Paper Recycling: Quality is Key to Long-term Success

A report compiled by
The American Forest & Paper Association

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The American Forest & Paper Association
America's Forest & Paper People—
Improving Tomorrow's Environment Today™

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Foreword

This report is comprised of three components. Part One is the Jaakko Poyry/SERA Single Stream Total Cost Analysis study commissioned by the American Forest & Paper Association in July 2003. The purpose of the study is to better understand the impact of recycling processes on a system-wide, cost basis.

Part Two is the Executive Summary from the AF&PA Recovered Fiber Quality Study, which was undertaken by R.W. Beck in October 2002. This study looked at rates of prohibitives and outthrows in recycling programs nationwide.

Part Three is a summary piece written by the AF&PA Recovered Fiber Executive Committee which ties the finding of the two aforementioned studies together into a summary on the need for quality in paper recovery systems.

As a whole, the three pieces are meant to present yet an additional paper in the ongoing debate around paper recovery and the need for quality in recycling systems. Our understanding of the impact of recycling systems on recovered paper streams is growing and information will continue to be studied and shared as it is gathered.

For additional information on this compilation or on AF&PA's efforts to increase recovery of high-quality paper, please contact AF&PA at 202-463-2700.

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SERA

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SINGLE STREAM RECYCLING – TOTAL COST ANALYSIS

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ORGANIZATION OF THE REPORT

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I. EXECUTIVE SUMMARY

A. Background

While communities believe the adoption of single stream curbside collection reduces costs and increase volumes, pulp and paper mills believe their recovered fiber quality is negatively impacted, directly increasing costs. A study commissioned by the American Forest & Paper Association (AF&PA) in 2002,[1] showed that prohibitives (any material that, if it exceeds allowed limits, would make recycled paper unusable at the grade specified) were significantly higher for recovered fiber collected in Single Stream (SS) systems (programs where all recyclables are collected in one container) compared to traditional Dual Stream (DS) curbside systems (where paper is collected in a bin separate from other recyclables).

To date, little or no work has been completed to assess the system-wide cost impacts of SS versus DS systems. Consequently, the AF&PA commissioned a study to address the following objective:

Assess the impacts on recovered fiber costs and recovered paper volumes at three stages – collection, processing, and papermaking – for SS and modified single stream (MSS) programs compared to DS programs.

Jaakko Pöyry Consulting (JPC) of Tarrytown, NY and Skumatz Economic Research Associates, Inc. (SERA) of Superior, CO were selected to analyze these impacts. SERA addressed the collection / processing stages of SS and JPC focused on the mill economics associated with SS collection. The work was conducted by the JPC/SERA team between June and October, 2003.

B. Key Findings

The JPC/SERA analysis found cost savings for collection, but cost increases to processors and mills. Overall, the cost difference for operating a SS program versus a DS program is:

- Savings of $10-20/ton for collection.
- Additional cost of $5-15/ton for processing.
- Increased cost of $5-13/ton of recovered fiber at paper mills.
- An average net increase of $3/ton system wide.

After collection and processing, we estimated that there was a net increase of all materials recovered in curbside recycling of 1-3 percentage points. However, because of the higher level of prohibitives in recovered fiber from SS programs as found in an R.W. Beck study commissioned by AF&PA in 2002, approximately 1% more recovered fiber would be required to generate the same quantity of recycled paper and board. The net after residue removals at the mills could not be estimated, so no overall conclusion can be drawn regarding paper volumes specifically.

C. Approach

The research involved analysis of three stages surrounding SS, MSS and DS systems – and ultimately derived a "market" or value chain analysis.

1. "Recovered Fiber Quality Study," Prepared for the American Forest & Paper Association by R.W. Beck, October 2002.

- For the **collection** stage, the study entailed analyzing costs and net tonnages for a large number of SS, MSS, and DS programs – separate from the effects of demographics and other collection program differences. SERA interviewed just under 100 SS and MSS programs, along with more than 100 DS programs for comparison.
- For the **processing** stage, the research compared the costs and net tonnages for SS facilities compared to non-SS facilities. More than 45 material recovery facilities (MRFs) were examined by SERA, including 2 site visits.
- For the **mill** stage, the analysis entailed examining the impacts in terms of increased recovered fiber costs, increased investment, revenue losses, and increased operating costs. To estimate the costs associated with SS over DS fiber, 3 paper / board segments were studied that utilize the majority of old newspapers (ONP) and residential mixed paper (RMP), the primary grades of recovered fiber collected through curb-side programs. During the study, JPC interviewed 24 mills, representing a significant share of the market capacity.

Interviews and site visits were conducted between May and September 2003.

D. Detailed Results by Stage

Collection

- Single stream collection is becoming increasingly common. The economic benefits at the collection stage have been the primary driver of this growth. The results showed that single stream added about 2-5 percentage points of new recycling collected;[2] however, net tonnage increases were smaller after accounting for changes in contamination. Recycling program savings varied between 5% and 25% depending on the productivity of the program prior to conversion.

Processing

Significant investments in SS MRFs have been made across the nation, including facilities in California, Arizona, Illinois, Ohio, Virginia, and North Carolina. Additionally, a corporate commitment to SS has been made by several large collection / processing companies, nationwide and regionally. The JPC/SERA study found:

- Processing costs are higher, on average, but vary considerably based on age of facility, age and type of equipment, number of processing steps, and other factors.
- Newer SS facilities appear to produce materials that meet and exceed the quality of many of the poorer / older DS facilities.
- DS facilities tend to be older; if retrofitted with similar equipment, then contamination at new DS facilities might be lower than those achieved at new SS facilities.

On average, contamination at single stream facilities is higher than dual stream facilities; although there is considerable variation by age and type of processing facility. This reduces the recycling tonnage gains after collection and processing to a net increase of 1-3 percentage points.

Papermaking

Since much of the paper industry is still trying to understand the quality differences between SS and DS, and few mills regularly measure quality of recovered fiber in a comprehensive way, the 2002 AF&PA study served as a basis for quality in the absence of any mill-specific data on quality. Within

2. Expressed as recycled tons/generation, where generation includes the sum of disposal, recycling, and other diversion.

that study, ONP prohibitives were measured to be 2.0% and 3.3% for DS and SS, respectively; RMP prohibitives were measured to be 1.1% and 1.7% for DS and SS, respectively.

The analysis shows that if SS were implemented universally across all curbside collection, assuming the quality differences per the 2002 R.W. Beck study, the total industry cost for the U.S. mills producing grades that utilize curbside ONP and RMP will increase about $50 million per year. A portion of this cost is due to the fact that, according to the R.W. Beck study, mills would need to buy more recovered fiber, and ultimately dispose of more rejects, due to the lower quality of SS material.

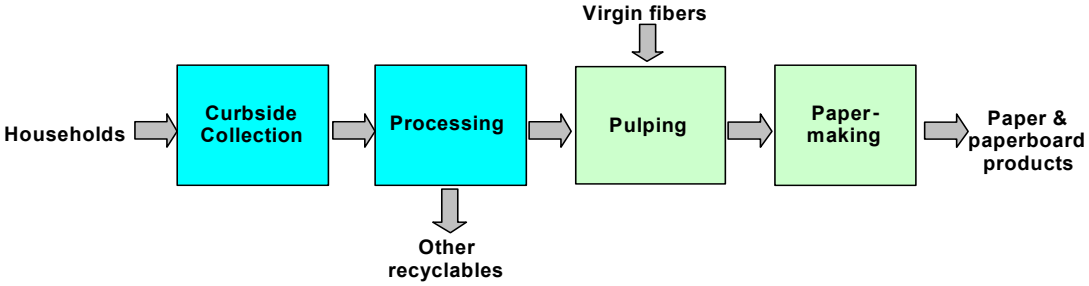
The impact on newsprint producers that use some recycled fiber is estimated to average about $3.50/ton of newsprint. Note that average recovered fiber use for these producers is roughly 55%. The average cost for recycled board mills is about $4.50/ton of recycled board. Again, note that only a portion of their fiber is from curbside collected materials.

Expressed on the basis of curbside recovered fiber, the impact is estimated to be $5 and $13/ton of recovered fiber for newsprint and recycled board produced, respectively, averaging about $8/ton. ONP and RMP delivered prices to a mill have generally ranged between $40 and $100/ton on a historical trend basis, depending mainly on grade, region and freight considerations. Remembering that producers (particularly board producers) can use a mixture of curbside material within their process, the estimated cost impact of SS over DS is 6-18% of the purchased fiber cost, averaging 11%.

Results: Costs

The impact on the total value chain was calculated. JPC/SERA computed the cost per ton to get one ton of materials to the mill. The net cost across all three stages is estimated to increase about $3/ton of recovered fiber.

Net Cost Impact – Total Value Chain



Avg. Costs Differences by Value Chain Segment –US$/ton of ONP/RMP				
	Collection	Processing	Pulping / Papermaking	System Net
Cost **savings** with SS	**$15 (10-20)**			
Cost **increase** with SS		**$10 (5-15)**	**$8 (5-13)**	**$3 (0-8)**

The results showed that SS did not save money on a system-wide basis. If anything, it was somewhat more expensive than DS. Moving to SS increased net volumes of materials going into

recycling markets. Finally, our results show a cost savings for collection was more than offset by increases in costs to processors and mills.

Results: Volume

The results of this study show there is an increase of about 1-3 percentage points in net recycled tonnage after collection and processing[3]. A separate AF&PA study indicates that there may be about 1 percentage point higher prohibitives from SS systems over DS, which may reduce the mill-usable recycled tonnage somewhat from the figures found in this study.

3. Expressed as a percent of residential tonnage generated.

II. CONTEXT FOR THE STUDY

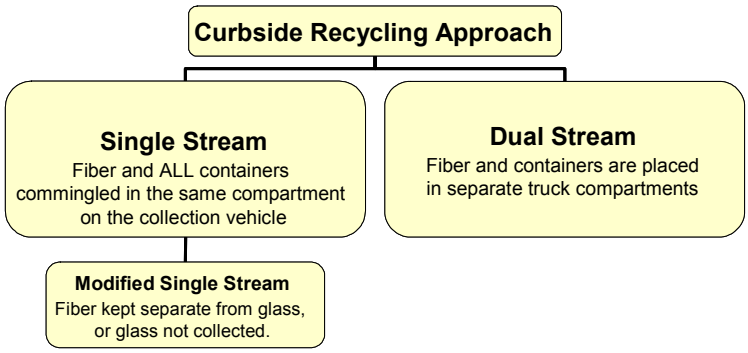
A. Background

Many communities are looking for methods to decrease recycling program costs, boost efficiencies, and increase sustainability. Improving recovery rates and collection efficiencies are two key ways to accomplish this goal.

