	3	4	3	5	1	2
Tearing Resistance	3	4	3	5	1	2

Source: Jaakko Poyry Consulting, Inc., 1991

BHK = Bleached hardwood kraft
 BSK = Bleached softwood kraft
 UHK = Unbleached hardwood kraft

USK = Unbleached softwood kraft
 GWD = Stone groundwood pulp
 TMP = Thermo mechanical pulp

4.4 Nonfiber Components of Paper and Paperboard

The nonfiber components of paper will affect the choice of recovered paper deinking and pulping options, the ultimate yield of usable fiber, and the amount of rejects and sludge for disposal. Nonfiber components, such as fillers, sizing, and coatings can be classified in two ways, additives and aids, as described below:

Additives

- Internal additives which are added to the stock or white water at the wet end of the machine before the paper is formed, or

- External additives which are applied to the surface of the wet web or paper sheet. There are also converting additives which are applied to the finished paper or paperboard during converting operations.

Aids

- Processing aids are intended to influence or control papermaking process variables.
- Functional aids are primarily intended to improve or control the properties or functionalities of the paper or paperboard produced.

4.4.1 Fillers

Fillers are classified as an internal additive and functional aid, and are used to increase opacity, brightness and smoothness; to improve the printing characteristics of the paper; and to reduce ink strike through. Fillers also reduce stiffness and bulk and make a limper sheet. Usually this is a disadvantage. Fillers generally reduce the strength of paper (fold, tear, and tensile). Internal bond strength is also reduced as the percentage of filler is increased. Examples of fillers are clays, titanium dioxide, precipitated and ground calcium carbonate and synthetic pigments.

4.4.2 Sizing

Surface sizing is used to improve surface strength for offset printing. It decreases porosity, improves ink holdout, and increases the strength and stiffness of paper.

Internal sizing can be used to improve internal fiber bonding as well as to decrease the water absorption properties of paper.

4.4.3 Coatings

Coatings are used to improve the surface characteristics, printability and overall appearance of paper. When applied to paper, coating will generally improve smoothness, ink holdout, print quality, and gloss. Opacity increases with heavier coating weight. As coat weight increases for a given basis weight, the base stock weight must be reduced correspondingly. A reduction in base stock weight lowers caliper, opacity, stiffness, and strength.

Some packaging grades, primarily folding boxboard, are coated to provide a superior printing surface.

The properties provided or enhanced by the nonfiber components of paper and paperboard are summarized in Chart 4-2. The properties are rated on a scale of 1 to 5 as follows:

<u>Scale</u>	<u>Properties Provided</u>
5	High
4	Medium
3	Neutral
2	Low
1	Very Low
0	Not Applicable

CHART 4-2
Nonfiber Characteristics — Relative Values

	Filler	Sizing	Coating
Brightness	5	0	5
Bulk	0	0	0
Cleanliness	4	3	4
Dimensional Stability	0	3	4
Folding Endurance	0	4	4
Formation	0	0	0
Opacity	5	0	5
Printability	5	4	5
Smoothness	5	0	5
Stiffness	0	4	4
Tensile Strength	0	4	4
Tearing Resistance	0	4	4

Source: Jaakko Poyry Consulting, Inc., 1991

4.5 Secondary Fiber Properties

Different grades of recovered paper provide different properties to paper. Some grades are more easily substituted than others. In general, the source (original product) of the recovered paper will dictate into which paper grades it can be recycled. A short description of the major grades of recovered

paper and the properties they provide was presented in Section 2, Definition/Grade Description of this volume. The properties provided by recovered paper are summarized in Chart 4-3.

CHART 4-3
Properties Provided by Recovered Paper

	OCC	HGD	OWP	PS	ONP	OMG	MP
Brightness	1	3	4	5	2	3	2
Bulk	2	1	1	2	4	4	3
Cleanliness	2	4	3	5	2	2	1
Dimensional Stability	2	3	3	3	4	3	2
Folding Endurance	4	4	3	4	2	3	2
Formation	2	4	4	4	4	3	2
Opacity	2	3	3	2	4	4	3
Printability	1	4	4	3	3	4	2
Smoothness	1	3	3	2	4	4	2
Stiffness	4	3	3	3	2	4	2
Tensile Strength	4	3	3	3	2	3	3
Tearing Resistance	3	2	2	2	1	2	2

Source: Jaakko Poyry Consulting, Inc., 1991

OCC = Old Corrugated Containers
HGD = High Grade Deinking
OWP = Office Waste Paper

PS = Pulp Substitutes
ONP = Old Newspapers
OMG = Old Magazines
MP = Mixed Paper

5 END-USES OF RECOVERED PAPER

The adage "where there is a will, there is a way" has been applied to the use of recovered paper by groups within the industry. Each grade of recovered paper has a tremendous variety of end-uses and assessing the best end-use is probably one of the most controversial and difficult aspects of recycling.

5.1

Purpose

A comprehensive assessment of potential end-use applications for recovered paper needs to consider two major factors:

- End-user demand and specifications, and
- The ability of the product to accept varied fibers.

5.1.1

End-User Specifications and Demand

End-user specifications, which are sometimes at odds with end-user demand, need to be considered to determine the best uses for recovered paper. Specifications for major end-products will be addressed separately from demand.

End-user demand is driven by interrelated forces, including legislative requirements, environmental pressures, and consumer demand. Federal and state legislative trends pertaining to recovered paper are summarized in appendix E.

5.1.2

The Ability of the Product to Accept Varied Fibers

This assessment answers two basic questions:

- Is it possible?
- Is it worth it?

Is it possible? (What are the technical limitations and fiber availability?)

In some cases, the use of recovered paper is dictated by the production equipment present in a facility (pulping, cleaning, and deinking) and the type of paper machine (e.g. cylinder vs. fourdriner). In other cases, the physical properties of the fiber are the key factors. Deinking and pulping technologies are discussed in Section 5 of this paper; physical characteristics and properties of virgin and recovered fiber are covered in Section 6.

The supply of various fibers (both virgin and recovered) as well as the ability of the user mill to secure and use the required fiber (i.e. vertical integration into forestry, pulping, and/or paper stock procurement) must be considered. Regional supply and recovery are discussed in Section 8.

Is it worth it? (What are the economic considerations?)

In general, if two products are competing for the same fiber source, the higher value-added product will prevail. The profit margin or value-added aspect of the various end-products are mill specific and depend on so variables that a general evaluation is neither possible nor desirable.

In the following sections, seven primary end-use markets will be discussed in terms of end-user demand and specifications and the ability of the product to accept varied fibers. Not all of these end-use products are manufactured from paper and paperboard produced in Minnesota. However, it is important to understand the range of uses for recovered paper in order to assess the potential impact of recovered paper use on the Minnesota forest products industry. Some end-use markets have historically used large percentages of recovered fiber as part of their furnish. These end-uses are marked with an asterisk (*):

- Folding Cartons*
- Corrugated Boxes*
- Newspapers
- Directories
- Magazines and Catalogs
- Communication Papers
- Tissue & Towel Products*

5.2 Folding Cartons

Folding cartons are manufactured from three primary boxboard grades — solid bleached sulfate (SBS), solid unbleached sulfate (SUS) and recycled boxboard. A potential fourth grade, coated natural kraft (CNK) is created when SUS is clay coated.

5.2.1 End-User Specifications and Demand

End-User Specifications

The primary end-user specifications for folding cartons are bulk and stiffness of the boxboard. These provide structural strength and protection for fresh bakery products and other food items, and prevent bulging of packed folding cartons for cereal, detergents, hardware items, and other dry goods.

Some folding cartons have graphic or printability requirements which conflict with the properties provided by recovered fiber. To minimize this conflict, recycled boxboard is often coated with clay to improve the printing surface.

In the late 1980s, there was great optimism for the use of recovered fiber in folding cartons. Several consumer products companies switched from virgin SBS to clay-coated recycled boxboard to convey a concern about the environment and the reduction of solid waste. However, due to lower performance characteristics of recycled boxboard versus SBS, a number of these companies have switched back to SBS or to CNK. The latter performs comparably to SBS, has a white top for printability and is more economical.

Due to a high quality print surface, SBS folding cartons are primarily used for cosmetic and liquor packaging. They are also used to convey an appearance of cleanliness, particularly in the food industry. The use of significant additional amounts of recovered fiber, other than PS or HGD, is perceived by the end-users to affect the appearance and cleanliness of these high quality cartons.

A blend of softwoods and hardwoods is used to make bleached board. The mix is varied according to the desired strength, density, and printability. Softwood content is higher for liquid packaging, for example, because of tear and tensile strength requirements. A multi-ply, virgin board typically has a high groundwood content in the middle ply. The top and bottom layers are made from a mixture of hardwood and softwood bleached kraft pulp. The cost is generally lower than for board made on a single-ply fourdrinier machine because of the use of lower cost groundwood pulp in the middle ply.

Unbleached (or recycled) boxboard typically consists of 100% recovered paper and is usually made in four or more plies on a multi-ply paper machine. The top layer is made from high quality recovered paper. Middle plies can be made with lower quality recovered paper such as ONP and mixed papers. The fiber content of the bottom layer (or back ply) depends on the strength and appearance preferred in the finished product. Fiber choices include ONP, OCC, and pulp substitutes.

The properties desired in the manufacture of folding boxboard and the properties provided by the various virgin and recovered fiber components are shown in Chart 5-1.

CHART 5-1
Interrelationships of Paper and Fiber Properties — Folding Boxboard

Properties	Desired	Provided				
	Folding Boxboard	OCC	ONP	MP	BHK	BSK
Brightness	3	1	2	2	5	5
Bulk	5	2	4	3	1	2
Cleanliness	3	2	2	1	5	5
Dimensional Stability	2	2	4	2	3	2
Folding Endurance	4	4	2	2	4	5
Formation	3	2	4	2	3	2
Opacity	0	2	4	3	4	2
Printability	4	1	3	2	4	2
Smoothness	4	1	4	2	4	2
Stiffness	5	4	2	2	2	4
Tensile Strength	4	4	2	3	3	4
Tearing Resistance	0	4	1	2	3	4

Source: Jaakko Poyry Consulting, Inc., 1991

Demand

Most folding cartons are used in the food, beverage, cosmetic, drug, and detergent markets. Smaller amounts are used to package hardware, clothing, and home furnishings. Overall demand for boxboard to make folding cartons and other products has been fairly stable over the past ten years, and is not expected to change much through 2000, as shown below. The strong growth between 1985-1990 generally reflects the economic conditions of the latter part of the decade.

	Demand (MM Tons)	C.A.G.R.*	
1980	10.3		
1985	11.0	1.4%	(1980-1985)
1990	13.0	3.3%	(1985-1990)
1995F	14.0	1.6%	(1990-1995)
2000F	15.0	1.4%	(1995-2000)

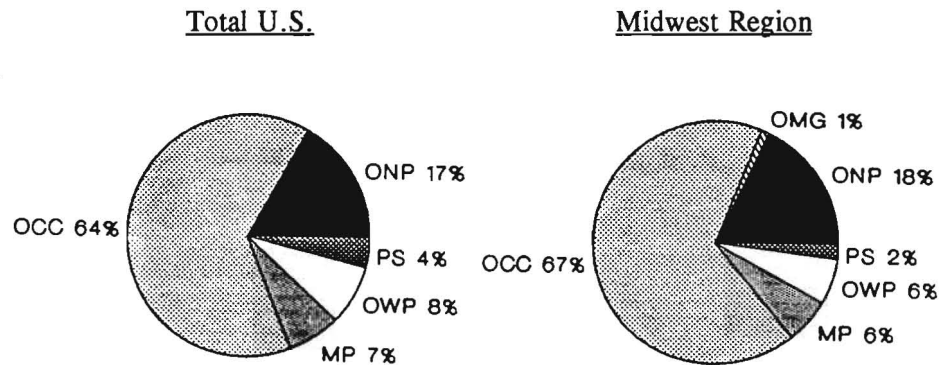
* Compound Annual Growth Rate

Increased demand for folding cartons, and the resulting use of recovered fiber will be minimal during the next decade, primarily for two reasons:

1. Most markets that use folding carton packaging are mature. Annual growth in demand for folding cartons is expected to range from 1-2% through 2000. Growth will be hindered by reduced packaging on health and beauty products, and reduced package size in other products.
2. Manufacturers of folding cartons are already major users of recovered fiber. Increased use will depend on technological developments in equipment and relaxation of end-user requirements for cleanliness and appearance.

Availability of Recovered Fiber

The specific grades of recovered fiber used to make boxboard are summarized below.



The U.S. recovery rate for OCC, the primary grade, was 53% in 1990 and is expected to increase to 67% by 2000, approaching practical recovery limits. The availability of OCC will be limited towards the end of the decade, causing a potential shortage of OCC available for use in lower value added products such as boxboard.