Curbside recycling programs have changed from collecting separate streams for each material, to two streams, paper and commingled containers (Dual Stream or DS). Research shows that the reduction of the number of streams has three basic effects:

- Increasing the amount of material collected at the curb,
- Decreasing the associated net program costs and the costs of collection, and [4]
- Increasing the amount of contaminants, prohibitives, and outthrows in recycling materials.

Defining Collection Options Studied



Previous studies on the effects of SS programs indicated efficiencies, but have led to varied conclusions.[5] Most of these studies were conducted before the widespread adoption of SS collection. Furthermore, the focus was often limited to the collection side of the picture. Some studies looked beyond collection to processing, brokers, and others in the chain; but the focus was not highly quantitative.[6] On the end-user or mill side, AF&PA undertook a study in 2002.[7] This study analyzed the composition of actual bales of recovered fiber being received by mills from both

4 Skumatz, Lisa A., Ph.D., "Nationwide Diversion Rate Study—Quantitative Effects of Program Choices on Recycling and Green Waste Diversion: Beyond Case Studies," Skumatz Economic Research Associates, Inc. (SERA), Seattle, Washington, July 1996.

5 "A Comparative Analysis of Applied Recycling Collection Methods in Saint Paul," Prepared for Saint Paul Neighborhood Energy Consortium by Eureka! Recycling, May 2002. ; Skumatz, Lisa A., Ph.D., "Achieving 50% in California: Analysis of Recycling, Diversion, and Cost-Effectiveness," Skumatz Economic Research Associates, Inc., Seattle, WA, Prepared for California Chapters of SWANA, Sacramento, CA, April, 1999.; "1999 Residential Recycling Pilot Projects," Prepared for Washington County, City of Portland, Clackamas County, Metro by Environmental Practices, Portland, OR, March 1999.; "Report of the Metro Solid Waste Advisory Subcommittee on Contamination and Loss of Recyclables," Solid Waste Advisory Subcommittee, Portland, OR, February, 2003.

6 Kinsella, Susan, "Single Stream: An Investigation into the Interaction Between Single Stream Recycling Systems and Recycled Paper Manufacturing," Prepared by Conservatree for The Sonoma County Waste Management Agency, CA, March, 2003.

7 "Recovered Fiber Quality Study," Prepared by R.W. Beck for the American Forest & Paper Association, October, 2002.

SS and non-SS facilities. Previous studies examined collection, but a broader perspective including collection, processing, and use of recyclables is needed to understand the impacts of SS on each of the players involved in the entire recycling loop.

B. Objectives

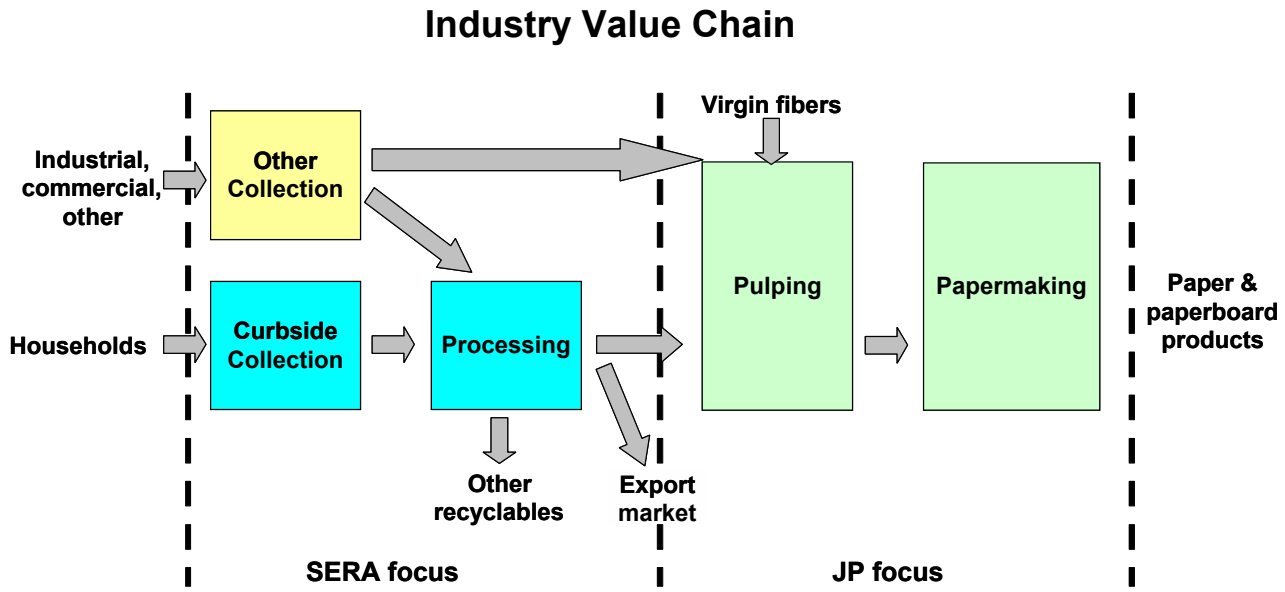
The American Forest & Paper Association (AF&PA) selected a team consisting of Jaakko Pöyry (JPC) and Skumatz Economic Research Associates, Inc. (SERA) to produce an independent and defensible study that fully analyzes the financial, diversion, and market impacts of SS versus DS collection of recyclables. This study focuses on assessing recovered fiber tonnages (gross and net) and costs at three stages – collection, processing, and papermaking – for SS and MSS programs compared to DS programs.

C. Research Teams and Roles

JPC/SERA independently analyzed the following segments of the recycling chain:

- SERA examined collection and processing by interviewing cities and MRFs, and used statistical modeling to examine the impacts on tonnage, contamination, and costs attributable to the change to SS / MSS systems. SERA also examined the impacts on other recycling streams beyond paper. Principal Investigator for this work was Dr. Lisa Skumatz.
- JPC examined paper markets, pulp and papermaking, and end-use impacts by interviewing mills. The Principal Investigator for this work was David Null.

The firms completed their respective findings and jointly assessed and modeled the impacts on the total value chain to derive an overall market assessment.



III. COLLECTION AND PROCESSING: METHODOLOGY AND DATA COLLECTION

A. Measurement Techniques

SERA investigated effects attributable to SS recycling both on the collection and processing levels. Analysis groups included:

- SS vs. DS
- Pre-post comparisons for communities before and after SS implementation ("Pre-Post" conversion).

Rather than relying on simple comparisons or case studies of SS and DS communities, which produce biased results, we used enhanced statistical techniques that are specifically designed to reliably isolate the SS impacts. The study examined the recycling and diversion rates after statistically "controlling for" demographic and program design differences (collection frequency, materials accepted, etc.) known to affect recycling program performance. SERA has conducted similar analyses in the past and demonstrated the reliability of the technique and key factors influencing performance and cost.[8] The technique:

- Used data from multiple and varied communities, assuring results were not anomalies;
- Used results from hundreds of years of program operating experience;
- Used proven statistical techniques to sort the influences of differing factors between communities and programs;
- Supported analysis of patterns to determine whether community features (urban versus rural, etc) resulted in systematic impacts; and
- Produced information showing the reliability of our findings.

Finally, SERA examined differences in curbside program costs per ton to determine the financial impacts of the SS program.

B. Data Collection

SERA collected program design, performance, and demographic information from almost 100 SS and MSS communities.[9] A list of regions with SS programs was constructed, and a sample of communities and MRFs from those areas were selected to interview. SERA also maintains in-house samples that are representative of the U.S. from which a DS collection sample was drawn. This information was further supplemented with 1) reports, conference proceedings, networking, and literature, and 2) community data gathered from several sources – most notably SERA's database of 1,100 community programs, as well as new data collected for the project.

Detailed interviews with communities generally took several calls to complete. Demographic data was largely gathered from census databases. Table 1 provides an overview of the types of information collected.

8 The multivariate regression analysis we used here were applied successfully by SERA in many previous studies, including: Nationwide diversion rate study (also included yard waste programs, RR 9/96), California analysis of recycling impacts and costs (also yard waste, RR 8/99, 9/99), including construction of cost curves, Rhode Island recycling container analysis, Iowa recycling and bottle bill analysis, Massachusetts recycling cost-effectiveness analysis (also yard waste 2001), and analysis of outreach and education expenditures (RR 8/01).

9 In previous work, SERA collected key data from 70 SS communities, several hundred non-SS communities, and from a dozen MRFs. We updated and augmented this information and used it in the analysis for this report.

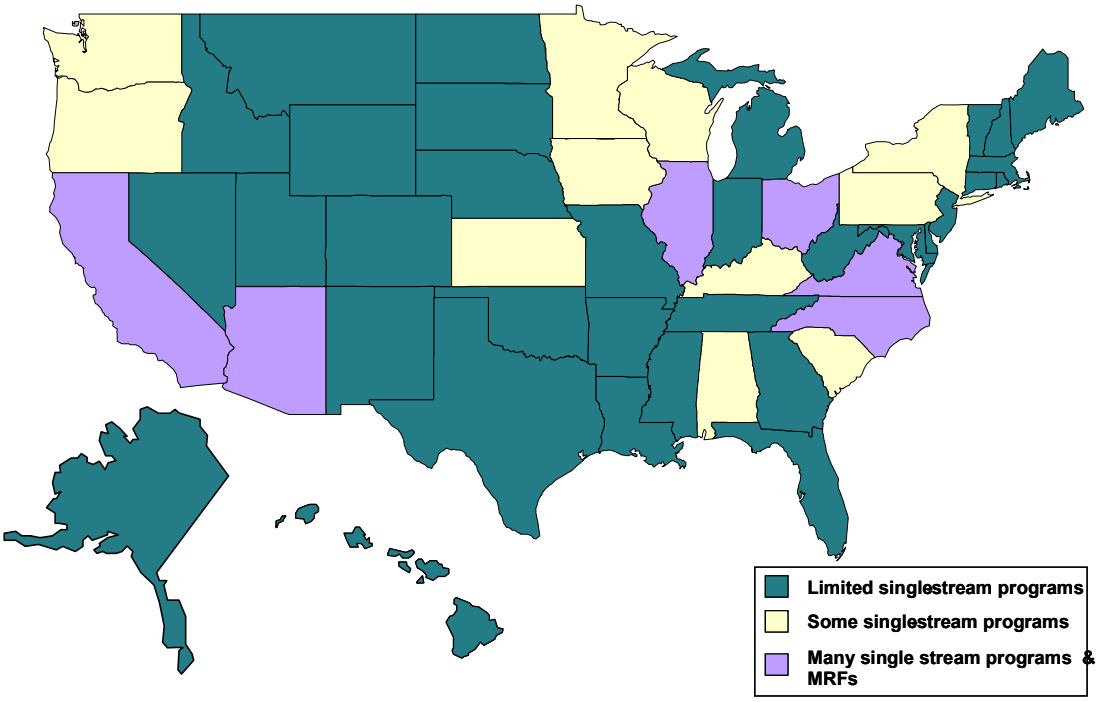
Table 1: Data Collected for Collection and Processing Analyses

Collection	Processing
• Households served • Collection arrangement (hauler, municipality, etc.) • Collection method for recycling (manual, semi- or fully-automated) • Recycling collection frequency • Materials included • Container size, type • Year of program change or year the program went into place • Other programs in place • Program cost (equipment / capital and operational) covering collection cost, processing, transport, etc. • Outreach / educational expenditures • Tonnage disposed • Tonnage recycled (by material, where available), and paper / non-paper tonnages • Garbage and recycling charges • Disposal and recycling / processing tip fees • Demographic and other data • Bottle bill versus non-bottle bill states • Pre-Post data	• Age of facility, age of key equipment / design • SS versus DS, or both (with estimated shares) • Capacity, shifts, throughput • Technology and equipment • Operational details (conveyor depth, speed), processes used • Processing level for various streams • Tonnages for paper and non-paper recovered materials • Information on grades including at least mixed paper, #6 ONP, #7 ONP, and #8 ONP • Contamination levels and related issues • Operating cost, covering yield, labor, energy disposal, maintenance, etc. • Capital cost, covering equipment, etc. • Value / prices of paper and materials at different quality levels • Conversion Costs and Pre-Post data • Location / region of country • Local demographics • Other

IV. COLLECTION RESULTS: RECYCLING AND COSTS

At the collection stage, SS programs are attractive because of increased recycling rates and decreased costs. The distribution of SS systems is shown below:

Prevalence of Single-Stream Systems



A. Comparison of Average Recycling / Cost Changes and Community Differences

Table 2 below highlights differences in the communities in the three key groups of communities – dual stream, modified single stream, and single stream. While some might focus on the fact that the recycling rates are about 4 percentage points higher on average in single stream communities, in fact, the higher recycling rate might possibly be due to the fact that single stream communities have higher income, higher population, or any combination of the other differences between the community groups. It is not valid to attribute the differences to single stream without accounting for all the other influencing factors. The statistical analysis method described in the next section accounts for the range of key differences, and investigates whether single stream systems are the cause of any of the difference in recycling rates above and beyond these other demographic and programmatic differences.

Table 2. Differences Between Communities in the Database

(Note: This does *not* represent all communities nationwide, only sampled communities in the database)

	Municipalities with DS	Municipalities with MSS	Municipalities with SS
Regional Characteristics			
Recycling Performance	14.4%	17.5%	18.6%
Median Housing Value	$142 946	$142 211	$180 271
Pop >95K	20%	30%	33%
Rural	14%	0%	9%
Suburban	35%	30%	44%
	Municipalities with DS	**Municipalities with MSS**	**Municipalities with SS**
Urban	21%	60%	16%
Bottle Bill	31%	10%	55%
Collection Program Characteristics			
Collection Same Day as Garbage	27%	70%	11%
Municipal Collection	28%	60%	24%
Weekly Collection	69%	70%	89%
Automated Collection	6%	40%	60%
>8 Materials Collected	23%	30%	75%
Drop-off Recycling	55%	60%	53%
Toter Container	5%	75%	68%
Container Size (gallons)	19	n.a.	58.8
Age of Recycling Program (years)	18.9	6.8	12.9

n.a. = Not available.

B. Statistical Analysis of SS Collection Tonnage / Recycling Results

Using special statistical techniques allowed us to separate out the variety of factors that affect recycling rates and identify whether SS systems were responsible for increasing recycling. The statistical models indicate that factors that raised recycling rates included:

- Low population.
- High median housing value.
- Frequent collection.
- Non-municipal collection.
- Collection of eight or more recyclable materials.

Above and beyond these influences, we found that SS collection adds an average of 2-5 percentage points of curbside recycling collected in a community.

SERA examined the data to determine whether any of the following factors affected the performance parameters of SS systems. Results included:

- **Modified Single Stream**: Indicative results show cost savings similar to those from SS systems (see next section), but tonnage increases were minimal for these systems, likely because of the elimination of the heavy glass component.
- **Larger / wheeled containers and fully automated collection**: Wheeled containers and larger containers for recycling did not show significantly higher recycling rates above and

beyond the increases from SS. No increase in tons for automation was found either; however, nearly all SS systems use automated, wheeled carts, so disentangling separate effects from SS is difficult statistically. There was some evidence that cities with wheeled containers seemed to have slightly higher costs.

- **Bottle Bill States**: No differences in impacts were found for bottle bill versus non-bottle bill states until the effects of more aggressive bottle bill legislation was included. When distinctions were made for bottle bill states that used 10-cent deposits or included more enhanced container lists, indicative results showed a fairly consistent negative impact on tonnage recycled through the curbside programs.

C. Pre-Post SS Recycling and Cost Changes

Only a small sample of communities was available that had recycling and / or cost data for periods both before and after SS implementation. All nine communities reported increased recycling rates at levels similar to the results reported earlier (about 16%, ranging from 7-34%, and 12% in terms of lbs/household). For a household, the average increase in recycling reported by six communities after SS implementation is an average of 110 lbs, with a minimum reported increase of 12 lbs and a maximum of 250 lbs. However, these changes in the recycling rates may reflect modifications in collection frequency, an increase in container size, or an increase in the amount of recycling education, rather than the switch to SS. Because the Pre-Post analysis compares the start-up performance and costs of a SS program to an established DS program, the findings are not a reliable indicator of the differences between established SS and DS programs. It should be noted that three out of four communities for our limited sample that had pre-post information noted their costs increased after introducing SS, an average of 9%. The cost increases may be attributed to initial purchase costs of automated trucks or containers. The Pre-Post findings are less reliable than the results derived from the statistical work because of the very small sample sizes.

D. Analysis of Collection Cost Impacts

Few communities were able to report cost information for their programs, making the results from this section less robust than the recycling percentage analyses. However, the analysis indicates there are several factors that consistently lowered costs:

- Larger populations.
- Less frequent collection.
- Collection of at least 8 materials.
- Collection provided by the municipality.[10]

Beyond these factors, SS tended to show lower collection costs than other collection systems. The analysis indicated:

- Collection cost savings were between 5% and 25% depending on prior system.
- Savings of approximately $10-20/ton of recyclables collected in SS communities.
- Individual results vary from zero savings to significant decreases; some communities show an initial increase in costs from container purchases, but savings from collection.
- Some communities concurrently decreased collection frequency, but after removing that effect, savings were still attributable to SS collection.
- Haulers report increased productivity of staff and truck operation, resulting in fleet and staff decreases.

10 Fully automated collection was often associated with lower costs, but was not as consistent as the other factors.

In summary, the myriad variations in collection programs, community demographics, and other factors make it impossible to rely on a simple comparison to analyze the recycling and cost impacts of SS collection. Using appropriate statistical analysis of collection data shows that SS results in an overall increase in community recycling rates, and a decrease in collection costs. However, this is only part of the picture – the following sections examine the impacts on other phases of the value chain, ultimately allowing a "net" analysis of the impacts of SS programs.

V. PROCESSING ANALYSIS: TONNAGE, COST, AND INTERVIEW RESULTS

A. Approach, Background, and Data Issues

Structured interviews were conducted with large and small processing facility managers to gather quantitative data on systems, costs, volume, contamination, and other differences between SS and DS facilities. During interviews, we requested data or best estimates, and engaged in candid dialogs on relative sizes of impacts, strengths and weaknesses of their own and other facilities, and information on issues and influencing factors.[11] While it is recognized that these facilities managers have a vested interest in making their own facility look as good as possible, we gathered information from a variety of locations, interviewed large players and outside parties, and augmented the information with published data to try to identify and control for this potential tendency. Published data were also used as a source for some information on DS facilities.[12]

B. Pre-Post Tonnage and Cost Analysis / Results

The variations in facilities made it difficult to conduct as statistical a study as the analysis of community programs; however, we were able to draw meaningful conclusions with a reliance mostly on Pre-Post analysis and detailed interviews. Our detailed analysis of the MRF interview shows:

- **Costs:** Data from MRFs show that the processing costs due to changing from DS to SS increases between $5-$25/ton, with an average about $10/ton. The increases vary for new versus old facilities and other factors.
- **MRF Processing Fees**: Only half of the 10 cases from which we received information on Pre-Post changes in MRF reported fee increases; the other half reported leaving fees unchanged. The increases ranged from $0-$12/ton, and averaged $2.75/ton increase. In percentage terms, the increases ranged from 0-25%, with an average of 7% increase.
- **Quantities**: All other things being constant, contamination levels were somewhat higher for SS facilities.[13] Thus, while facilities received 2-5 percentage points of material, more contaminants were removed during processing, so the net increase in recycled materials after collection *and* processing was 1-3 percentage points.[14] Results from a separate AF&PA study indicates mill-usable tonnage may be further reduced (by perhaps 1 percentage point of recovered fiber) after paper mill residues are taken into account.