Supplies of ONP, OWP, and PS are also expected to tighten by 2000 as demand for these fibers increases. Greater use of MP may become necessary by the end of the decade in order to maintain current utilization rates of recovered paper in boxboard.

5.2.2

Ability of Product to Accept Varied Fibers

Fiber Substitution Ability

Folding carton boxboard already uses most major grades of recovered paper to some degree. Low cost grades such as ONP, OWP, and MP could displace more OCC, especially when they can be hidden in the inner layers of multi-ply board or used to produce a brighter surface.

Significantly increasing the use of recovered fiber in food grade packaging, especially packaging in direct contact with food, is not realistic. While the U.S. Food & Drug Administration (FDA) does not prohibit the use of recovered fiber in direct contact with food, it does require that the package be certified as "free from harmful and deleterious materials". Most recycled boxboard mills are reluctant to provide this level of verification.

Although board mills could produce recycled SBS using PS or lightly printed HGD grades, they would compete with printing & writing and tissue producers for limited supplies of recovered fiber. Existing virgin board mills are already integrated to virgin fiber, so substitution of recovered fiber is more than a question of ability. The economic implications of excess virgin pulp capacity must also be considered.

Economic Considerations

The ability to pay for fiber is extremely mill specific. Fiber paying ability is based on profit margins, and generalizations cannot be made.

Producers of recycled boxboard compete with containerboard (linerboard and corrugating medium) producers for supplies of OCC, and with newsprint, tissue and building materials producers for other grades. Prices for OCC are expected to increase by the end of the decade as the availability decreases. While the selling price for boxboard is higher than linerboard or corrugating medium, boxboard's greater ability to accept alternative fibers will also dictate to some extent where OCC is used.

Producers of SBS or white top boards would compete with printing & writing, market deinked pulp, and tissue mills for supplies of white fibers such as PS, HGD and OWP. Based solely on comparisons of product selling prices, it would appear that producers of printing & writing papers (\$840-\$2,440 per ton) can generally afford to pay more for recovered fiber than producers of SBS (\$750-\$840 per ton) or tissue (\$700-\$1,000 per ton for jumbo rolls).

5.3

Corrugated Boxes

Linerboard and corrugating medium (fluting) are combined to construct a corrugated box. The corrugated box has traditionally been used primarily as a shipping container to protect a product from its point of manufacture, through the distribution chain, to its ultimate end-user. More recently, they have been used for point-of-purchase (POP) displays.

5.3.1

End-User Specifications and Demand

End-User Specifications

Corrugated boxes used in the interstate shipment of products on common carriers are subject to Rule 41 for rail and truck shipments. These regulations specify the minimum construction requirements of corrugated boxes relative to the size and weight of the packaged product.

In early 1991, an Alternate Rule 41 and Item 222 were introduced to allow corrugated containers to comply with edge crush and compression strength standards rather than basis weight and burst strength. The alternate rule favors the use of high performance linerboard — an improved grade which provides higher stacking strength at a lower basis weight. High performance linerboard would be used with heavier weight medium. The increase in weight of the medium would not completely offset the decrease in weight of the linerboard. This could result in lighter boxes and less recovered fiber required, but also less OCC available for recovery.

Another corrugated box requirement is graphic print quality. Most corrugated boxes are used to contain a product during transit, and printing is limited to basic product identification. However, a growing portion of corrugated boxes used for retail displays has a white outer liner to enhance the graphics of the box. Surface printability is important for these boxes.

The properties desired in the manufacture of linerboard and corrugating medium, the two components of containerboard are different. The primary requirements of linerboard are a high level of edge crush stiffness and burst resistance, along with good appearance and printability on one surface. These needs are satisfied by using high yield, well refined kraft on the top liner. Starch may be used to help meet strength requirements. The properties desired in the manufacture of linerboard and the properties provided by the various virgin and recovered fiber components are shown in Chart 5-2.

CHART 5-2
Interrelationships of Paper and Fiber Properties — Linerboard

Properties	Desired	Provided			
	Linerboard	OCC	ONP	MP	USK
Brightness	2	1	2	2	1
Bulk	0	2	4	3	2
Cleanliness	2	2	2	1	3
Dimensional Stability	2	2	4	2	1
Folding Endurance	4	4	2	2	5
Formation	4	2	4	2	2
Opacity	0	2	4	3	5
Printability	3	1	3	2	1
Smoothness	4	1	4	2	1
Stiffness	5	4	2	2	4
Tensile Strength	5	4	2	3	5
Tearing Resistance	3	3	1	2	5

Source: Jaakko Poyry Consulting, Inc., 1991

The corrugating medium or fluted layer provides much of the stiffness required for corrugated box construction. For this purpose, the major requirements are stiffness and resistance to crushing. Sheet finish and appearance can be ignored in most instances. Generally, semichemical pulps are ideal for corrugating medium because of high stiffness and crush resistance, although these pulps are notably weak with respect to the more common strength criteria.

The properties desired in the manufacture of corrugating medium and the properties provided by the various virgin and recovered fiber components are shown in Chart 5-3.

CHART 5-3
Interrelationships of Paper and Fiber Properties — Corrugating Medium

Properties	Desired	Provided				
	Corrugating Medium	OCC	ONP	MP	USK	Semi-chem
Brightness	1	1	2	2	1	1
Bulk	1	2	4	3	2	4
Cleanliness	2	2	2	1	3	3
Dimensional Stability	2	2	4	2	1	2
Folding Endurance	3	4	2	2	5	2
Formation	2	2	4	2	2	3
Opacity	0	2	4	3	5	5
Printability	0	1	3	2	1	1
Smoothness	1	1	4	2	1	1
Stiffness	5	4	2	2	4	5
Tensile Strength	3	4	2	3	5	2
Tearing Resistance	0	3	1	2	5	2

Source: Jaakko Poyry Consulting, Inc., 1991

Demand

Industrial production is considered to be an indicator of demand for linerboard and medium by corrugating plants. With the advent of Alternate Rule 41, square footage will continue to parallel industrial production. Tonnage demand, however, will depend on the acceptance and use of high performance linerboard. Tonnage growth may slow or even decline, particularly if source reduction takes hold. Overall demand for linerboard and corrugating medium is shown below:

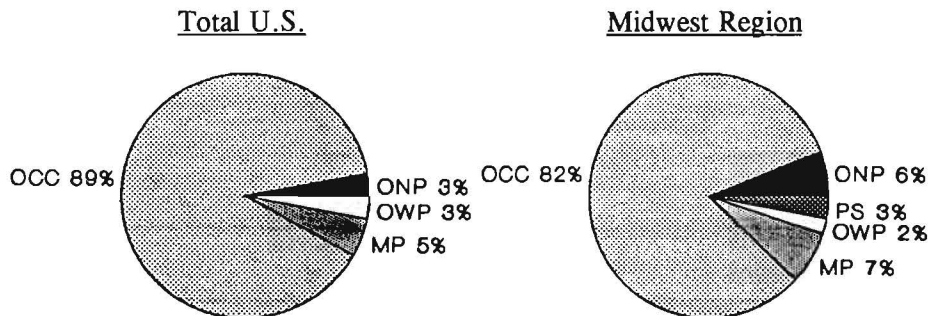
	Demand (MM Tons)	C.A.G.R. *	
1980	17.4		
1985	19.6	2.4%	(1980-1985)
1990	21.6	3.7%	(1985-1990)
1995F	25.6	1.7%	(1990-1995)
2000F	28.1	1.9%	(1995-2000)

* Compound Annual Growth Rate

The ultimate end-users of corrugated boxes are aware that linerboard and medium contain recovered fibers, but most do not specifically request it. Some end-users, however, are requesting corrugated boxes with a minimum recovered fiber content of 35%. Others, such as McDonald's and Walmart, are simply asking suppliers to use corrugated boxes with a high percentage of recovered fiber.

Availability of Recovered Fiber

The specific grades of recovered fiber used to make containerboard are summarized below:



Over one million tons of new recycled linerboard capacity have been announced for start-up over the next few years, with an additional 600,000 tons under study. Recovery of OCC is expected to approach maximum practical rates by 2000, and concerns about availability might hinder mill expansions. A potential shortage of OCC, especially in the South and West regions of the U.S., will encourage users to seek alternative grades or to develop improved nonfiber additives to provide the desired properties for stacking strength (edge crush and stiffness).

Corrugating medium, which currently uses large amounts of recovered fiber, is one of the lower value-added products in the paper product chain. Use of recycled corrugating medium provides a less costly way of adding or increasing the recycled content in corrugated containers. Corrugating medium is made from OCC, ONP and MP. With the use of high-performance linerboard, a heavier weight medium provides increased stacking strength. Under certain circumstances, (i.e. where stacking strength is not as important), manufacturers will replace some OCC with lesser strength fibers.

5.3.2

Ability of Product to Accept Varied Fibers

Fiber Substitution Ability

Containerboard (linerboard and medium) accounts for 50% of the recovered fiber currently utilized by the U.S. paper and board industry. OCC is the recovered fiber of choice, due to its strength and stiffness properties. This grade accounted for 89% of the recovered fiber used in containerboard in 1990. By 2000, it is expected to provide over 90% of the total recovered fiber requirements for this end-product.

With such high utilization of one grade specifically for its physical properties, there is limited opportunity to substitute alternative recovered fibers. An exception is the possible use of ONP, OWP, or PS in white top linerboard. White top linerboard is currently a small portion of the total linerboard market, but is expected to grow dramatically if source reduction forces corrugated shipping containers to double as retail displays. This dual role would present an opportunity for increased use of white grades of recovered paper. In Europe, white top linerboard represents over 35% of the total market, compared to less than 15% in the U.S.

MP and OWP grades could replace some OCC in corrugating medium, especially in areas where OCC supplies are tight. These grades are compatible with the requirements of corrugating medium, which include fiber structural strength but not uniform color or even surfaces. Use of heavier medium, probable under the new Alternative Rule 41, will also favor substitution of lower grades.

Economic Considerations

Linerboard and medium are considered commodity grades. In general, producers of commodity grades want to be low cost producers in order to obtain maximum profit margins and compete successfully. To be a low cost producer of commodity products, vertical integration is required and economies of scale are important. A producer's ability to pay for fiber is, however, based on mill specific profit margins.

The use of recovered fiber in linerboard in North America is limited compared to Western Europe or Japan, where usage has been driven by the economics of manufacture (i.e. high cost of virgin fiber). The economic incentive to use recovered fiber in North America, and particularly in the U.S., is more limited than in Europe and Japan as most of the American producers are fully integrated into virgin kraft. These producers are located in the U.S. South, the lowest wood cost region in North America.

5.4

Newspapers

The high visibility of newspapers in the municipal solid waste stream and the proven ability of newsprint producers to make an acceptable quality recycled newsprint have caused newspapers to be prime recycling targets. Newsprint is also the focus of recent legislation and voluntary agreements for recycled content.

5.4.1

End-User Specifications and Demand

End-User Specifications

In the broadest sense, newsprint can be defined as any paper capable of being run through a modern high speed printing press and producing an acceptable sheet of newspaper at a reasonable cost. The functional requirements of newsprint are runnability on the press, printability, good general appearance, and low price.

Newsprint furnish has historically been a mixture of mechanical pulp and lightly refined chemical pulp. The mechanical pulp contributes valuable properties to the newsprint, all of which are related to printability. The most important is opacity. The strength properties of mechanical pulp are usually insufficient to produce a sheet that runs well on the presses. As a result, the paper is usually reinforced with kraft chemical pulp in amounts that can reach 30%, although the trend is toward less kraft. While giving newsprint better strength, chemical pulp also adversely affects the printing characteristics and increases the manufacturing costs.

Recent developments in newsprint have seen a shift from stone groundwood to TMP. This has allowed significant reductions in the amount of kraft pulp required (as low as 4-5%) and there are at least two mills in North America using a 100% TMP furnish.

Because of the printing method used in the newspaper publishing industry, newsprint must meet a number of requirements related to runnability. The major requirements are sufficient web strength to prevent breaks during printing and adequate fiber bonding to prevent surface linting. As newsprint mills rely on increasing amounts of recovered ONP as the primary fiber source, strength properties will begin to deteriorate. Currently, mechanical pulp fibers can be recycled only two or three times in a closed system before fiber strength falls below minimum requirements.

To compensate for the strength loss, an increased amount of virgin fiber may be needed. The long fibers in OMG also provide strength. Other ingredients such as starch, resins, or surface sizing may be added to increase

strength properties and to improve the printing surface. Additives decrease porosity, but porosity is essential for coldset inks to be absorbed into the surface of the paper. Thus, user specifications seem to be at odds with user desires for recycled content paper, and compromises are likely.

The properties desired in the manufacture of newsprint and the properties provided by the various virgin and recovered fiber components are shown in Chart 5-4. The properties are rated on a scale of 1-5 as follows:

	Newsprint	Properties Provided
Scale	Properties Desired	By Recovered and Virgin Fibers
5	Very Important	High
4	Important	Medium
3	Limited Impact	Neutral
2	Not Important	Low
1	Undesirable	Very Low
0	Not Applicable	Not Applicable

CHART 5-4
Interrelationships of Paper and Fiber Properties — Newsprint

Properties	Desired	Provided				
	Newsprint	ONP	OMG	GWD	TMP	BSK
Brightness	3	2	3	3	3	5
Bulk	4	4	4	4	5	2
Dimensional Stability	2	4	3	3	3	2
Folding Endurance	3	2	3	1	1	5
Formation	3	4	3	4	4	2
Opacity	5	4	4	5	4	2
Printability	4	2	3	4	4	2
Smoothness	4	4	5	5	4	2
Stiffness	4	2	3	3	4	4
Tensile Strength	4	2	3	1	2	4
Tearing Resistance	0	1	2	1	2	4

Source: Jaakko Poyry Consulting, Inc. 1991

Demand

Recycled newsprint is not a new product. Some producers have been making good quality recycled newsprint for several years. Some of these suppliers use 100% recovered paper in their newsprint furnish.

Newspaper publishers in states face legislation requiring the use of recycled newsprint. In 1990, seven states had laws which required the use of recycled content newsprint; publishers have voluntarily agreed to minimum content goals in five other states.

The prolonged recession and slackening advertising revenues have caused a recent decline in newsprint demand. Most newspapers contain fewer pages due to reduced advertising. Some newspapers have gone out of business; others have merged morning and evening editions into one paper.

Daily newspapers account for 70%-75% of the newsprint consumed in the U.S. Daily newspaper readership has remained flat over the last 20 years. Sunday readership has increased slightly during the same time. The percentage of the adult population reading newspapers, however, has dropped to about 65% of the total U.S. adult population from just over 70% in 1980.

The short-term forecast demand for newsprint looks troubled. Newspapers are competing with other media to convey news, advertising, and entertainment. Commercial and cable television report the news instantaneously from around the world. The advent of the VCR and video movie rental stores have also had an impact on reading as a form of relaxation and entertainment.

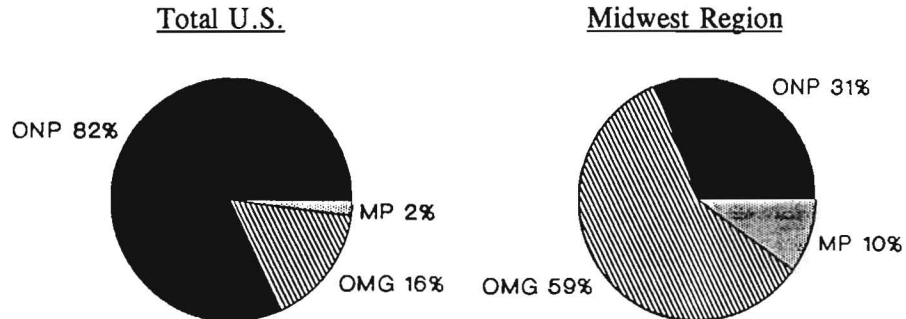
The result is a growth forecast for newspapers which falls below GNP growth for the decade. However, recycled newsprint suppliers are becoming the preferred suppliers at most newsprint printing plants. This status is due to the need of newspaper publishers to comply with laws and voluntary agreements supporting the use of recycled newsprint. The demand for newsprint is summarized as follows:

	<u>Demand</u> <u>(MM Tons)</u>	<u>C.A.G.R.*</u>	
1980	11.4		
1985	12.8	2.3%	(1980-1985)
1990	13.4	0.9%	(1985-1990)
1995F	14.6	1.8%	(1990-1995)
2000F	15.6	1.8%	(1995-2000)

* Compound Annual Growth Rate

Availability of Recovered Fiber

The specific grades of recovered fiber used to make newsprint are summarized below:



The main fiber used, ONP, is currently in excess supply in most regions of the country. Newspapers are readily identifiable by residents, and municipal recycling collection programs require newspapers to be separated from municipal waste. The current oversupply is expected to reverse by 1995, as several new recycled newsprint mills come on line.

Magazines, catalogs, and inserts are another source of fiber for newsprint; they supply strong chemical fibers and the clay coating adds opacity. As advanced flotation deinking systems become more common, OMG will be required in greater quantities as an economical source of clay.

Most OMG comes from publishers and newsstands in the form of scrap and unsold magazines. Only a few municipalities currently collect magazines with newspapers; more are likely to do so in the future.

5.4.2

Ability of Product to Accept Varied Fibers

Fiber Substitution Ability

Recycled newsprint contains primarily ONP and OMG. There are few other sources of mechanical fiber that can be substituted. Old telephone books (OTB) is the only other grade of recovered paper made almost entirely from mechanical fiber. However, OTB poses collection, cleaning, and bleaching challenges for the average recycled newsprint mill. Hot melt glues, coatings, and yellow dies must be removed by the deinking process. A continuous source may also be difficult to obtain since telephone books are generally distributed only once a year in most areas.

As additional flotation deinking capacity comes on line, additional OMG will be required. ONP, however, will continue to be the dominant recovered

fiber used in newsprint, and recycling of ONP into newsprint is considered the best use for the fiber.

Economic Considerations

The economic incentive to use recovered fiber in newsprint in North America has historically been limited for several reasons. Newsprint is manufactured primarily from mechanical pulp, which is the lowest cost virgin pulp produced. Additionally, most of the production capacity is located in regions away from metropolitan areas, making procurement difficult and increasing the cost of recovered fiber.

As a result of the strong demand by consumers and supporting legislation, the current supply structure has been challenged. New recycled newsprint mills are being contemplated near metropolitan areas to take advantage of the short transportation distances. These mills can achieve comparable, or even lower operating costs than the most efficient virgin producers.

Deep discounts currently maintain operating rates at reasonable levels and protect market share, and these have caused profits to plunge. Nevertheless, most mills face similar hardships, and investment in deinking is viewed as necessary to maintain supplier relationships. Despite conflicting economics, recycled newsprint capacity will also be added in traditional producing regions such as Canada, where most of the mills are located away from large metropolitan areas.

The use of recovered fiber at these mills is not driven by economics but by the necessity to respond to consumer demand.

5.5 Directories

Directories include telephone directories published by the Regional Bell Operating Companies as well as independent utilities and publishers. Most of the paper used to make directories is 18-22.5 pound directory paper. Newsprint, coated groundwood, SC, and freesheet grades are also used. A shortage of recycled directory paper has prompted some publishers to substitute recycled content newsprint.

5.5.1 End-User Specifications and Demand

End-User Specifications

Recycled content is a critical issue in the directory publishing industry. Most phone companies are publicly owned and have a desire to convey an environmentally friendly image. Although some state legislation is aimed at recycled fiber content of telephone directories, the primary driving force

comes from directory publishers. publishers are pushing their paper suppliers for recycled content directory paper. The Yellow Pages Publishers Association (YPPA) has established goals for recovered fiber content. As of March 1990 these goals were: 10% recovered fiber content by 1993, 25% by 1995, and 40% by 1998.

Most directories are printed on high speed offset and flexographic presses which require sufficient surface strength to prevent linting, plus a surface which accepts offset printing inks. In addition, directory publishers want a uniform sheet in terms of physical properties and color to insure that the paper runs consistently on the press and the printed directory presents a quality image. Due to lower basis weights, the opacity of the sheet is very important.

Telephone directory users require two properties:

- Opacity so there is no read through from printing on the back of the page.
- Brightness so there is good color contrast between the paper and the ink.

The properties desired in the manufacture of uncoated groundwood papers (e.g. directory and SC papers) and the properties provided by the various virgin and recovered fiber components are shown in Chart 5-5.

CHART 5-5
Interrelationships of Paper and Fiber Properties — Uncoated Groundwood

Properties	Desired	Provided								
	Uncoated Groundwood Paper	BSK	GWD	TMP	HGD	OWP	PS	ONP	OMG	Filler
Brightness	4	5	3	3	3	4	5	2	3	5
Bulk	4	2	4	5	1	1	2	4	4	0
Cleanliness	3	5	4	4	4	3	5	2	2	4
Dimensional Stability	5	2	3	3	3	3	3	4	3	0
Folding Endurance	3	5	1	1	4	3	4	2	3	0
Formation	5	2	4	4	4	4	4	4	3	0
Opacity	5	2	5	4	3	3	2	4	4	0
Printability	5	2	5	4	4	4	3	3	4	5
Smoothness	5	2	5	4	3	3	2	4	4	5
Stiffness	4	4	3	3	3	3	3	2	4	0
Tensile Strength	4	4	1	2	3	3	3	2	3	0
Tearing Resistance	0	4	1	2	2	2	2	1	2	0

Source: Jaakko Poyry Consulting, Inc., 1991

Demand

Demand for directory papers was highest immediately following the break up of AT&T in 1984, and settled somewhat between 1989-1991. The long-term growth forecast, which is expected to parallel changes in population and advertising expenditures through the end of the decade, is presented below:

	Demand (MM Tons)	C.A.G.R.*
1985	0.5	
1990	0.7	6.8% (1985-1990)
1995F	0.8	2.6% (1990-1995)
2000F	0.9	2.6% (1995-2000)

* Compound Annual Growth Rate

Directory publishers issue over 6,300 new directories every year. Because of the wide distribution of directories to households and businesses, the recyclability of the old directories is an immediate concern when new directories are distributed.

Availability of Recovered Fiber

The availability of ONP and OMG as discussed for newspapers also holds true for directories. The current oversupply of ONP is expected to tighten as new deinking facilities come on line at newsprint mills.

Directory publishers in states are under pressure to reduce the amount of directories going to landfill sites. Even though end-users would like to see old directories (OTB) recycled into new directory paper, very few are used for this purpose. Certain glues used in the binding of telephone directories are considered contaminants. In addition, covers are generally printed with UV-cured inks which are very difficult to deink. This presents an opportunity for mills able to reuse OTB. Most OTB collected through recycling programs is used in tissue products, building materials, animal bedding, and mulch.

5.5.2

Ability of Product to Accept Varied Fibers

Fiber Substitution Ability

Recycled content directory paper, like newsprint, contains primarily ONP and OMG. The only other source of mechanical fiber that can be substituted is OTB, ONP is and will probably continue to be the dominant recovered fiber used in directory paper. Thus, directory paper will compete with newsprint for available supply. However, competition is not currently an issue since there is very limited production of recycled content directory paper.

Economic Considerations

The ability to pay for fiber is very mill specific, and no two mills will have the same costs. However, an initial comparison of the prices of directory paper (\$750-\$870) and newsprint (\$497-\$621) suggests that directory paper manufacturers might fare well in a price based competition for limited supplies of recovered fiber.

The economic incentive to use recovered fiber in directory paper can be compared to newsprint. The fiber furnish is mostly mechanical pulp and the paper is only machine calendered. The producers of directory paper are all integrated into mechanical pulp, but several producers purchase the softwood kraft pulp component of the furnish from open markets. The ability to substitute some of the purchased softwood kraft pulp with pulp substitutes offers an economic incentive for some producers. Market deinked pulp cannot always be substituted because it generally contains a high percentage of hardwood fibers.

Another major consideration is new capacity based on 100% recovered fiber. The ability to use old telephone directories as a fiber source could result in

an economic incentive and strong consumer appeal. There is currently very little directory production based on recovered fiber, but it is likely that a recycled product containing a mix of ONP, OMG and old directories as its main fiber sources will evolve.

5.6

Magazines and Catalogs

A wide range of coated and uncoated groundwood and freesheet papers are used to make magazines and catalogs. The magazine industry typically uses uncoated and coated groundwood papers (Coated #4 and #5). Although the use of recovered fiber in magazine papers is increasing, it currently represents less than 5% of the total paper used in magazine and catalog publishing.

5.6.1

End-User Specifications and Demand

End-User Specifications

Quality, availability, and price are the three key end-user requirements for publication papers. Most magazines and catalogs are printed using the heatset offset or rotogravure processes. The most important quality requirements relate to printing characteristics:

- Smoothness of surface for print quality
- Gloss of both paper and print
- Brightness for readability
- Opacity for readability and no show-through
- Porosity for ink absorption
- Surface strength to eliminate linting

For the printer, the most important factors are smoothness for print quality and surface strength to eliminate linting. Gloss is important in some catalogs and upscale publications. Printers also desire sheet uniformity, including porosity for ink absorption. For rotogravure printing, a particularly smooth sheet with good compressibility is desired for runnability on the press.

An industry survey conducted for this paper indicated that limited availability is the overwhelming reason for not using more recovered fiber in magazines and catalogs. Due to this limited availability and high demand, recovered fiber content grades currently sell at a premium compared to virgin fiber products.