C. Net Tonnage and Costs

This study relied on reported contamination figures to assess changes associated with SS collection; the JPC/SERA study did not include budget to do field inspection of bales. The best quantitative information on quality may be the 2002 AF&PA study[15] in which a sample of paper bales coming into mills was sorted. The study showed an increase in prohibitives for SS systems over

11 Note that in the analyses, we weighted the results from facilities handling larger volumes of tons more heavily than small facilities.
12 "2001-2002 Directory of Materials Recovery Facilities in the United States," Governmental Advisory Associates, Inc., 2003.
13 In some facilities, container lines were replaced at the same time as the conversion to SS. The resulting lower contamination from container lines mitigates some of the increase from SS conversion, accounting for some of the variation in the changes in contamination levels reported by different facilities.
14 For clarification, the 2-5 (and 1-3) percentage point figures refer to an increase as a percent of total tonnage collected and recycled from the residential sector, not as a percentage increase over previous recycling or recovered tons.
15 "Recovered Fiber Quality Study," Prepared for the American Forest & Paper Association by R.W. Beck, October 2002.

levels from DS sources. Prohibitives for ONP increased from about 1.5% for DS bales to 2.5% from SS, and from 0.7% for DS to 1.4% for SS for residential mixed paper.

However, the contamination of paper bales is only one component of the contamination issue. Identifying "net" new tons to market from SS requires examining contamination from other streams and the overall tonnage of materials that were removed and disposed as part of the MRF processing. Information from the detailed interviews and published MRF data allowed overall contamination levels to be estimated. However, note that these estimates are computed based on secondary data reports, which were gathered promising confidentiality, but were not separately verified using on-site inspections.

Data from 23 SS MRFs shows an average contamination level of 14.4% (9.9% using an average weighted by tons). Eighty percent of the facilities had contamination levels between 5-24%. The results from 28 DS MRFs reporting contamination show an average contamination level of 6.8% (and the average was the same for weighted and unweighted data). Eighty percent of these facilities showed contamination levels between 2-11%.

This implies that on average, contamination levels are about 3-8 percentage points higher in SS facilities compared to DS MRFs, ranging from about 3-13% (comparing high and low range values), and were about 3 percentage points higher weighted by tons.

The net results for tonnage and costs for a hypothetical community with 100,000 tons per year for residential generation are shown in Table 3, which provides an illustration of the impacts.

Table 3. Computing Net Recycling Tonnage Changes Under Single Stream

	Under DS system (Pre)	**Under SS system (Post)**
Tons generated	100,000	100,000
Tons recycled collected curbside	15,000	18,000
Recycling rate reported by town	15%	18%
Assumed contamination rate (removed during processing)	7%	10-14%
Net tons recycled and processed	13,950	15,480-16,200 (11-16% net increase)
Net recycling rate (after removing contamination)	13.9%	15.5-16.2% (1.5-2.2 percentage points added)

Reviewing the cost impacts shows that for a hypothetical community that generated 100,000 residential tons, the community might report an increase of 3 percentage points of recycling. However, after the removal of contaminants during MRF processing, the net increase in recycling would be about 2 percentage points and may be subject to further reductions at the mill stage.

The cost per ton to operate a SS facility is typically in the range of 10% greater than a multiple stream facility with a similar level of technology. However, ascertaining the cost to convert a facility to SS processing is difficult to quantify because many facilities implement other investments and upgrades above and beyond those needed solely to operate as a SS processor.

The findings indicate that the quality of material produced at the MRF depends more on the quality of the incoming stream, age and type of processing equipment, whether container lines were upgraded, number of processing steps used, quality / concern of the on-site processing managers, and similar factors – not solely on whether the facility is SS or DS. In addition, quality is also

influenced by education of residents, acceptance of downgrading by cities and uneven definitions / acceptance, export market and willingness to take variety of materials, and other factors.[16]

16. MSS seemed to show lower contamination levels than SS, but data from these systems was limited. However, for SS systems, no MRF reported receiving a lower price for paper grades because of prohibitives / quality issues, which may be partly due to downgrading of bales (full #7 price instead of reduced #8 price), variations in what is accepted as ONP, or other factors. Some facilities stopped sorting paper because of lower paper prices.

VI. MILLS / END-USER ANALYSIS: METHODOLOGY AND STUDY ISSUES

A. Mills / End-User Approach

Measuring cost differences between using SS and DS fiber within pulping and papermaking operations is a difficult undertaking for a variety of reasons. Direct "before and after" or side-by-side comparisons are usually not possible. In addition to the differences in mills inherent to their design, operation or product mix, several other factors exist which increase the complexity of measuring cost differences associated with using SS recovered fiber. Such factors include:

- Many mills use a combination of "virgin" and recycled fibers. Curbside collected recovered fiber (RCP) may only comprise a portion of the recycled fiber, depending on fiber type(s).
- Mills cannot easily identify, nor do they track the collection methods of their incoming recovered fiber.
- Frequently, the curbside recovered fiber utilized at a mill is comprised of a mixture of *both* DD and DS recycled fiber, coming from a large number of local and regional suppliers.
- Mill personnel have a low understanding of how much of the fiber comes from SS versus DS systems.
- The increasing consumption of SS recovered fiber has changed gradually, resulting in a gradual shift in processing costs.

Without the ability to use a "before and after" or side-by-side approach, direct comparisons between different mills, or the same mill at different points in time are usually not possible to evaluate the cost impacts that using SS over DS fiber will have on a mill. Mill personnel can, however, estimate the expected impacts if asked to assume that all curbside material is of a certain quality level. Defining two quality levels, representing SS and DS, allows mills to estimate cost differences between using SS and DS fiber.

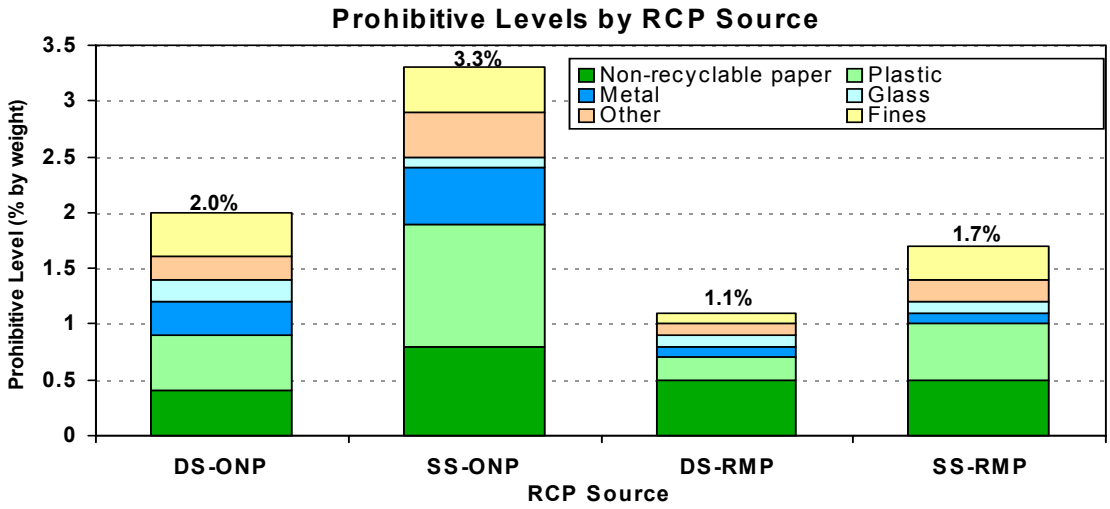
B. Quality of SS and DS Recovered Fiber Assumption Used Within the Analysis

Most mills using recycled fiber do not thoroughly measure the quality of their incoming recovered fiber. Virtually no purchasing decisions with respect to quality are made on the basis of whether fiber comes from a SS or DS source, but rather if the supplier meets minimum quality requirements. Such a "pass or fail" decision is usually based on previous experience with a supplier, or visual inspection of an incoming load, but, with few exceptions, is not based on rigorous quality testing performed by the mill.

Due to this limited mill data and experience, quality of SS recovered fiber vis-à-vis DS was defined per the 2002 AF&PA study. This study is the most comprehensive, representative, and statistically rigorous study available on the quality of SS and DS recovered fiber.

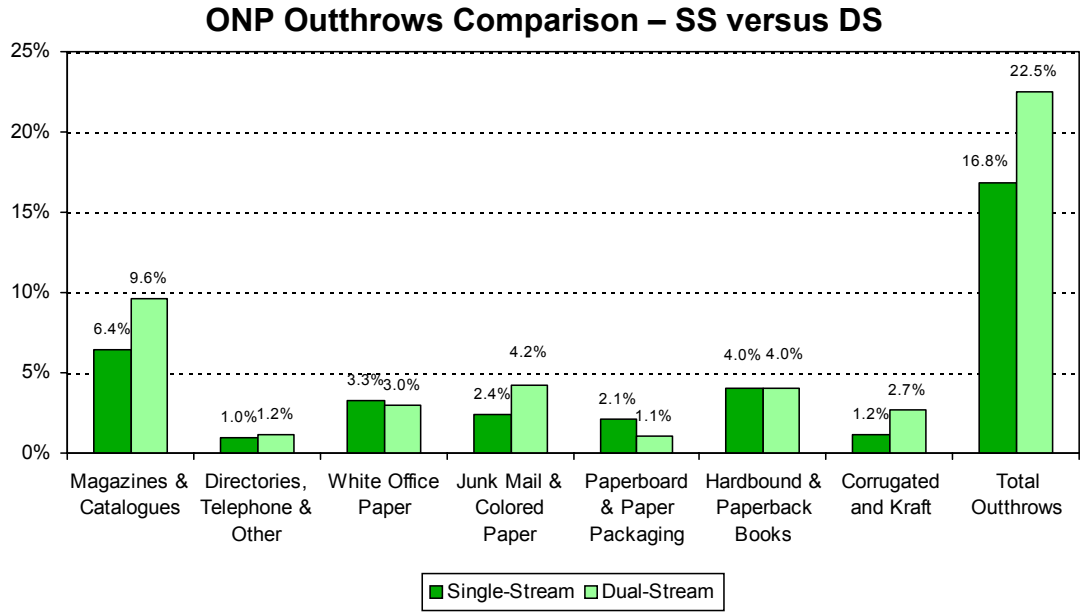
Results of prohibitive levels measured within the 2002 AF&PA Study indicate that:

- SS ONP contains a higher percentage of prohibitives than DS ONP (3.3% versus 2.0%).
- SS RMP contains a higher percentage of prohibitives than DS RMP (1.7% versus 1.1%).