Availability is a key end-user requirement, especially for publications with a large circulation. While there are currently dozens of brands of recycled

publication paper on the market, obtaining enough recycled content paper to print a national weekly magazine is still virtually impossible.

The cost of paper often represents up to 50% of the cost of printing a very long run magazine or catalog, and publishers are not willing to sacrifice costs for increased recycled content. In a recent informal survey, several major magazine publishers were asked if they would consider using recycled paper even if they had to pay more for it. The responses ranged from "absolutely not" to "maybe, but probably not."

For recycled content fine papers, OWP provides an acceptable fiber mixture. Assuming OWP can be sufficiently deinked to the required cleanliness levels, it can also be used in coated freesheet grades. OWP is not, however, an acceptable fiber source for coated and uncoated mechanical publication grades. These grades would require OMG and possibly ONP, when sufficiently deinked.

The properties desired in the manufacture of coated groundwood (Chart 5-6) and coated freesheet (Chart 5-7) are compared to the provided by various virgin and recovered fiber components below:

CHART 5-6
Interrelationships of Paper and Fiber Properties — Coated Groundwood

Properties	Desired	Provided								
	Coated Groundwood Paper	BSK	GWD	TMP	HGD	OWP	PS	ONP	OMG	Coating
Brightness	5	5	3	3	3	4	5	2	3	5
Bulk	3	2	4	5	1	1	2	4	4	0
Cleanliness	4	5	4	4	4	3	5	2	2	4
Dimensional Stability	5	2	3	3	3	3	3	4	3	4
Folding Endurance	3	5	1	1	4	3	4	2	3	4
Formation	5	2	4	4	4	4	4	4	3	0
Opacity	5	2	5	4	3	3	2	4	4	5
Printability	5	2	5	4	4	4	3	3	4	5
Smoothness	5	2	5	4	3	3	2	4	4	5
Stiffness	4	4	3	3	3	3	3	2	4	4
Tensile Strength	4	4	1	2	3	3	3	2	3	4
Tearing Resistance	0	4	1	2	2	2	2	1	2	4

Source: Jaakko Pöyry Consulting, Inc., 1991

Chart 5-7
Interrelationships of Paper and Fiber Properties — Coated Freesheet

Properties	Desired	Provided					
	Coated Freesheet	HGD	OWP	PS	BSK	BHK	Coating
Brightness	5	3	4	5	5	5	5
Bulk	1	1	1	2	2	1	0
Cleanliness	5	4	3	5	5	5	4
Dimensional Stability	5	3	3	3	2	3	4
Folding Endurance	4	4	3	4	5	4	4
Formation	5	4	4	4	2	3	0
Opacity	5	3	3	2	2	4	5
Printability	5	4	4	3	2	4	5
Smoothness	5	3	3	2	2	4	5
Stiffness	4	3	3	3	4	2	4
Tensile Strength	4	3	3	3	4	3	4
Tearing Resistance	4	2	2	2	4	3	4

Source: Jaakko Poyry Consulting, Inc., 1991

Demand

Both the magazine and catalog markets are maturing. Growth in demand is gradually declining — tonnage demand is increasing, but at a lower rate each year. Increases in demand are dependent on the success of publishers in identifying and fulfilling the needs of highly specific target groups. Historical and projected growth trends for SC papers and coated groundwood are shown below:

	SC Papers		Coated Groundwood	
	MM Tons	C.A.G.R.*	MM Tons	C.A.G.R.*
1980	nom.		2.7	
1985	1.0	n.a.	3.7	6.4%
1990	1.4	7.2%	4.8	4.9%
1995F	1.6	3.2%	5.4	2.8%
2000F	1.9	3.2%	6.2	2.8%

* Compound Annual Growth Rate

Magazines with an environmental theme or editorial position have led the trend towards increased use of recycled content paper. Similarly, catalogs

aimed at the environmentally conscious consumer tend to use recycled content papers.

At the present time, demand is driven by publishers rather than legislation. Time, Inc. has indicated a strong desire to order recycled content coated paper for several of their publications. They are working with several suppliers to find an adequate supply.

The environmental push has collided with a serious economic downturn. For several years magazine publishers have faced reductions in advertising expenditures and subscription levels, combined with increased distribution/ mailing costs and greater competition from other magazines/media. These factors work against increased use of higher priced recycled content papers.

Catalog companies have also been affected by the economic down turn. In addition to the prolonged recession, postal rates and UPS delivery charges have increased. As paper comprises up to 50% of the total cost, catalog publishers reluctant to use the more expensive recycled content paper.

Distribution cost pressures are forcing some magazine and catalog publishers to reduce their basis weights by 2-4 pounds. The push to lighter basis weights makes a high utilization rate of recovered fiber in coated paper difficult to achieve, since these papers need very strong fibers to support the coatings and still keep overall sheet weights down.

Fiber Availability

Publication papers contain mostly groundwood fibers. Substitution of recovered fiber for virgin groundwood fibers would require ONP or OMG, placing mills in competition with manufactures of recycled newsprint (and to some extent, directory) for limited supplies of recovered paper.

Chemical fiber needs could be filled by a variety of grades of recovered paper, including OWP, HGD, or PS. PS and HGD are already in short supply, with little potential for increased availability. The outlook for OWP is better, but several manufacturers of market deinked pulp have already announced plans for new capacity based on OWP. Tissue producers are also becoming larger consumers of OWP.

Recycled content can also be achieved through the use of market deinked pulp. This is a likely alternative since relatively little recovered paper appears to be available for direct use in groundwood printing & writing paper.

5.6.2

Ability of Product to Accept Varied Fibers

Fiber Substitution Ability

The heavy use of light weight coated papers for both magazine and catalog production limits the potential use of recovered fibers as substitutes for virgin fibers. The high strength needed to support blade coating while keeping overall sheet weights to a minimum favors the continued use of virgin fiber and the absolute minimum use of recovered paper.

Economic Considerations

The economic incentive to use recovered paper in uncoated or coated groundwood papers is very dependent on mill specific conditions. The supercalendering and coating associated with most of these grades places significantly higher requirements on the recovered fiber used. The fiber furnish for groundwood papers is a combination of mechanical and chemical pulp. Practically all producers are integrated into mechanical virgin pulp production, and there is little economic incentive to substitute recovered fiber. The chemical pulp component is, however, often purchased virgin market pulp, and may offer an economic incentive to use recovered fiber. To substitute virgin kraft pulp and be able to supercalender and/or coat the paper will demand the highest quality recovered fiber, such as PS or high quality market deinked pulp produced specifically to groundwood publication paper specifications.

5.7

Business Forms, Stationery, and Reprographic Paper

Business forms converters were among the first paper converters to use recycled content papers because they believed such papers would be less expensive than virgin grades.

Stationery and writing papers are often produced at small nonintegrated specialty mills. Because these mills rely on the open market for their pulp needs, they have tremendous flexibility to vary their furnish. Recycled content letterheads and stationery provide a highly visible channel for businesses to demonstrate environmental concern.

Reprographic or copy paper is one of the largest and fastest growing segments of the coated freesheet printing & writing grades. It is also one of the most common types of paper that end-users perceive can be made with recovered fiber.

5.7.1

End-User Specifications and Demand

End-User Specifications

The primary requirements for business forms are sufficient strength to be printed and enough stiffness to function properly in business and retail machines. Additional requirements are low density for continuous stationery forms and good formation (no pinholes) for carbonless base papers. If the print is legible, the appearance of the paper is less important.

Stationery and writing paper, available in a wide variety of shades and surface characteristics, is favored of recovered paper. Low density and resistance to scratching are important for writing papers. The use of recycled content paper also appeals to individual and corporate consumers.

Copy papers require stiffness and freedom from curl to run efficiently through photocopy machines. Brightness and overall sheet strength are generally less important in copy papers than in writing papers. Both of these characteristics are compatible with recovered fiber use. Dust or linting from cutting and sheeting may be a problem because of the need for increased maintenance of the copy machine.

Strength is not usually a limiting factor for fine paper (freesheet grades), whereas good sheet formation and opacity are. Consequently, sulfite and hardwood kraft pulps are preferred over long fibered kraft as a furnish stock. In a modern fine paper mill, a typical furnish would be 75% hardwood kraft and 25% softwood kraft.

The properties desired in uncoated freesheet and properties provided by various virgin and recovered fibers are compared in Chart 5-8.

Chart 5-8
Interrelationships of Paper and Fiber Properties — Uncoated Freesheet

Properties	Desired	Provided					
	Uncoated Freesheet	HGD	OWP	PS	BSK	BHK	Sizing
Brightness	5	3	4	5	5	5	0
Bulk	0	1	1	2	2	1	0
Cleanliness	5	4	3	5	5	5	3
Dimensional Stability	5	3	3	3	2	3	3
Folding Endurance	2	4	3	4	5	4	4
Formation	4	4	4	4	2	3	0
Opacity	5	3	3	2	2	4	0
Printability	5	4	4	3	2	4	4
Smoothness	5	3	3	2	2	4	0
Stiffness	4	3	3	3	4	2	4
Tensile Strength	4	3	3	3	4	3	4
Tearing Resistance	4	2	2	2	4	3	4

Source: Jaakko Poyry Consulting, Inc., 1991

Demand

Business forms, stationery, and reprographic paper are made from uncoated freesheet. Other end-uses include envelopes, commercial printing, and books. A small amount of business forms is made from groundwood paper.

The driving force for use of recovered fiber in business forms was cost savings. This market continues to be targeted as a primary market for uncoated freesheet papers made with recovered fiber.

Demand for recycled copy paper and stationery originates from government offices, as states have passed legislation that requires or gives preference to the purchase of such paper products. Another driving force is the growing number of companies, striving to be good corporate citizens, that request recycled content copy paper and stationery.

The demand for uncoated freesheet papers continues to show steady tonnage growth, while exhibiting the gradually declining rates of increase associated with mature end-use markets.

	<u>MM Tons</u>	<u>C.A.G.R.*</u>
1980	8.0	
1985	10.0	4.5% (1980-1985)
1990	12.0	3.7% (1985-1990)
1995F	13.4	2.2% (1990-1995)
2000F	14.9	2.2% (1990-2000)

* Compound Annual Growth Rate

Although the industry survey conducted for this paper indicated that end-users are currently purchasing some recycled content paper, it also indicated that the end-users plan to purchase more recycled paper in the future. This will be driven by both legislative action and consumer demand.

Availability of Recovered Fiber

The ability to use various grades of recovered fiber depends on the pulping, deinking, and cleaning capabilities of the individual mill. Non-integrated mills have a limited number of choices. Market deinked pulp is currently in short supply, while virgin market pulp is plentiful. Pulp substitutes (PS) are already being recovered to the greatest extent possible, and some mills have switched to direct entry computer printout (CPO) as a substitute.

At mills where cleaning and deinking capacity exists, the choices expand to include HGD and OWP. Supplies of HGD, like PS, are limited, but collection of OWP is evolving.

Over the long term, the availability of market deinked pulp is expected to increase dramatically. Almost two million tons of new market deinked pulp capacity are planned to come on line before the end of the decade. This represents one of the best opportunities for increased use of recovered fiber in the printing writing category.

5.7.2

Ability of Product to Accept Varied Fibers

Fiber Substitution Ability

Market deinked pulp presents a tremendous opportunity for fiber substitution, especially at mills already purchasing virgin market pulp. By 2000, over 1.5 million tons of virgin market pulp could be displaced by market deinked pulp in printing & writing mills in the Northeast and Midwest. The extent of this substitution will depend on end-user demand for recycled printing & writing products, the quality of the pulp, and competing demand from tissue & towel producers.

Consumer demand for recycled printing & writing products will also drive demand for OWP, HGD, and PS directly at mills. High margin printing &

writing products have an economic advantage in the bid for limited supplies of high quality recovered fiber. Therefore, fiber substitution is more likely to take place in other grades of paper and board as printing & writing producers win the competition for high grade recovered fibers.

Economic Considerations

The economic incentive to use recovered fiber in uncoated freesheet papers depends significantly on the configuration and location of the mill. The fiber furnish for uncoated freesheet papers is based on chemical kraft pulp. The percentage of softwood and hardwood kraft may vary, but for most commodity grades a higher percentage of hardwood is used because of its good formation properties and low cost. Softwood kraft pulp is added to provide sufficient strength.

The production of uncoated freesheet commodity grades is concentrated in low wood cost regions of the U.S., mostly in the South where the commodity grades are produced at large fully integrated facilities. There will be limited economic incentive for these producers to use recovered fiber unless there is an incremental capacity gain.

For nonintegrated uncoated freesheet producers, the economics are quite different. Several of these mills produce specialty paper grades which command a higher selling price than the commodity grades. The economic incentive to substitute purchased kraft pulp with recovered fiber is strong for several small nonintegrated mills.

It is likely that use of recovered fiber in uncoated freesheet paper grades will grow in the future. Producers may seek to satisfy consumer demand for recycled content paper by using recovered fiber at nonintegrated mills, where the economic incentive is the strongest.

5.8

Tissue & Towel Products

The tissue & towel market consists of both the consumer and the commercial and institutional (C&I) market. In both segments, upscale products tend to use more virgin fiber while lower value-priced products use more recovered fiber.

5.8.1

End-User Specifications and Demand

End-User Specifications

For tissue — which includes bathroom tissue, facial tissue, and napkins — softness, absorbency, and the appearance of cleanliness are the most important end-user requirements, followed by strength. For toweling grades,

absorbency and strength are most important, followed by softness and appearance.

Tissue & towel grades are functional products in the eyes of the consumer. A soft facial tissue for a stuffy nose offers some comfort to the sufferer of the common cold. The ability to soak up spills quickly and efficiently is expected of paper towels.

Softness can be improved while maintaining a high degree of recovered fiber content by using multiple head boxes on the tissue machine and placing the recovered fiber in the middle layer.

The primary grades of recovered paper used for tissue products are HGD and OWP. Absorbency is usually increased when recovered fiber is utilized. The properties desired in tissue products and properties provided by various virgin and recovered papers are compared in Chart 5-9.

CHART 5-9
Interrelationships of Paper and Fiber Properties — Tissue

Properties	Desired	Provided						
	Tissue	HGD	OWP	PS	ONP	MP	BHK	BCTMP
Brightness	5	3	4	5	2	2	5	4
Bulk	5	1	1	2	4	3	1	4
Cleanliness	5	4	3	5	2	1	5	5
Dimensional Stability	2	3	3	3	4	2	3	3
Folding Endurance	2	4	3	4	2	2	4	2
Formation	5	4	4	4	4	2	3	4
Opacity	0	3	3	2	4	3	4	4
Printability	2	4	4	3	3	2	4	2
Smoothness	2	3	3	2	4	2	4	4
Stiffness	1	3	3	3	2	2	2	3
Tensile Strength	3	3	3	3	2	3	3	2
Tearing Resistance	3	2	2	2	1	2	3	1

Source: Jaakko Poyry Consulting, Inc., 1991

Demand

Tissue & towel grades have used recovered paper for years. these grades are the primary users of mixed papers (the papers that are not, or cannot, be sorted into one of the other main grades). Recovered fiber is used in the

industrial and lower priced consumer products as an economical source of fiber rather than as a way of complying with a legislative or regulatory statute.

	<u>MM Tons</u>	<u>C.A.G.R.*</u>
1980	4.4	
1985	5.0	2.6% (1980-1985)
1990	5.9	3.4% (1985-1990)
1995F	6.4	1.7% (1990-1995)
2000F	6.9	1.5% (1995-2000)

* Compound Annual Growth Rate

Demand for tissue & towel products are expected to follow GNP growth in the future increasing at about 1-2% per year through the year 2000. When the economy is poor, consumers will purchase lower priced tissue & towel products. When the economy improves, consumers move to the upscale brands. The C&I market also suffers during economic downturns because of reduced employment and travel. Therefore, although total tissue & towel demand is fairly steady, product quality levels vary, depending on the economy.

Availability of Recovered Fiber

Of the grades of recovered fiber currently used to make tissue & towel grades are forecast to be in short supply by 1995, especially PS, HGD, ONP, and OCC. These grades can be used in other paper and board products with higher paying abilities. The grades of recovered paper with the best potential availability are MP and OWP.

MP is currently recovered at a very low rate. Potential availability, however, will be limited by the lack of incentives to the collector, low value, and limited market potential. OWP is an evolving grades. The number of collection programs is increasing, and processors are beginning to find ready markets for certain grades or combinations of grades. Future availability of both MP and OWP will be dependent on mills' abilities to handle contaminants present in mixed and co-mingled grades, and their success in controlling the quality of the paper.

5.8.2.

Ability of Product to Accept Varied Fibers

Fiber Substitution Ability

The grades of recovered paper used in the various quality levels of tissue & towel products depend on the specific physical properties desired in the end-product. For example, lower quality tissue & towel products are based in

part on groundwood recovered fiber, while freesheet recovered fiber is preferred for higher end products.

Economic Considerations

The economic incentive to use recovered fiber in tissue & towel production depends on a number of variables. The most important ones include markets served, mill configuration, and geographical location. As previously discussed, the tissue markets can be broadly divided into the consumer and C&I markets. The companies serving the premium consumer market typically use virgin bleached kraft pulp for the majority of their fiber furnish. Several of these producers have world scale operations in low wood cost regions and are fully integrated into kraft pulp. Despite a possible economic incentive to substitute part of the virgin pulp with recovered fiber, market image will limit its use.

On the other hand, of the companies serving the C&I market often operate small nonintegrated mills, and base most of their fiber furnish requirements on recovered fiber. From a tonnage standpoint, the C&I market is dominated by a limited number of world scale operations such as Fort Howard.

Use of recovered fiber is significant in the C&I markets which are forecast to grow faster than the consumer markets. It is likely, however, that use of recovered fiber will also increase in some lower quality consumer markets.

APPENDIX B: *RECYCLED FIBER IN NORTH AMERICA*

RECYCLED FIBER IN NORTH AMERICA: CHANGES AND EMERGING OPPORTUNITIES IN THE 1990s

**A pragmatic assessment of the
business opportunities in
North America for seven grade categories
of paper and paperboard**

Jaakko Pöyry Consulting, Inc.
560 White Plains Road
Tarrytown, New York 10591
Telephone: (914) 332-4000
Fax: (914) 332-4411

Franklin Associates, Ltd.
4121 West 83rd Street, Suite 108
Prairie Village, Kansas 66208
Telephone: (913) 649-2225
Fax: (913) 649-6494

RECYCLED FIBER IN NORTH AMERICA: Changes and Emerging Opportunities in the 1990s

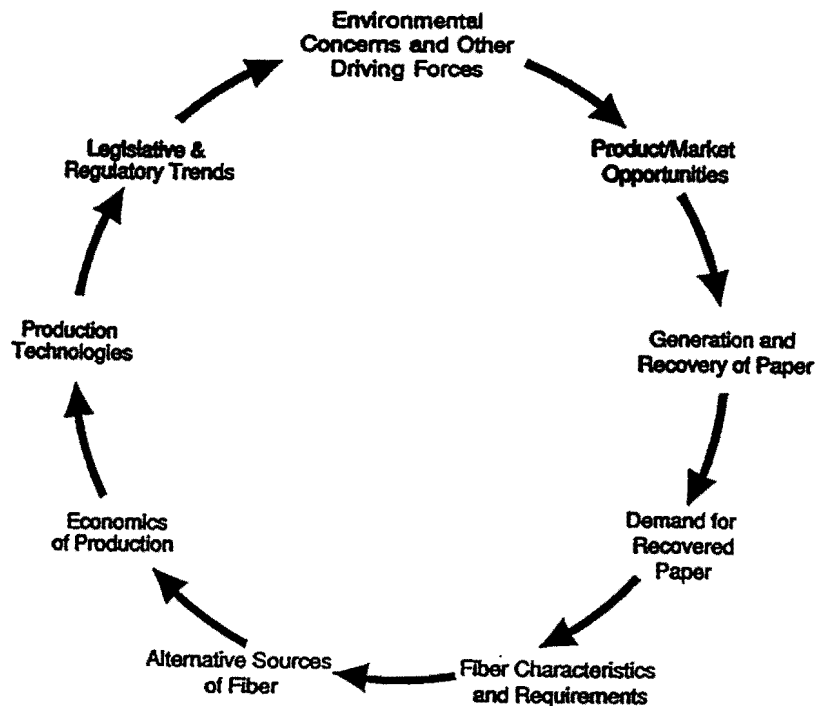
The pace of planning and capital investment for recycling projects is accelerating. The driving forces leading to change are a mixture of federal, state, and local government solid waste initiatives, as well as rapidly changing paper industry customer demand for recovered fiber-containing products. The focus is dramatically shifting to the recycling potential for mixed papers, office papers and other non-traditional recycled fiber sources.

In fact, the 1990s will see major restructuring in the paper industry. Most grades of paper and paperboard will need to be recovered at levels approaching the maximum practical limits by 1995 to satisfy the demand for recycled fiber. Mixed paper poses technological and economic challenges to the recycler and will be the only underutilized grade of recovered paper during the decade.

The study confirms that the use of recovered fiber will increase at a rapid rate until about the middle of the decade and then growth will slow between 1995 and 2000. By the year 2000, overall utilization by North American (U.S., Canadian and Mexican) mills will reach 34% and consume over 43 million short tons of recovered fiber. For the U.S., utilization will be about 36%, but overall fiber recovery (which includes exports and other uses) will reach 45%.

Business opportunities are available for astute firms that have or can obtain the resources required to combine the procurement, technology, and marketing required for recycled product offerings. Those not having these resources could find themselves at a strong competitive disadvantage.

The study has combined the resources of two well-known consulting firms — Jaakko Pöyry Consulting, Inc. and Franklin Associates, Ltd. The study team assessed the full circle of business issues that surrounds recycling, affecting every participant. The study findings and conclusions are presented within the context of this circle of business issues. These issues are presented in a circular fashion because no special order is implied; the issues are all interrelated and interact in a variety of ways for different participants.



The report discusses in detail the recovered fiber processing technologies and emerging trends and technologies, as well as alternative fiber sources and the opportunities for substituting these alternative fibers for the traditional fibers in specific grades.

The study evaluates the consequences of the "Free Trade Agreement" between the U.S. and Canada and the potentially emerging North American Free Trade Agreement, which includes Mexico. In addition, the report assesses the supply and demand of recovered fiber by paper grade and type of paper produced in each geographic region. Also discussed are the implications of interregional shipments of recovered papers on the supply/demand situation in 1990, 1995, and 2000.

Utilizing Jaakko Pöyry's proprietary pulp and paper mill manufacturing cost model, manufacturing costs for each major grade of paper produced in a region are presented, based on a typical mill configuration for the region.

BUSINESS IMPLICATIONS

The study identifies a number of business issues and implications for all groups and agencies involved with recycled paper and paperboard. Several business issues are common to more than one group, while others are specific to a single category. Groups for which there are significant business implications include:

- Paper Mills
- Paper Merchants
- Printers and Converters of Paper and Paperboard
- Government Agencies (Federal, State, and Local)
- Private Waste Collectors, Paper Stock Dealers, MRF Operators
- End-Users (Publishers, Packagers)
- Process Technology Equipment and Chemical Suppliers

PRINCIPAL STUDY OBJECTIVES

The principal objectives of this study are:

1. To identify and assess the business opportunities for recovered fiber:
 - In geographic regions
 - By end-use products
2. To assess the recovered fiber supply/demand balance in North America
3. To project opportunities and business implications for all groups involved with recycled paper to 1995 and 2000

THE REPORTS

The study is comprised of a six-volume report, with the following titles:

Volume I	Executive Summary and North American Overview
Volume II	The Canadian and Mexican Overview
Volume III	The Midwest Regional Report
Volume IV	The Northeast Regional Report
Volume V	The South Regional Report
Volume VI	The West Regional Report

The table of contents of the Executive Summary, North American Overview, and a Regional Report are appended to this brochure.

GEOGRAPHIC COVERAGE

The study analyzes each of four major regions of the U.S., (Northeast, Midwest, South and West) plus Canada and Mexico.



METHODOLOGY

The research and analysis of the study drew upon the complementary skills and credentials of Jaakko Pöyry and Franklin Associates in the field of recycled fiber and recovered paper. The research team coordination took advantage of the special skills of the two organizations.

The primary information contained in the study is based on over 800 questionnaires and interviews with regulatory agencies at the federal, state and local levels, legislators, waste collectors, recovered paper dealers and brokers, environmental groups, processing equipment manufacturers, recycled paper mill managers, paper industry experts, and end users of fiber-containing paper and paperboard. Data were also obtained from the Jaakko Pöyry data bases of paper mills, paper and paperboard grades. In addition, information was obtained from the non-proprietary files of both consulting firms and the professional knowledge of the senior personnel of both firms.

CREDENTIALS

- Jaakko Pöyry Consulting

Jaakko Pöyry Consulting, Inc. is the North American arm of the Jaakko Pöyry Group. The Jaakko Pöyry Group is the world's largest independent engineering and management consulting group serving the pulp and paper industry. Founded in 1958, the Jaakko Pöyry Group has offices in 22 foreign countries and relies on this extensive network of industry consultants to understand the emerging technologies and end-use market opportunities around the world.