Source: Recovered Fiber Quality Study, R.W. Beck for AF&PA (2002)

The 2002 AF&PA analysis also indicates that total outthrows in SS ONP are lower than DS. Differences in pulping / deinking technology could impact which fibers are retained for papermaking, affecting yield, product quality and other operational parameters.

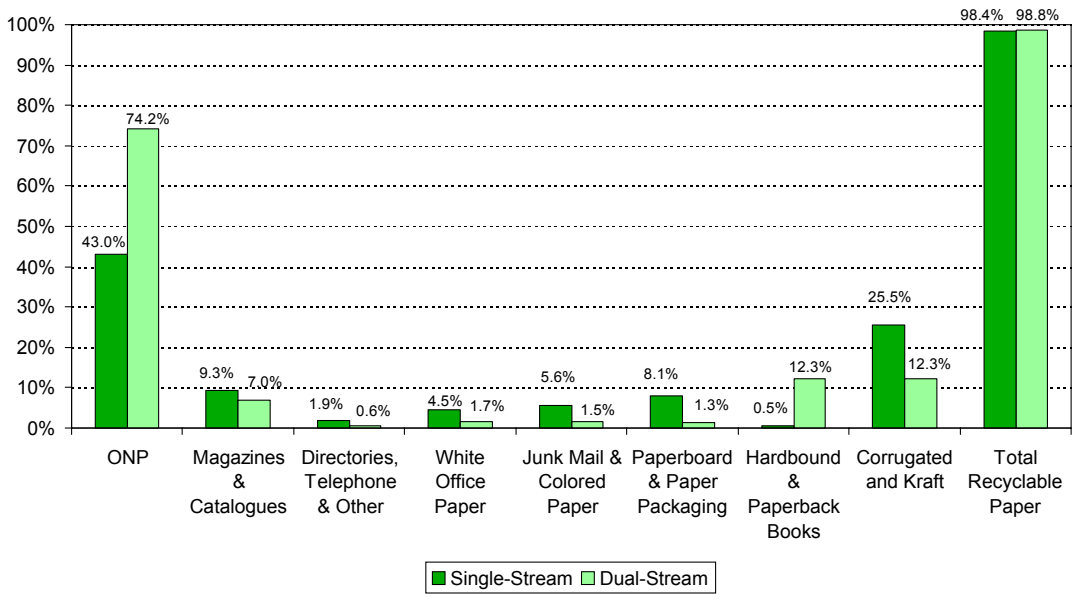


Source: Recovered Fiber Quality Study, R.W. Beck for AF&PA (2002)

Virtually no difference is seen in the total amount of recyclable paper present in SS or DS residential mixed paper, although individual categories show distinct differences. When RMP is used for production of board grades, virtually all recyclable paper is utilized in the sheet. When used in deinking systems feeding newsprint or tissue production, pulping or washing technologies can impact the amount of fiber retained. Most notably, drum pulping technology will reject most

corrugated and kraft papers, and deinking washing systems result in a yield loss when using papers with high pigment content such as magazines and catalogues.

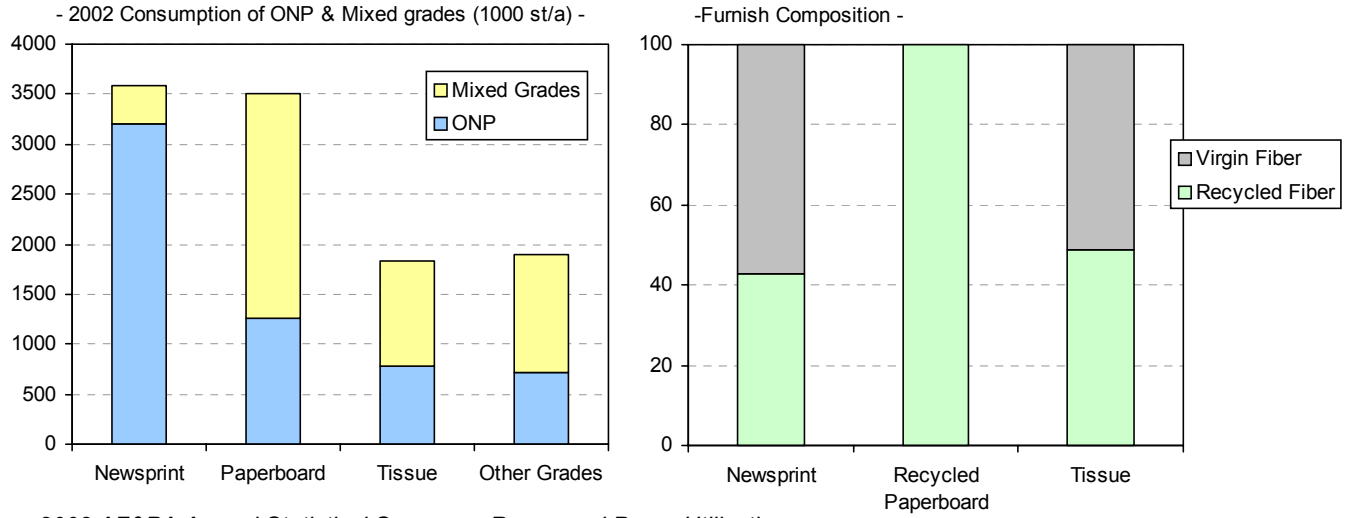
RMP Recyclable Paper Composition – SS versus DS



Source: Recovery Fiber Quality Study, R.W. Beck for AF&PA (2002)

C. Mill Sampling and Interview Approach

Three paper / paperboard grade segments – newsprint, tissue and recycled paperboard – were selected for analysis based on their relatively high use of ONP and RMP.



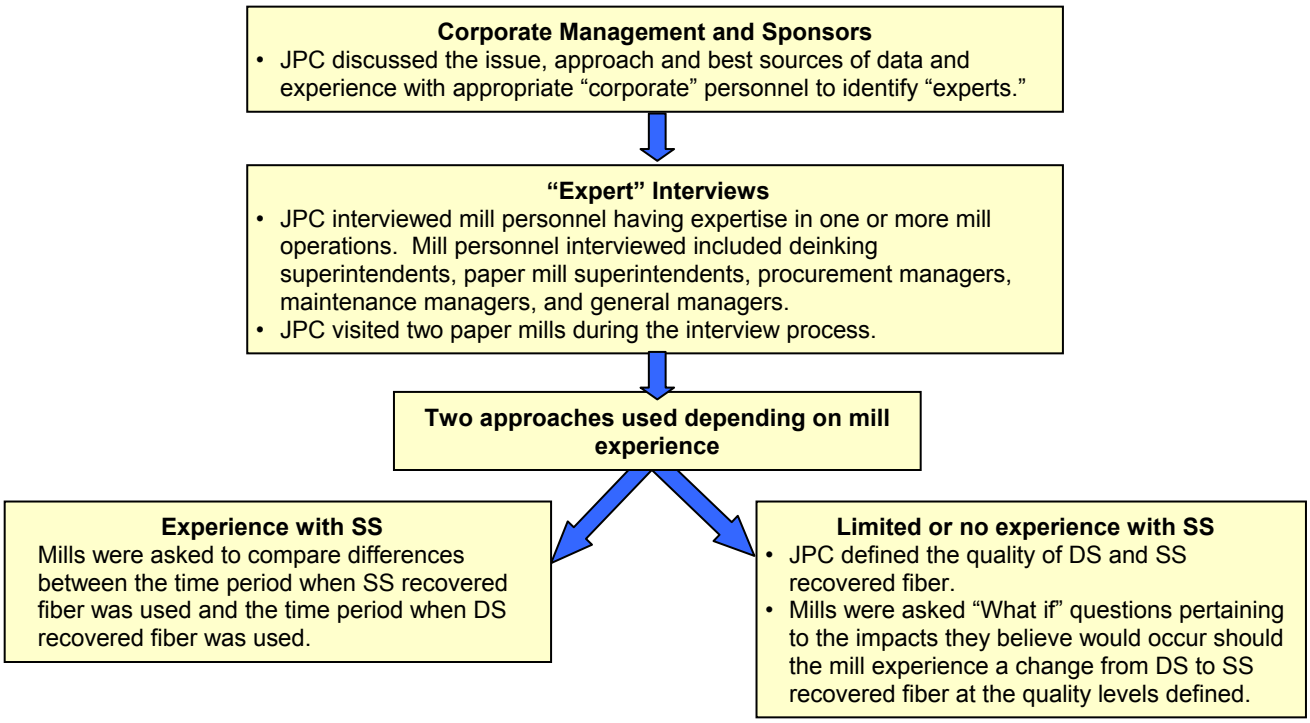
Source: 2003 AF&PA Annual Statistical Summary, Recovered Paper Utilization

A cross-section of major U.S. consuming mills of ONP and RMP within these segments was selected for interviews and analysis. Mills sampled were based on:

- Input from AF&PA Recovered Fiber Executive Committee members

- Regions of the U.S. where SS has presence
- Willingness to be interviewed
- Use of recycled fiber from curbside programs as a proportion of total fiber used, and therefore the potential impact that SS would have on the mill

While the majority of corporations and mills have virtually no empirical data regarding the impacts of SS recovered fiber, the general decline in overall recovered fiber quality in recent years has provided a foundation of understanding. JPC approached the issue by conducting numerous interviews using the following approach:

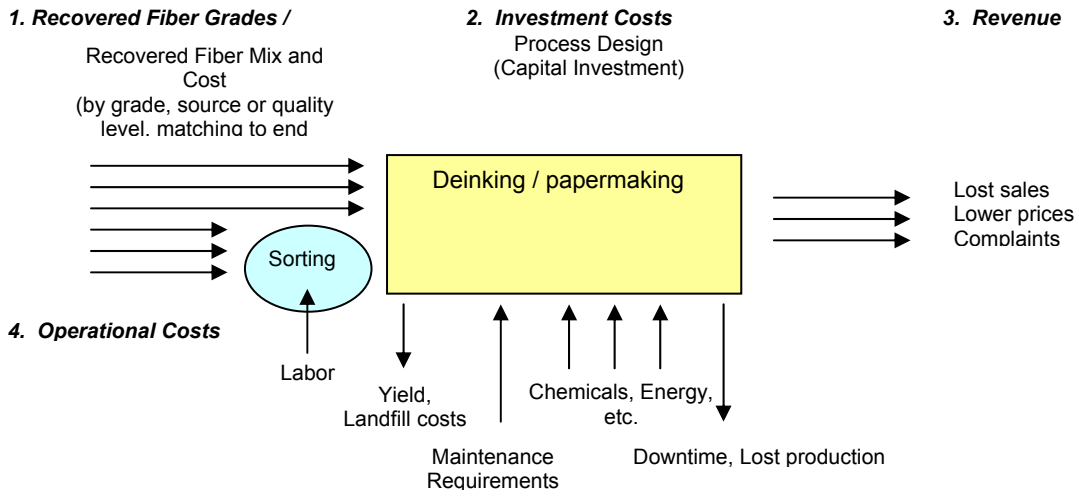


D. Discussion of Types of Cost Impacts Incurred by Mills

Production costs are impacted in four general ways as mills deal with different quality levels of recovered fiber:

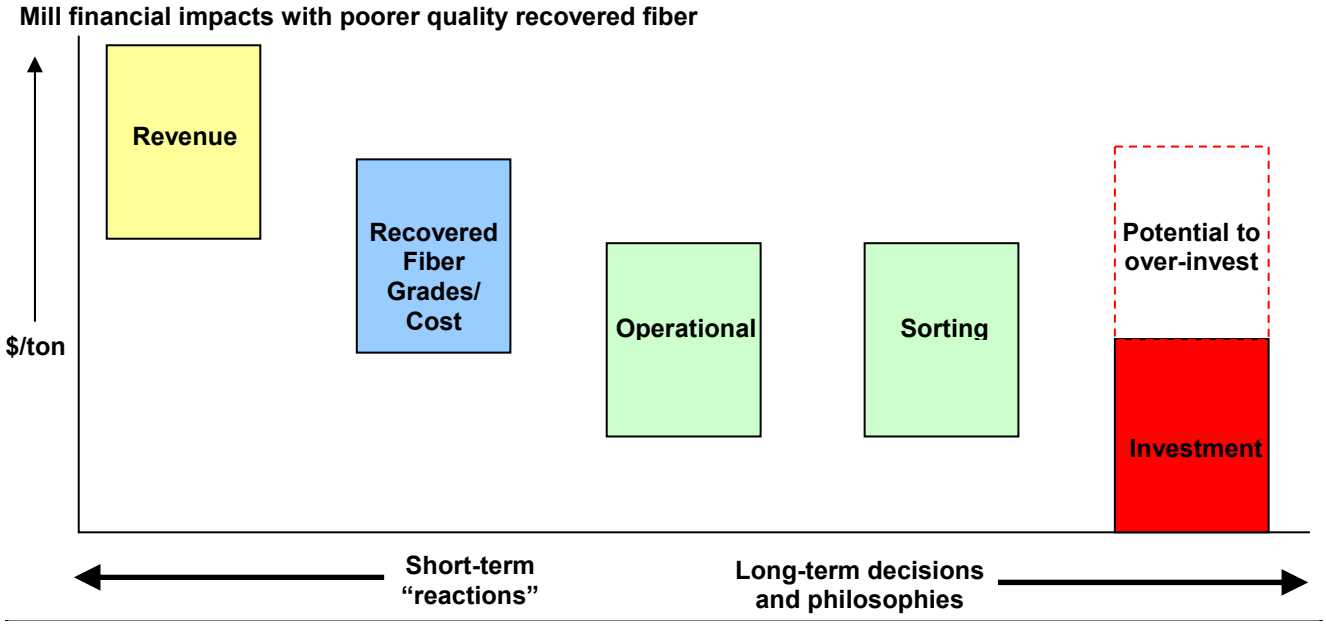
- recovered fiber grades / costs
- Investment costs
- Revenue
- Operational costs

Mills use a combination of approaches to optimize the effect of these costs as the quality of recovered fiber changes. The specific approach at each mill varies depending on the grades produced, recovered fiber availability, deinking process, etc.

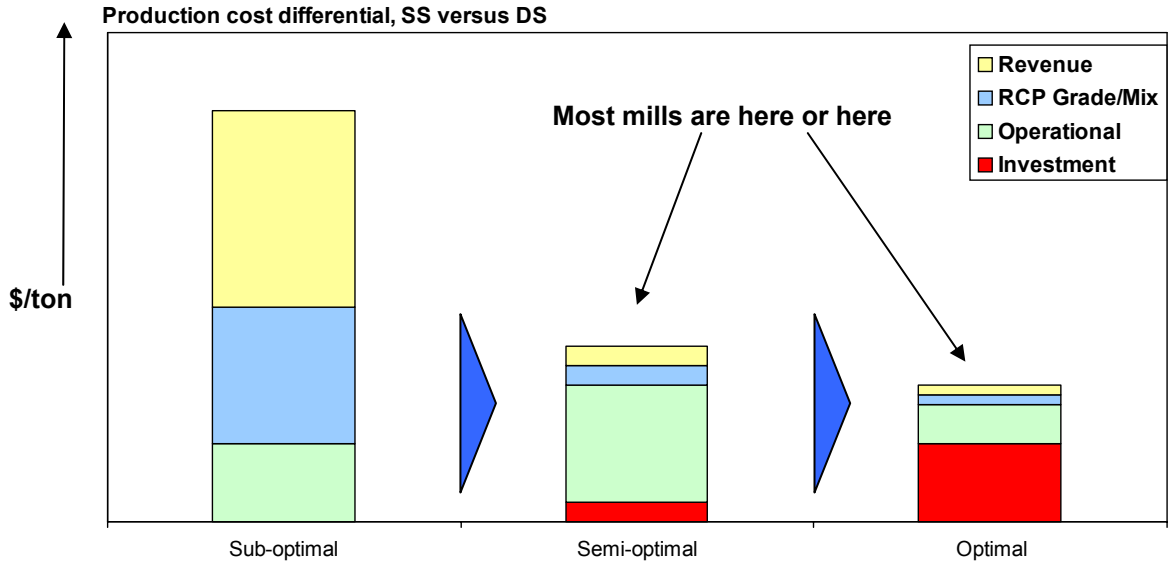


A certain hierarchy of these costs exists which allow mills to incorporate a variety of solutions to mitigate poorer quality recovered fiber. Since the impacts of one category could offset or eliminate those within another, mills learn to implement a variety of operational changes through time in order to optimize or minimize the negative cost impacts.

Generally, revenue impacts are the most expensive for a mill to take, and therefore usually the least preferred. Switching to higher quality (and cost) recovered fiber may return the mill to its "baseline" operations, but this too is viewed as being a short-term solution that is too expensive to maintain. Over the long-term, mills will make process and operational adjustments to minimize the cost of using a more expensive recovered fiber whenever possible. Long-term decisions also usually include some type of investment within the mill in order to use lower quality recovered fiber.



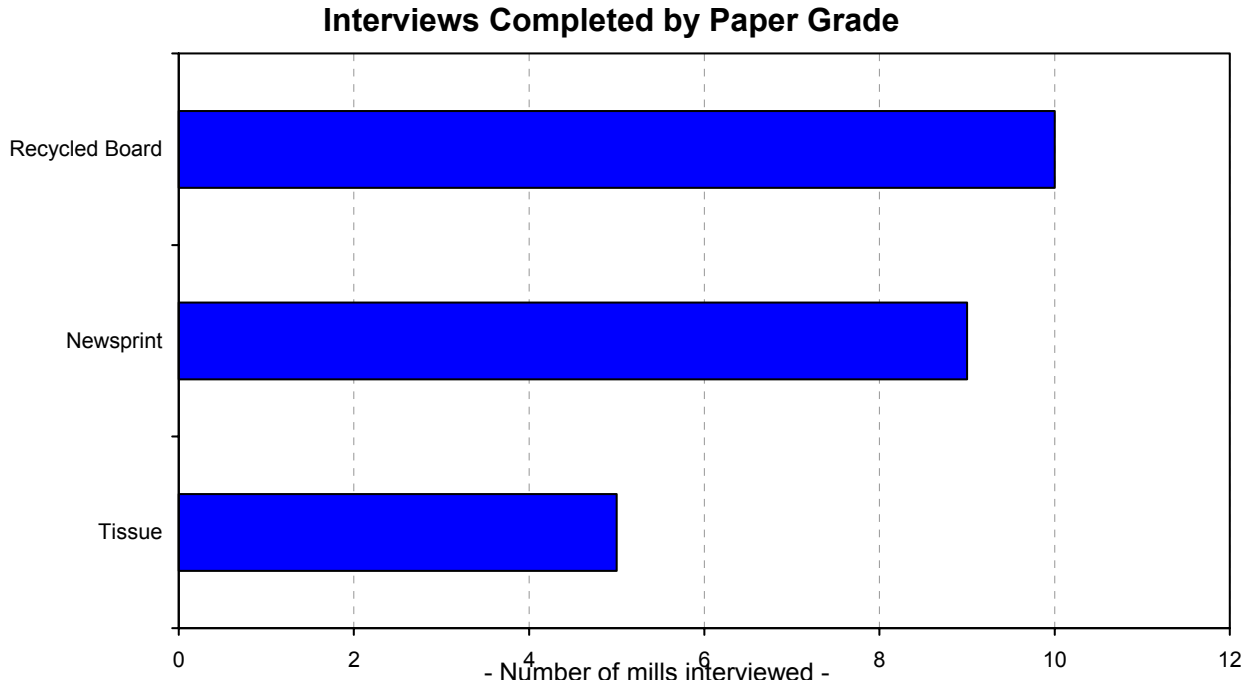
Through time, mills learn to adapt to SS and optimize their strategy to overcome quality differences in recovered fiber. When faced with the reality of steadily declining quality of recovered fiber, mills optimize their operating approach, including the need for investment, in order to minimize additional manufacturing costs. Due to the steady decline in recovered fiber quality of the past several years, many mills have already begun to learn how to optimize their operation in order to minimize additional costs. Through the course of interviews conducted in this analysis, mills were able to share their experiences with using different operating approaches to deal with lower quality recovered fiber. However, since most of these experiences are based on a gradual decline in recovered fiber quality or the shift from DS to SS for only a portion of their recovered fiber utilized, estimated impacts for a wholesale shift to SS are to a large degree speculative.