Jaakko Pöyry Consulting has completed a number of assignments in the recycled fiber business area, including researching the North American section of the Jaakko Pöyry world-wide 1989 multi-client study, "Recycled Fibre, an Underutilized Opportunity", and conducting an analysis of office waste paper available by state and by waste paper category for the Northeast Recycling Council (N.E.R.C.) part of the Northeast Council of State Governments and funded by the U.S. EPA. In addition, Jaakko Pöyry Consulting, Inc. has completed numerous proprietary studies on the business implications and opportunities of recycled fiber for several North American forest products companies.

- Franklin Associates, Ltd.

Franklin Associates, Ltd. conducted an important part of the research, relying on their well-known work in paper recycling and waste management issues for both private and public organizations in North America. Over the past 17 years, Franklin Associates has prepared a series of reports for the American Paper Institute dealing with recycled fiber supply and demand, plus policy issues affecting the industry. The most recent of these published reports was "Paper Recycling: The View in 1995", which provided the background information leading to APT's announced goal of 40 percent paper recovery by 1995. In addition, Franklin Associates has done many confidential recycled fiber supply studies for paper companies considering building greenfield mills or expanding use of recycled fiber at existing mills.

In the public sector, Franklin Associates has done many studies dealing with solid waste management policy issues and markets for recovered paper for the U.S. Environmental Protection Agency, state agencies and regional and local government agencies. Two recent Franklin Associates projects are of particular significance: a major study on supply/demand for recovered office paper done for the National Office Paper Recycling Project, a joint private/public group; and assistance in evaluating the potential impact of proposed new definitions and standards for recycled-content paper purchasers being done for the national Recycling Advisory Council.

TABLE OF CONTENTS - EXECUTIVE SUMMARY

Page	
1	BACKGROUND
3	OVERALL CONCLUSIONS
7	SPECIFIC FINDINGS AND CONCLUSIONS
8	Environmental Concerns and Other Driving Forces
8	Legislation and Regulatory Trends
9	Market Opportunities
10	Generation and Recovery of Paper
11	Demand for Recovered Paper
12	Supply/Demand Balance
13	Fiber Characteristics and Requirements
14	Alternative Sources of Fiber
15	Economics of Production
16	Production Technologies
18	BUSINESS IMPLICATIONS
19	Paper Mill Management
21	Paper and Paperboard Conversion
22	Federal, State and Local Level Government
22	Private Industry, Paper Stock Dealers, MRF Operators
23	End-Users — Publishers, Package, Printer, Office, etc.
24	Process Technology Equipment and Chemical Suppliers
25	Environmental Groups
27	NORTH AMERICAN SUMMARY

TABLE OF CONTENTS - North American Overview

Volume I Page		Page	
1	INTRODUCTION	19	DRIVING FORCES
1	Study Purpose	19	Consumer Demand
3	Study Parameters	20	Trends in Source Reduction of Packaging
4	Base Year	25	Federal and State Legislation/Regulation
4	U.S. Regions Considered	27	Reauthorization of RCRA
5	Comparability of AFY Data	29	Waste Converter Rules
6	Capacity vs. Production	30	Summary of State Legislative and Regulatory Trends
7	Market Detached Pulp	33	Summary of Disposal Capacity Driving Forces
9	DEFINITIONS	35	OVERVIEW OF THE U.S. PAPER AND PAPERBOARD INDUSTRY
10	Recovered Paper	35	Characterization of the Industry
10	Waste Paper	37	Overall Capacity
11	Secondary Fiber	39	Regional Capacity
13	DESCRIPTION OF RECOVERED PAPER GRADES	42	Overall Production
13	OM1 Newsprint	42	Paper Production
14	OM1 Magazine	44	Paperboard Production
15	OM1 Corrugated Containers	45	Regional Production
15	Office Waste Paper	46	Use of Recovered Fiber
16	High-Grade Deinking	46	Regional Use of Recovered Fiber
17	Mixed Paper	49	Integrated Pulp Production
17	Pulp Substitutes	50	Paper Machine Age and Tirm Size

TABLE OF CONTENTS (continued) - North American Overview

Page	Page
51	143
52	143
52	143
54	144
54	146
56	148
58	150
61	153
62	158
65	161
66	162
68	165
68	167
69	170
72	181
73	185
75	188
76	187
77	189
78	191
81	193
82	194
83	195
86	195
89	197
89	198
89	199
97	200
97	201
102	202
104	217
105	217
106	218
108	219
108	220
112	220
112	220
117	221
117	221
122	221
124	223
125	223
128	223
130	223
132	224
134	225
136	225
138	226
138	226
140	226
140	226
	229
	243

END-USES OF RECOVERED PAPER
 Purpose
 End-User Specifications and Demand
 Ability of Product to Accept Varied Fibers
 Folding Cartons
 End-User Specifications and Demand
 Ability of Product to Accept Varied Fibers
 Corrugated Boxes
 End-User Specifications and Demand
 Ability of Product to Accept Varied Fibers
 Newspapers
 End-User Specifications and Demand
 Ability of Product to Accept Varied Fibers
 Directories
 End-User Specifications and Demand
 Ability of Product to Accept Varied Fibers
 Magazines and Catalogs
 End-User Specifications and Demand
 Ability of Product to Accept Varied Fibers
 Business Forms, Stationery, and Photographic Paper
 End-User Specifications and Demand
 Ability of Product to Accept Varied Fibers
 Tissues & Towel Products
 End-User Specifications and Demand
 Ability of Product to Accept Varied Fibers
 GENERATION AND RECOVERY OF PAPER IN THE U.S.
 Introduction and Overview
 Summary of U.S. Generation and Recovery
 Generation and Recovery in 1990, 1995, 2000
 Grade by Grade Generation and Recovery
 Generation and Recovery of Old Newspapers
 Generation and Recovery of Old Magazines
 Generation and Recovery of Old Catalogued Conditions
 Generation and Recovery of High Grade Dublishing
 Generation of Recovery of Mixed Paper
 Generation of Recovery of Office Waste Paper
 Generation and Recovery of Pulp Substitutes

SUPPLY/DEMAND BALANCE
 Introduction and Overview
 Methodology Used to Evaluate Supply/Demand Balance
 Determining Maximum Recovery Potential
 Overall Supply/Demand Balance
 Regional Supply/Demand Balance
 Supply/Demand Balance — A Perspective
 ECONOMIC ASPECTS OF USING RECOVERED PAPER
 Manufacturing Costs of Selected Paper Grades
 Capital Costs
 DEWINDING AND PULPING TECHNOLOGIES
 Fiber Requirements
 Pulp Processing Technology
 Fiber Separation
 Cost-efficient Removal
 Cost-efficient Removal Units
 Pulp Properties
 Strength
 Optical
 Pulpability
 Cost-efficiency
 Paper Manufacturers
 Environmental Concerns
 PROPERTIES OF VIRGIN FIBER AND RECOVERED FIBER
 Virgin Fiber Characteristics
 Hardwood and Softwood
 Northern vs. Southern
 Pulping Processes
 Non-Fiber Components of Paper and Paperboard
 Fillers
 Bindings
 Coatings
 Secondary Fiber Properties
 End-Use Products
 CANADA SUMMARY
 Characterization of the Industry
 Recovered Fiber Performance Requirements
 Demand
 Supply
 Supply/Demand Balance
 Legislative/Regulatory
 Free Trade Agreement
 Technology
 Manufacturing Costs
 MEXICO SUMMARY
 Characterization of the Industry
 Recovered Fiber Performance Requirements
 Demand
 Supply
 Supply/Demand Balance
 Legislative/Regulatory
 Free Trade Agreement
 Technology
 Manufacturing Costs
 Definitions
 Abbreviations

TABLE OF CONTENTS - Regional Volumes (II-VI)

Page	Map of the Region	Page	Supply/Demand Balances
1	OVERVIEW OF THE PAPER AND PAPERBOARD INDUSTRY IN THE REGION	111	COST COMPETITIVENESS OF VIRGIN VERSUS RECYCLED PRODUCTS
1	Capacity	113	Price History of Key Grades of Recovered Paper
3	Production	113	General Observations and Overview
4	Use of Recovered Paper	114	Old Newspapers - PSI Grade #6
6	Integrated Pulp Production	115	Old Corrugated Containers - PSI Grade #11
7	Paper Machine Age and Tonn Size	117	Mixed Paper - PSI Grade #1
7	Paper Machine Age and Tonn Size by Grade	118	Pre-Consumer White Ledger - PSI Grade #41
18	REGIONAL DRIVING FORCES	119	Post-Consumer Sorted White Ledger - PSI Grade #40
19	State Legislation and Regulations Affecting Municipal Recovery	120	Recovered Paper Prices Summary
19	Waste Reduction Goals	121	Manufacturing Costs of Selected Paper Grades
21	Fiber Content Regulations	128	Overall Resin Summary
22	Market Development and Procurement Regulations	127	Lumberboard
22	State Legislation and Regulations Affecting Commercial Recovery	130	Medium
23	Local Legislation and Regulations	133	Newspoint
23	Trends in Municipal Recovery Programs	138	SC-A
25	Types of Collection and Materials Recovered	139	Coated Groundwood
28	Responsiveness of Municipal Officials, Paper Stock Dealers, and Recycling Mills	142	Uncoated FreeSheet
31	Environmental Pressures	146	Coated FreeSheet
32	Population Density		
32	The Future of State and Local Collection Programs		
33	State by State Legislative Activity	151	BUSINESS ISSUES AND OPPORTUNITIES
41	REGIONAL GENERATION AND RECOVERY OF PAPER	151	The Status of the Region
41	Introduction and Overview	154	Lenses and Opportunities in the Region
41	Summary of Regional Generation and Recovery	154	Future Supplies of Recovered Paper
41	Regional Generation and Recovery in 1990, 1995, 2000	155	New Regional Users
45	Grade by Grade Regional Generation and Recovery - 1990, 1995, 2000	158	Fiber Quality
46	Generation and Recovery of Old Newspapers - 1990, 1995, 2000	166	Paper Stock Dealer System
48	Generation and Recovery of Old Magazines - 1990, 1995, 2000	157	Market Detailed Pulp
52	Generation and Recovery of Old Corrugated Containers - 1990, 1995, 2000	158	Common Regional Lenses
55	Generation and Recovery of High Grade Dairying - 1990, 1995, 2000	159	Municipal Collection
58	Generation and Recovery of Mixed Paper - 1990, 1995, 2000	160	Fiber Substitution
59	Generation and Recovery of Office Wastepaper - 1990, 1995, 2000	162	Industries
62	Generation and Recovery of Pulp Substitutes - 1990, 1995, 2000	162	Legislation and Fiber Content
63	Recovered Paper Procurement: Trends and Options	162	Stocks Disposal
67	REGIONAL RECOVERED PAPER DEMAND	165	List of Mills in the Region
67	Background and Assumptions		
67	1990 Overview, Forecasts 1995, 2000		
70	Domestic Demand for Recovered Paper by End-Product		
70	1990, Forecasts 1995, 2000		
73	Distribution Rates for Recovered Paper by End-Product		
73	1990, Forecasts 1995, 2000		
81	Average Mix of Recovered Paper by End-Product		
81	1990, Forecasts 1995, 2000		
85	Recovered Paper Use by Grade		
67	Use of Old Newspapers - 1990, 1995, 2000		
89	Use of Old Magazines - 1990, 1995, 2000		
91	Use of Old Corrugated Containers - 1990, 1995, 2000		
83	Use of High Grade Dairying - 1990, 1995, 2000		
85	Use of Mixed Paper - 1990, 1995, 2000		
87	Use of Office Waste Paper - 1990, 1995, 2000		
89	Use of Pulp Substitutes - 1990, 1995, 2000		
101	Absentive Domestic Use for Recovered Paper		
101	Domestic Use in 1990		
102	Alternative Domestic Use in 1995, 2000		
103	Export Demand for Recovered Paper		
103	Export Demand in 1990, 1995, 2000		
105	INTERREGION SHIPMENTS OF RECOVERED PAPER		
105	Interregion Shipments - 1990, 1995, 2000		

APPENDIX C: ABBREVIATIONS AND ACRONYMS

API	American Paper Institute
BHK	Bleached Hardwood Kraft
BSK	Bleached Softwood Kraft
CPO	Computer Printout
DLK	Double Lined kraft
DTPA	Pentasodium Diethylene Triamine-Pentaacetate
EPA	U.S. Environmental Protection Agency
FAS	Formaindine Sulfinic Acid
FDA	(US) Food and Drug Administration
GWD	Stone Groundwood
HD	High Density
HGD	High Grade Deinking
LD	Low Density
LWC	Light Weight Coated Paper
MD	Medium Density
MT	Metric Ton (1,000 kg)
MP	Mixed Paper
NBHK	Northern Bleached Hardwood Kraft
NBSK	Northern Bleached Softwood Kraft
NDLK	Natural double lined kraft corrugated cuttings
ONP	Old newspapers
OMG	Old magazines
OCC	Old corrugated containers
PCB	Poly-chlorinated biphenyls
PGW	Pressurized Groundwood
pH	used to express the acidity and alkalinity of a material on a scale of 0 to 14 with 7 representing neutrality and less than 7 increasing acidity and numbers greater than 7 increasing alkalinity.
PS	Pulp Substitutes
PSI	Paper Stock Institute
RCRA	Resource Conservation and Recovery Act of 1976
SC	Supercalendered Paper
SGW	Stone Groundwood
T	Ton (short ton) 2,000 lbs
TMP	Thermo Mechanical Pulp
UHK	Unbleached Hardwood Kraft
USK	Unbleached Softwood Kraft
US	United States of America
WP	Waste Paper

APPENDIX D: DEFINITIONS

Many of the definitions that follow are in a state of transition. Although heavily ingrained in daily use, some terms are likely to be phased out, and new ones will be adopted. An attempt has been made to accommodate this dynamic state in the definitions that follow, and to make them working definitions.

The term paper is used in the generic sense to include both paper and board grades, as well as converted products.

Boxboard

A general term for paperboard used in a wide variety of products, including card stock, folding cartons, setup boxes, cupstock, milk cartons, and foodboard. Boxboard may be bleached, unbleached, lined, coated, or uncoated, and made from virgin wood pulp, recovered paper, or both.

Building Papers and Boards

Building papers are used for underflooring, tarred or asphalt-coated vapor barrier, etc. The major products include gypsum board liner, roof felts, and floor felts. Building board also includes structural, acoustical and core materials.

Chemical Paper

See Freesheet Paper.

Collection

The separation and movement of a material to a processing facility for the purpose of marketing it to an end user. Some collected material may have to be disposed because it has no market or does not meet market specifications. Collection is often confused with recovery, which means the material has reached an end user for reuse. See Recovery.

Containerboard

This term includes the component materials — linerboard and corrugating medium - used in the manufacture of corrugated shipping containers (commonly called corrugated boxes) and other corrugated board products.

Contaminants

Foreign materials which must be removed to make the final product unacceptable. Often small amounts of these materials are tolerable but large amounts are unacceptable. Contaminants must be removed in the recycling process. The final product determines the type of the contaminant. Thus ink is a contaminant in some bleached pulps but not in most semi- or unbleached pulps. Nonfibrous materials are usually contaminants.

Construction Paper

Construction paper has two definitions in the paper industry. The first definition, which is used in this report, is paper and paperboard used in the building industry, also described under Building Papers and Boards. Construction paper is also a grade of paper used in schools, most often produced in a variety of colors.

Converting Scrap

Includes the trim, misprint, spoiled product, shavings, and/or heavily inked waste created as paper and board are converted into finished products. Converting scrap is a valuable material that is almost always recovered for recycling.

Corrugating Medium

A paperboard used by corrugating plants to form the corrugated or fluted part of a corrugated box. Corrugating medium is also called medium, or fluting.

Deinking

A process to remove ink from paper. Other materials such as filler, coating, and contaminants are also removed during the deinking process. Deinked fiber or pulp is the end-product of the process. Deinking grades are a broad category which includes all printed papers recovered for recycling. Deinked paper is finished paper made from deinked pulp. (Also see High-grade Deinking)

Depolyed Fiber

Recovered paper that has had the polyethylene coating removed. It usually refers to the fiber originating from polycoated milk carton or cup stock.

Direct Entry

The use of recovered paper directly in a papermaking furnish immediately after repulping. Several grades of recovered paper fall into this category, including mill broke, pulp substitutes, and market deinked pulp. Recovered paper used to make brown grades such as boxboard, linerboard, and corrugating medium, can also be used through direct entry.

Double Lined Kraft (DLK)

Also known as natural double lined kraft (NDLK), this is the scrap generated by corrugated box plants. DLK is a subgrade of OCC.

Freesheet Paper

Refers to paper which is primarily chemical pulp and free of groundwood (contains less than 10%). Freesheet paper includes a wide range of products such as bond, ledger, duplicating, envelope, stationery, etc. The term freesheet is often used interchangeably with wood-free.

Generation

A term that indicates the paper product has ended its useful life and is available for recovery or discard. Thus, generation includes converting scrap as well as discarded paper both recovered and uncollected. Generation as used in this report is synonymous with new supply.

Groundwood Paper

Paper made principally from mechanical wood pulp. Groundwood paper fiber furnish can contain up to 50% chemical fiber. Groundwood papers include newsprint, publication and directory paper. Groundwood paper is also called mechanical paper, or wood-containing paper.

High Grade Deinking (HGD)

For the purposes of this report, high grade deinking (HGD) paper only includes paper recovered from printing and converting operations, and excludes office waste paper.

Ledger

A trade term for a group of high-grade papers used in offices and print shops. Ledgers include reprographic (copier) paper, letterheads, envelopes, or other publication papers. Ledger papers are usually printed. In the paper stock industry, ledgers are also classified as white, colored, laser, or mixed.

Linerboard

Paperboard used as the facing material in the production of corrugated shipping containers.

Mechanical Paper

See Groundwood Paper.

Mill Broke

Paper scrap that occurs in the paper manufacturing process up to and through the slitter-rewinder. Mill broke includes side run rolls, trim, and obsolete or damaged rolls of unfinished paper. Mill broke is not classified as recovered paper except for that portion containing recovered fiber initially. Technically, broke that is traded, sold, or shipped to another mill for repulping is not recovered paper, but is often reported as such.

In the paper mill, wet broke refers to paper resulting from a break in the forming or press section, while dry broke refers to paper resulting from a break in or after the dryer section.

Mixed Paper (MP)

A mixture of various qualities of paper not limited as to type. In the context of this report it includes paper grades not normally considered recoverable/recyclable, e.g. tissue & toweling.

Office Waste

Includes all of the solid waste associated with the human activity in offices and office buildings. It consists principally of paper (mostly printing & writing grades, but also newspapers, corrugated boxes, packaging, and miscellaneous papers; restroom wastes, glass, aluminum, plastics, food scraps, and unclassified trash.

Office Wastepaper (OWP), as used throughout this report, includes all printing & writing papers generated in the office.

Old Corrugated Containers (OCC)

Discarded corrugated shipping containers. OCC is primarily discarded from retail stores, commercial buildings and manufacturing operations, with a smaller percentage coming from households. Converting scrap from box plants (DLK) is also included in OCC within this report.

Old Magazines (OMG)

Printed and bound publication papers. Hard covered publications or books are not included. Normally, old magazines are composed of an uncoated or coated paper with a brightness greater than 70. In some classifications, the unbound coated publications found in newspapers is included in old magazines.

Old Newspapers (ONP)

Discarded newspapers. ONP is primarily discarded from residences, with smaller amounts available from offices, hotels, or other points of generation outside the home. ONP also includes newsprint distributed with daily newspapers, and advertising inserts printed on other grades of coated and uncoated groundwood or supercalendered papers. Over-issue newspapers, news blanks, and pressroom scrap are also included in this general category.

In Canada, ONP includes old magazines (OMG) which is a separate grade in the United States.

Paper Stock

Traditional term for paper recovered for recycling. The Institute of Scrap Recycling Industries publishes a booklet of paper stock standards and definitions. There are currently over 50 grades of paper stock, excluding specialty grades. The term paper stock is used less frequently today, but is still used by some of the traditional packers, brokers, dealers, and mills engaged in buying and selling waste paper.

Post-Consumer

Materials that have served their intended purpose, and which may be recovered or discarded. This category includes ONP, OMG, OCC, CPO, mail, and advertising inserts. It does not include those materials and by-products generated from, and commonly reused, within an original manufacturing process. The term is gradually falling into disuse within the paper industry, but is embedded in many state laws, section 6002 of the Resource Conservation and Recovery Act, and the EPA guidelines for recycled paper. Post-consumer is still a common term in the paper trade and with consumers of recycled paper.

Post-Industrial

Waste or scrap resulting from converting or printing operations. This material is also referred to as pre-consumer waste.

Post-Mill

Dry broke and scrap that leaves a mill. It is classified as pre-consumer waste.

Pre-Consumer

Dry paper and paperboard generated during the paper making process, including envelope cuttings, bindery trimmings, carton manufacturing wastes, mill wrappers, butt rolls, and other paper waste resulting from printing, cutting, forming, and other converting operations. Pre-consumer waste is usually clean and consistent in quality, hence, it has traditionally been reused within the paper industry. Pre-consumer waste includes post-industrial waste, post-mill waste, converting scrap, etc. Also referred to as Manufacturing Waste.

Printing & Writing Paper

A large category of paper grades and products that constitute communications papers. The API grade structure includes coated and uncoated groundwood paper as well as coated and uncoated freesheet paper. Related papers are thin papers, cotton fiber papers, and bleached bristols. The API also classifies printing & writing papers by end-uses in broad categories: magazine publishing, book publishing, labels and wraps, commercial printing, office reprographics, envelopes, business forms, and stationery and tablet.

Pulp Substitutes (PS)

A grade of high quality recovered paper used as a direct substitute for virgin wood pulp. This material requires little or no special processing or cleaning. Pulp substitutes includes envelope cuttings, solid bleached sulfate boxboard cuttings, etc. (see Boxboard Cuttings).

In Canada, pulp substitutes also include printed post-consumer waste which is defined as high grade deinking in the U.S. Canada does not have a recovered fiber category for high-grade deinking or office wastepaper.

Reclaimed Fiber

Fiber recovered from what would otherwise have been waste materials. It is similar to the terms waste paper, secondary fiber, paper stock or recovered paper. The term is not in common use today in the paper industry.

Recovered Paper

Post-consumer paper products that have been recovered and diverted from the solid waste stream, or which have never been discarded as solid waste. They are intended for sale, use, reuse, or recycling, whether or not such materials or by-products require subsequent separation and processing. Recovered paper excludes mill broke. Recovered paper is becoming the accepted term for paper that has a recycling or reuse application. However, other terms, such as waste paper, secondary fiber, and paper stock, are still in common usage. Recovered fiber is the cellulosic material derived from recovered paper.

Recovery Rate

The ratio of recovered paper (numerator) to new supply (denominator). Recovery level is used interchangeably with recovery rate.

Recycled Content Paper

A term which is likely to replace the broader, more generic term, recycled paper. Recycled content means any product containing recycled fiber which may vary from less than 1% to 100%. The percentage of fiber may be specified on the finished product label. In the future, the term recycled paper will probably be limited to paper containing 100% recovered fiber.

Recycled Fiber

Previously used as a synonym for recovered fiber.

Recycled Paper

See Recycled Content paper.

Rejects

Solid materials which are selectively removed in the recycling process or any other screening process. Ideally, rejects are only materials which cannot be used in the recycled pulp. In practice, rejects include small amounts of useable papermaking fiber.

Reuse

The use of a product or package two or more times before it is discarded. A classic example is the refillable beverage bottle. Other examples include reusable crates (in place of corrugated boxes), refillable milk bottles, and grocery sacks when they are returned and refilled. Reuse is becoming a significant consideration in all packaging.

Secondary Fiber

Previously a term used to identify paper fiber that has been through at least one use and has commercial value as a raw material in some secondary application. This also encompassed use in the same product it came from originally.

Secondary fiber has also been defined as wood pulp obtained from manufacturing residues from lumber mills and forestry operations. Since secondary fiber could refer to recovered fibers from paper products or fiber from wood pulp residues, we have avoided the use of this term in this report.

Waste Paper

A term used for decades to designate secondary fiber or paper stock used for recycling. The term is commonly used in and outside the paper industry. The trend is to use the term only for discarded paper, and to substitute the term recovered paper for material destined for recycling or reuse.

Wood-Containing Paper

See Mechanical Paper.

Wood-Free Paper

See Freesheet Paper.

Yield

The percentage of input material that ends up in the finished product. In recycling, yield accounts for the loss of short fibers and nonfibrous materials such as coatings, inks, and other contaminants.

APPENDIX E: FEDERAL, STATE, AND LOCAL LEGISLATION

Background

Legislative and regulatory activity affecting recycling generally falls under one of three main areas:

- 1) Reduction of solid waste, including separation of materials for recycling, mandatory collection of recyclables, and product bans.
- 2) Minimum content standards.
- 3) Procurement preference laws.

In the United States, legislative and regulatory activity is occurring on the Federal, State and Municipal level. Most activity is directed toward reducing the amount of material disposed of in the solid waste stream, with goals varying from 25-50% reduction in the next five to ten years. The motivation is the increasing cost of solid waste disposal and the diminishing landfill capacity.

While most states have some sort of recycling or waste reduction regulations and goals, only four states actually require municipalities to report their progress: Minnesota, California, New Jersey and Rhode Island. Legislation will have a greater impact on recovery and market development in these states than in states where regulations and goals are not as strictly enforced.