VII. MILLS / END-USER ANALYSIS: COST AND INTERVIEW RESULTS

A. Description of Mill Interview Sample

Three paper / paperboard grade segments – newsprint, tissue and recycled paperboard – were selected for analysis based on their relatively high use of ONP and RMP. A cross-section of major U.S. consuming mills of ONP and RMP within these segments was selected for interviews and analysis. Interviews were conducted with 24 mills, and 2 mills were visited for a "first-hand" observation of how operations are affected by deterioration in recovered fiber quality.



Interview results from recycled board and newsprint mills were generally consistent regarding the impact that SS, or "dirtier" fiber would have on their operations. These results provided a foundation from which to estimate effects on recycled board and newsprint mills. Estimating the potential impact SS would have on tissue mills proved much more difficult due to the low amount of residentially collected grades used relative to higher quality recovered fiber, as well as confidentiality concerns expressed by producers. For these reasons, the impact of SS on the tissue industry has been roughly estimated in a manner different than recycled board or newsprint, but consistent with the findings from within these two grades.

Mills within the interview sample are using a varying degree of SS fiber today. Hence, the approach used within this study was to ask mills to estimate how manufacturing costs would change given a switch from DS to SS fiber. A similar approach was employed for mills using a mix of DS and SS, in that mills were asked to estimate costs if the entire recovered fiber stream was composed of SS fiber.

Only one mill within the interview sample is using SS exclusively today. Some are using only DS or a combination of SS and DS, while others do not know the collection method used for their recovered fiber.

Table 4. Furnish Composition of Interview Sample

Source of Fiber for Interviewed Mills			
	Single Stream	Other	Unknown
Newsprint	29%	53%	18%
Recycled Board	10%	80%	10%

B. Qualitative Discussion of Mill Interview Results

Differences in mill configuration, grades produced and operating philosophy introduce significant differences when comparing cost impacts of increased contamination between mills. Since no two mills are designed nor operate identically, results for each mill are unique. Some of these differences include:

- Capacity
  - Downtime or lost production
  - Fixed and "semi-variable" annualized costs represented on "per ton" basis
- Fiber source
  - Percent recycled content and proportion of residential fiber used
  - Capability to substitute virgin fiber for recycled fiber
  - Design capacity versus utilization of fiber systems
- Mill configuration
  - Pulping technology (conventional batch, conventional continuous, drum)
  - De-trashing, screening and cleaning technologies
  - Deinking technology (washing and / or flotation)
  - Paper machine configurations
  - On-site warehousing available for recovered fiber
  - Utility services present at a mill (water, sewer, landfill)
  - Technical ages of equipment
- Paper/board grades produced
  - Physical characteristics (strength, brightness, cleanliness requirements)
- Management / operating philosophies
  - Fiber procurement
  - Sorting at mill
  - Capital

Mill Findings: Revenue Impacts

Most mills believe final product quality levels would need to be maintained at present levels or better. Adjustments would be necessary in other areas of the papermaking process to mitigate an increasing level of contaminants within the recovered fiber stream. For these mills, no impact would be seen on revenue.

Among mills that felt an impact would be seen in the revenue category, a few different reasons were cited, including:

- Some mills felt product prices could be impacted as a result of being forced to downgrade final product quality.
- Alternatively, a few mills might have to produce lowered value products.
- A portion of the interviewees believe that complaints would increase. Unclear to mills is at what point additional complaints or a degradation of quality would lead to lost business. These mills felt that quality could deteriorate below a certain threshold level, causing a loss of customers or orders.

Increased metal contamination is of particular concern within food-grade applications, however predicting this effect quantitatively became difficult for mills to do.

Mill Findings: Recovered Fiber Grade/Price Cost Impacts

Mills interviewees do not believe they benefit from the lower price for SS compared to DS of the same basic grade. Current recovered fiber pricing structure is based on established quality parameters. Furthermore, since mills pay delivery costs from the seller's dock, differences in freight costs can be significant for suppliers providing similar quality. Given transportation costs and other factors, recovered fiber prices do not appear to be highly responsive to quality variations.

Increasing the quality of wastepaper grades purchased and utilized within a mill is viewed as a short-term solution. Rather than "sweetening the furnish," long-term viability is believed to require additional investment to overcome lower quality. Such investment is related to the stock preparation (pulpers, screening / cleaning) area.

Mills with limited on-site warehousing do not have the ability to blend fiber of varying quality. The vast majority of mills accept fiber on a pass / fail basis, and use it almost immediately within their process. Minimal quantitative testing is done to incoming wastepaper, relying more on visual inspection for contaminants. A small handful of mills have instituted rigorous quality testing from which to judge supplier quality.

Suppliers of wastepaper are responsive to improving quality when pressed to do so by the mill. Before changing suppliers, mills tend to show patience in allowing a supplier to try to improve quality. Mills also report that there is significant variability in fiber quality observed for DS and SS, although few have empirical data to support this assertion.

Mill Findings: Operational Cost Impacts

Operational cost impacts fall into three broad categories: materials, labor and productivity. Mills expect a cost increase in more than one, but not necessarily all of these categories.

Materials

- Yield – increased contamination levels require increased rejects, directly increasing recovered fiber fiber consumption and cost.
- Landfill costs – increase proportionately with the higher level of rejects.

- Maintenance materials – primarily wear items such as screen baskets, pulper rotors and extraction plates, pump impellers, cleaner cones, pipes, valves, etc. This impact is difficult for mills to estimate accurately.
- Chemicals – pulping, deinking, bleaching or water treatment are the major areas expected to increase. Minimal to no impact is expected for many mills.
- Water usage and energy – minimal impact expected, except in cases where new equipment would need to be installed.

Labor

- Additional personnel – an increase in headcount due to personnel needed to sort and / or monitor incoming wastepaper.
- Overtime – required for maintenance or clean-up costs following a significant fiber-related operational event within the stock preparation area.
- Labor costs were found to increase for a very small proportion of the interview sample.

Productivity

- Costs within this category are associated with lost production due to fiber-related operational problems. These effects are mill-specific, depending on:
    - Range in lost production expected, including several mills expecting no lost production.
    - Costs are measured in terms of mill-specific contribution potential. (Contribution = Net sales – Variable costs)

Operational costs increase gradually with increasing prohibitives until some major event happens (i.e. several hours of fiber-related downtime or equipment failure.) Once an event like this occurs, costs can increase exponentially. Through the course of mill interviews, it became very difficult to estimate at what point (or quality level) these events might occur or what true costs would be associated with them.

Mill Findings: Investment Cost Impacts

Mills assume that recycled pulp quality provided to papermaking operations must remain constant, in spite of decreasing recovered fiber quality. Consequently, a pulping operation must adapt in several ways to provide consistent quality to papermaking operations. Lower quality fiber would be expected to warrant capital investment at several mills. All of the equipment suggested to be necessary is within the pulping and screening / cleaning areas.

Some producers have made investments within the last five years that position a mill to operate using lower quality fiber. Such investments include drum pulpers, modifications to existing pulpers, or additional screening / cleaning stages. Even considering these recent investments, manufacturing cost economics are still expected to worsen within other cost categories.

Investment in pulping technology is viewed by some producers as a double-edged sword. As mills upgrade equipment to process lower quality fiber, some interviewees think it could contribute to an overall decline in quality.

Investment costs within this analysis have been calculated on a "per ton" basis, assuming initial investment amounts estimated by mills participating in the analysis. These investment costs are comprised of two components within the cost modeling, including depreciation (initial investment, depreciated over 20 year life) and cost of capital (average net book value, 8% cost of capital).

C. Analysis of Mill Cost Impacts

Newsprint Producers

Through the course of seven mill interviews with producers of recycled-content newsprint, the manufacturing cost differential was estimated for mills using SS over DS fiber. This production differential captures the additional manufacturing costs incurred by mills assuming a 100% conversion from DS to SS. Estimated costs for the interview sample range form $3-11 per ton of ONP, with an average of $5/ton ONP.

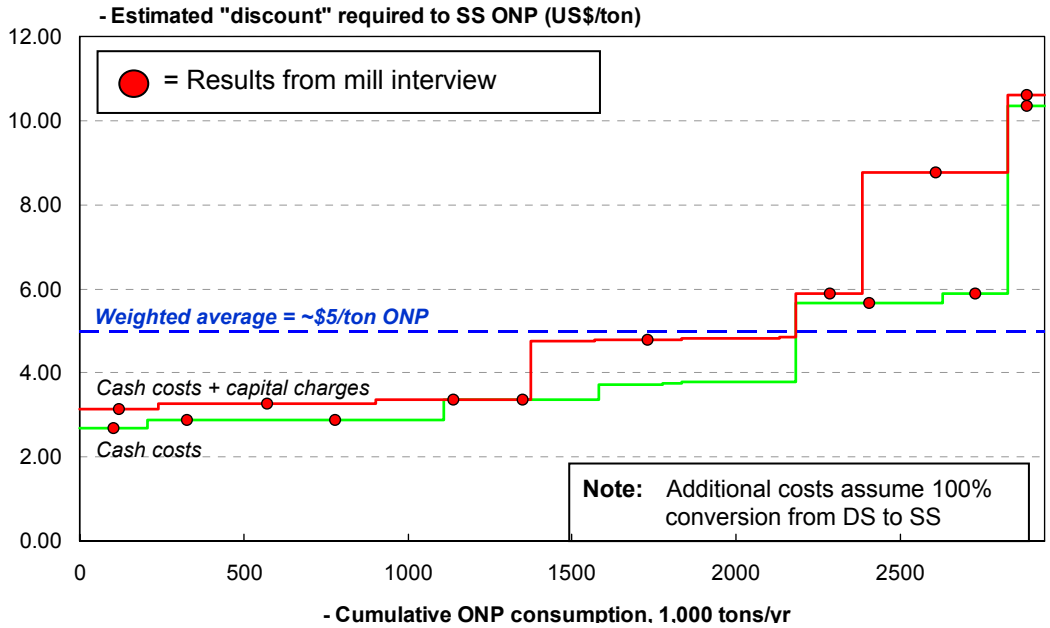
Table 5. Additional Newsprint Manufacturing Costs for SS over DS – Per ton of ONP

Newsprint Production Cost Differential (US$/ton ONP)			
	Industry Average	Interview Sample Low	Interview Sample High
RCP Grade/Mix	$0	N/A	N/A
Revenue	0.30	$0	$7.30
Operational	3.70	2.60	5.80
Investment	1.00	0	3.11
Total*	$5.00	$3.20	$10.60
*Note: Total low and high refer to mill totals of all cost categories. N/A = Not Applicable.			