Reauthorization of RCRA

Local governments are the first to see a disposal crisis, but may not be in a position to act. Many state and local governments are dealing with issues that involve national and international industries. In its role as regulator of solid waste disposal facilities, the Federal government has also initiated legislation. Much of the legislation on solid waste introduced in the U.S. Congress in 1991 dealt with interstate commerce issues. However, the reauthorization of the Resource Conservation and Recovery Act (RCRA), the primary bill governing solid waste management, could have significant implications for the recovered paper supply and demand balance from the United States as a whole.

While RCRA reauthorization is in the news in 1992, prospects for passage of a bill in this election year are not good. The general consensus in Washington is that a reauthorization bill will not be passed much before the end of 1992 or the first quarter of 1993. Meanwhile, there will be uncertainty created if the legislators in Washington posture for the November elections.

At this time, two bills are receiving considerable attention: S.976 (the Baucus Bill) and a draft bill sponsored by Representative Swift of the House Subcommittee on Transportation and Hazardous Materials (the Swift Bill).

The Resource Conservation and Recovery Act (RCRA) Amendments of 1991 (S.976) sponsored by Senators Baucus (Dem.-MT), Chaffee (Rep.-RI), and Burdick (Dem.-ND) was introduced in the Senate on April 25, 1991. S.976 sets national municipal goals for 1995 and 2000. The bill establishes:

- 10% source reduction of waste generated by the year 2000.
- Recycling of 25% of the municipal solid waste stream (excluding white goods, automobiles, yard wastes, construction and demolition wastes, and municipal sludge) by 1995.
- Increasing recycling to 50% by the year 2000.

The exclusion of yard wastes (19% of the solid waste stream) from the 1995 recycling goal creates some dilemmas. Even states well on their way to meeting local goals will have to pick up the pace to meet the proposed RCRA requirements.

A number of the bill's other provisions have strong implications for recovery of paper as well as specific directives for encouraging demand of recycled content products. Among those affecting the paper and paperboard industry are minimum annual recovery rates that would have to be achieved by the end of 1995.

	<u>RCRA</u>
Newsprint	52%
Corrugated cardboard	66%
Mixed paper grades	20%
High-grade deinking paper	50%
Pulp substitutes	100%
All grades of paper products	40%

This provision of RCRA is an attempt to put API's recovery goal of 40% into law. However, there are no specific end-use product recovery goals set by API, even though the various products are likely to achieve the RCRA recovery rates. Therefore, the only set goal is a 40% overall recovery of both pre-consumer and post-consumer paper. Interpretation of the wording of S.976 would seem to indicate a 40% recovery of post-consumer paper — a much more difficult goal to reach by 1995.

Under the proposed RCRA bill, if the recovery rates set forth are not met by the 1995 deadline, the EPA would be required to set minimum recycled

content standards for those grades not in compliance. Specifically, the Baucus Bill contains provisions for newspaper publishers. If the 52% recovery rate for newspapers is not achieved, RCRA would require newspaper publishers using more than 2,000 tons per year of newsprint to meet average recycled content mandates as follows:

- 1997 20%
- 1999 30%
- 2001 40%

In addition, daily newspapers with an annual circulation of 25,000 or more would be required to publish, as a part of their circulation statement, the average annual recycled content of the newspaper from the previous year.

A separate bill has been drafted by the House of Representatives, following hearings with industry which began in April of 1991. This draft bill (H.R. 3865, known as the Swift Bill) was released in the fall of 1991. Sections particularly relevant to the paper industry include:

- Requirements to divert significant amounts of materials from landfills and incinerators
- Minimum recycled content standards for many products, including newsprint and packaging. Standards for paper products would be set by EPA.

While the Baucus and Swift Bills differ in some details, both attempt to increase recovery of papers (supply) and to develop increased markets (demand) for recovered papers through minimum content standards.

Waste Combustor Rules

One regulation which would have supplemented recovery efforts for many areas was the 25% mandatory separation requirement proposed with the Municipal Waste Combustor Rule in 1989. The provision of the rule requiring waste-to-energy facilities to recover 25% of the incoming materials was deleted by the Presidential Council on Competitiveness in December of 1990.

The Council is a review board formed to safeguard industry from overregulation. It stated that the current administration would rather set performance standards that would allow industry the freedom to develop their own methodology for attainment. Setting a 25% separation requirement for incinerators was deemed to directly regulate throughput and processing, or in other words, to regulate design criteria. The flow of paper and plastics

would be reduced, however, jeopardizing the efficient operation of existing facilities.

Although some states have already enacted their own version of recycling requirements under incinerator regulations, federal regulations would have universally encompassed the estimated 164 municipal incinerators operating nationwide. These facilities have the capacity to burn an estimated 82,000 tons per day or nearly 30 million tons annually of municipal solid waste (MSW). Recovery of noncombustibles, such as metals and glass, would have been the most likely targets for recycling. Nevertheless, recovery of substantial amounts of paper would have been needed to meet the 25% requirement. This, in turn, could potentially create a need for supplemental fuel in order to properly fire the incinerators. The fuels of choice would most likely be oil or natural gas.

The National Resources and Defense Council (NRDC), and state attorneys general for New York and Florida have sued the U.S. Environmental Protection Agency (EPA) to reinstate the recycling requirement. The NRDC originally filed suit against the EPA to promulgate the waste combustor rule in December 1990. A similar requirement for front-end separation of recyclables was proposed for landfill operators under Subtitle D regulations, but this was not part of the final rule (40 CFR Parts 257 and 258).

State Legislative and Regulatory Trends

State legislation continues to provide a strong impetus for new waste reduction and recycling efforts at the local level. Much of the legislation will continue to affect the supply and demand for recovered paper. This stems from laws enacted to promote waste reduction and lessen reliance on landfill or incineration disposal.

At least 34 states have some sort of waste reduction goal. All but four of these are mandated by legislation. In general, state goals for waste reduction are being set within the range of 25-50% by 1995 or later. Thirteen states have goals of 40% or higher. Some states with lower goals may still be pushing waste reduction as strongly as those with higher goals by excluding leaf composting (New Jersey) or separating composting applications from waste reduction goals. However, waste reduction goals are not the whole picture.

Some communities already have taken the lead in managing their wastes. In order to achieve state-wide goals, state legislation must have some mechanism to encourage all communities to implement programs and meet goals. At least seven state laws require local units of government to pass ordinances for mandatory recycling. Nine states require local governments to provide recycling programs. There are other mechanisms to promote

implementation of recycling at the local level. One is to link local goals to funding allocation. Another is to require recycling alternatives as a part of the local solid waste management planning process.

While mandated commercial recovery of recyclables has been slower to develop than mandated residential curbside collection, it is coming. Seven states — Connecticut, Maine, New Jersey, New York, Pennsylvania, Rhode Island, and Wisconsin — have mandated commercial recovery. Office papers and corrugated boxes are usually the paper products affected by mandated recovery. In addition, some cities (e.g., New York City and Washington, DC) are beginning to mandate commercial recovery.

Recent legislative activity in solid waste continues to be heavy. Over 140 pieces of state legislation (from 38 states) on solid waste recycling were passed in 1990, according to the National Solid Waste Management Association (NSWMA). Activity has been equally as great in 1991. Essentially every state is promoting recycling at some level, with major recycling plans required in 33 states.

The nature of new legislation is changing. Among the trends in state legislation is an increase in product-specific recycled content legislation. By mid-1991, nine states had passed recycled content legislation for newsprint: Arizona, California, Connecticut, Illinois, Maryland, Missouri, Rhode Island, Wisconsin, and Oregon. Three of these states also passed laws requiring use of recycled content paper in telephone directories (Connecticut, Maryland, and Oregon). While product-specific legislation appears to be a trend among states, certain paper products seem most easily identified.

The purchase of recycled content printing & writing papers are sought by the procurement officials of nearly all 50 states. Specific purchase goals and price incentives are not uncommon. These are direct attempts to create a demand for and influence the supply of recycled content papers.

Minnesota

The Waste Management Act (MN Statute 115A), created in 1980, generally provides that each resident be given the opportunity to recycle and several sections directly affect the markets and potential markets for recovered paper. The statute also requires local government agencies to report their recycling activity and how they plan to achieve their goals in order to receive funding. This reporting requirement makes the potential recovery of paper in Minnesota likely to be higher than in other states where less focus and fewer resources are directed to recycling and solid waste management. The major sections of the statute which affect the generation and recovery forecasts included in this paper are:

- Chapter 115A.55 defines and clarifies solid waste reduction. The chapter provides for the coordination of public education, promotion, technical and financial assistance to solid waste generators for the purposes of recycling and/or reducing the amount of solid waste to be disposed of.

While this chapter does not (in itself) have a direct affect on recovery rates, clear definitions and guidelines are essential to successful implementation of state regulations and local goals.

- Chapter 115A.5501 sets goals for the reduction of packaging in the solid waste stream. The section establishes a goal of a 25% reduction in the amount of discarded packaging delivered to composting, incineration or disposal facilities by December 31, 1995, based on a reasonable estimate of packaging discarded in 1992.

The reduction of packaging in the waste stream can occur in two main ways:

- Source Reduction
- Increased Collection

Source reduction could result in increases of other materials through the substitution or elimination of bulky packaging. Examples of substitutions include McDonald's recent replacement of polystyrene clam shells with paper wrappers and Bausch & Lomb's replacement of polystyrene shipping containers with molded pulp. Both of these resulted in smaller amounts of packaging going to landfills, but increased paper packaging. Increase demand for some types of packaging, such as molded pulp, would generate markets for recovered paper.

Source reduction for packaging, however, is not entirely controllable at the local level. It is more likely that municipalities will choose to reduce the amount of packaging going to landfills by increasing collection for the purposes of recycling and reuse. This would result in increased recovery rates for mixed paper, but could create an oversupply if markets do not keep pace. Banning disposal of certain packages would have a similar effect.

- Chapter 115A.551 sets county goals for recycling. By December 31, 1993, non-metro counties must recycle 25% of their municipal solid waste; metro counties must recycle 35%. By December 31, 1996, non-metro counties must recycle 30% of their MSW; metro counties must increase their recycling rate to 40%.

Each county must also have a solid waste plan and recycling implementation strategy. Few states actually make their municipalities accountable for achieving their recycling goals. Recovery rates are expected to be higher in Minnesota than in other states where regulations and goals are not monitored and enforced as closely.

- Chapter 115A.552 provides that every resident of the state of Minnesota must be given the opportunity to recycle. In some cases, this opportunity must be in the form of curbside or centralized pick-up. In smaller municipalities, the opportunity to recycle can be provided through local recycling centers.

In order to achieve maximum recovery rates, each resident must be able to recycle. While most metro area residents in the nation have the opportunity to recycle, many rural area residents do not. Potential recovery of recyclables in Minnesota will be higher than in states where some residents do not have access to recycling.

- Chapter 115A.56 provides that recycled content labeling must disclose the amount of post-consumer material contained in a paper or paperboard product as a percentage of total fiber. While this chapter does not mandate post-consumer waste content in recycled products, it establishes labeling standards. It also creates a value-added incentive for post-consumer content.
- Chapter 115A.81 establishes the ability of a local government to require or designate that all or any portion of waste generated be delivered to a processing or disposal facility identified by the district or county. There are exemptions for several types of waste, including mixed MSW, waste not managed as a separate waste stream, and waste separated for reuse.

There are two interpretations to this provision:

- 1) It provides broad policy direction that counties will take a leadership role in assuring that materials have, in fact, been collected and have a reasonable economic market.
- 2) It is the county's responsibility to assure that markets exist, but that private collectors may choose whether to participate in the market system established by the county.

This provision has brought into question the ability of counties to prevent or enact flow-control of recyclable materials. All of the assumptions and forecasts in this paper assume that collection of recycling will occur before collection for incineration, and that no municipality will direct the flow of recyclable paper to incinerators.

- Chapter 115A.951 has been proposed to regulate the distribution and disposal of telephone directories. It would generally require directory publishers to ensure that books are recyclable and recycled. Publishers would be required to report recovery rates, disclose where the books were delivered for recycling, and verify that they were recycled.

Mandated collection would result in higher mixed paper recovery rates, but there are currently very few markets for used telephone books. The forecasts in this paper assume any increase in the collection of old telephone books will be a result of increased demand.

SCORE Legislation

While MN Statute 115A has been amended almost every year, the most significant changes occurred in 1989. The new laws and amendments made in 1989 are commonly referred to as the SCORE (Sub Committee On Recycling and the Environment) legislation.

The SCORE legislation further encouraged solid waste reduction and recycling by:

- Requiring related purchasing and recycling programs by state and local agencies.
- Setting recycling goals for counties.
- Distributing funds to counties.
- Imposing a sales tax on waste collection to fund programs.
- Establishing programs for market development and litter prevention.
- Encouraging the study of materials that cause problems in the waste stream.