These estimates were extrapolated across the entire U.S. recycled-content newsprint industry and are presented in the following cost / supply curve. The cost curves are summarized to a "cash" level, including recovered fiber grade / mix, revenue and operational impacts, and a full cost level which includes cash costs and estimated capital charges required for a 100% conversion from DS to SS.

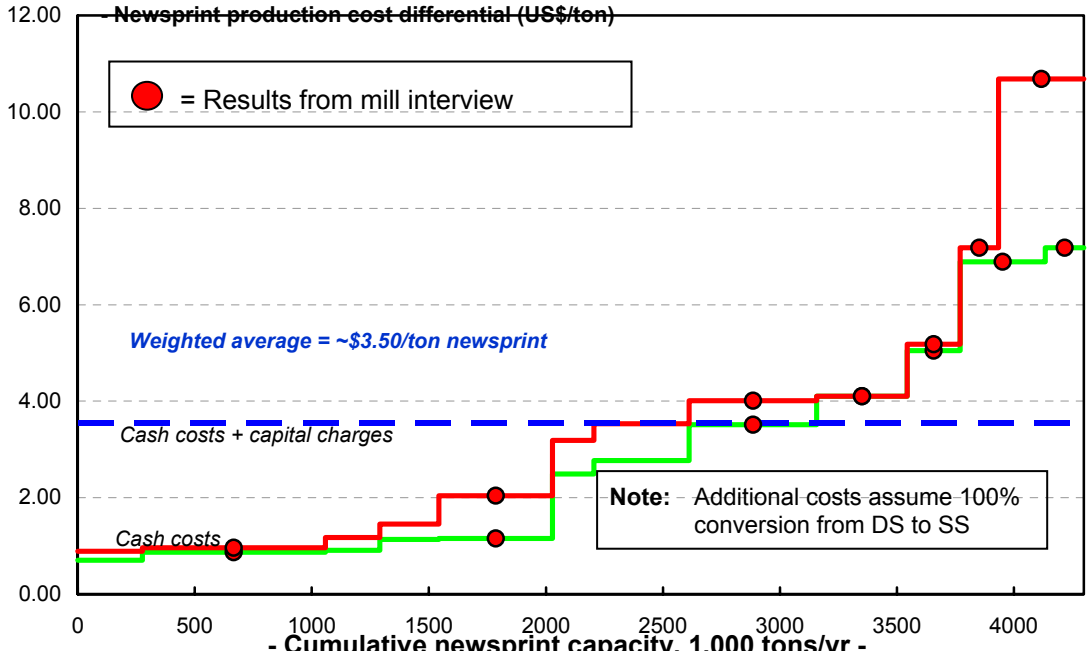
The weighted average "discount" depicted in the chart refers to the level at which SS would need to be priced lower than DS for mills to offset the additional costs they incur within their manufacturing operations.

Additional Newsprint Industry Costs for SS over DS – Per ton of ONP

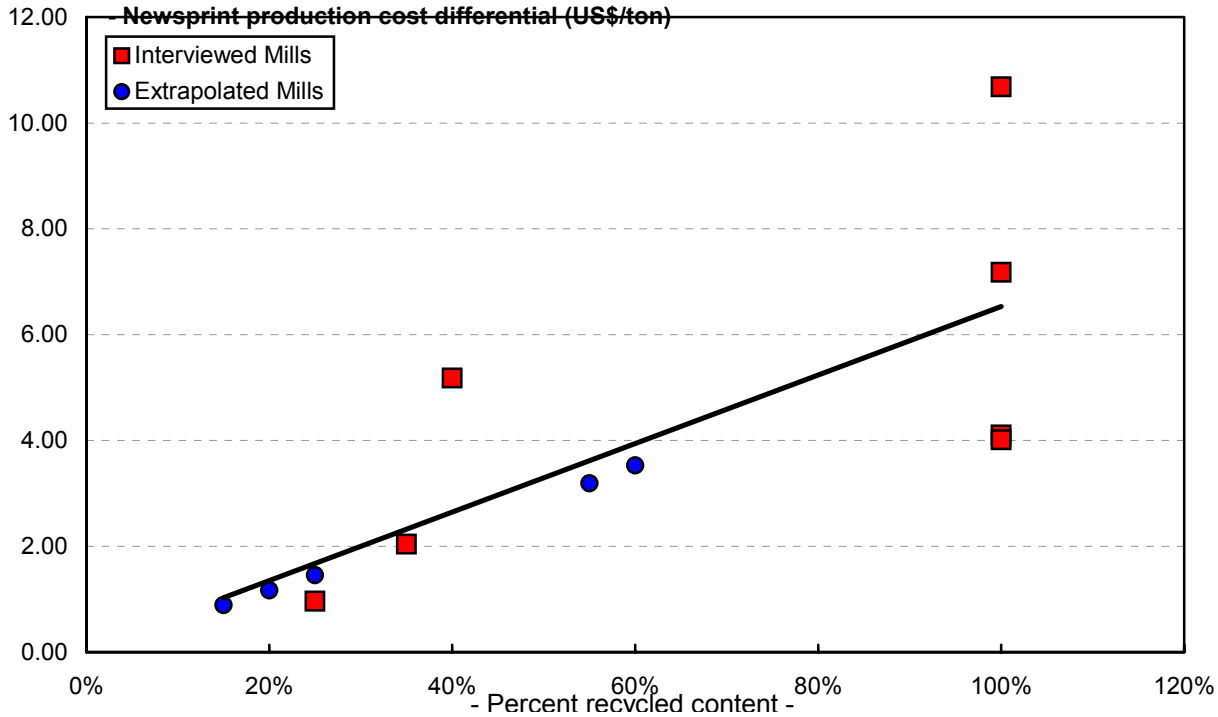


When additional costs to use SS over DS are measured per ton of product produced, the impact varies depending on the recycled content of the finished sheet. The estimated industry average of $3.50/ton newsprint applies to 4.3 million tons of annual capacity, compared to total U.S. newsprint capacity of 5.9 million tons.

Additional Newsprint Industry Costs for SS over DS – Per ton of Newsprint



Additional manufacturing costs incurred when mills use SS over DS show a high level of correlation between percent recycled content and costs measured per ton of newsprint produced. Hypothetically, the production cost differential to use SS if all production was 100% recycled would be approximately $6.50/ton of newsprint.



Recycled Board Producers

Through the course of nine mill interviews with producers of recycled board, the manufacturing cost differential was estimated for mills using SS over DS fiber. This production differential captures the additional manufacturing costs incurred by mills assuming a 100% conversion from DS to SS. Estimated costs for the interview sample range form $4-42/ton of ONP/RMP, with an average of $13/ton of ONP/RMP.

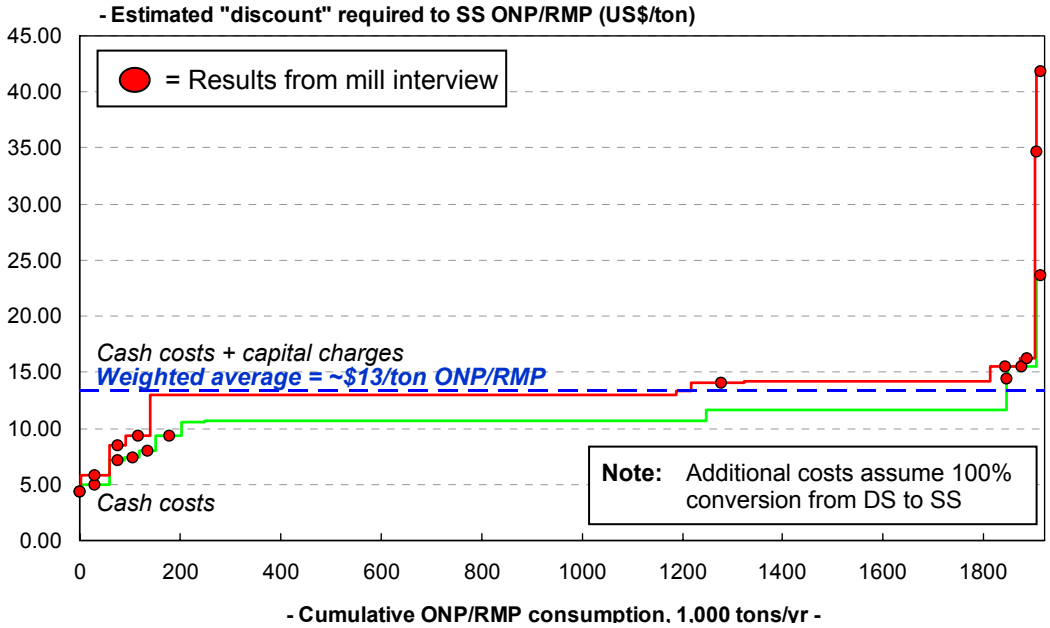
Table 6. Additional Recycled Board Manufacturing Costs for SS over DS – Per ton of ONP/RMP

Recycled Board Production Cost Differential (US$/ton ONP/RMP)			
	Industry Average	Interview Sample Low	Interview Sample High
RCP Grade/Mix	$0	N/A	N/A
Revenue	0.90	$0	$3.00
Operational	10.00	4.40	23.70
Investment	2.50	0	20.20
Total*	$13.40	$4.40	$41.90
*Note: Total low and high refer to mill totals of all cost categories. N/A = Not Applicable.			

These estimates were extrapolated across the entire U.S. recycled board industry and are presented in the following cost / supply curve. The cost curves are summarized to a "cash" level, including recovered fiber grade / mix, revenue and operational impacts, and a full cost level which includes cash costs and estimated capital charges required for a 100% conversion from DS to SS.

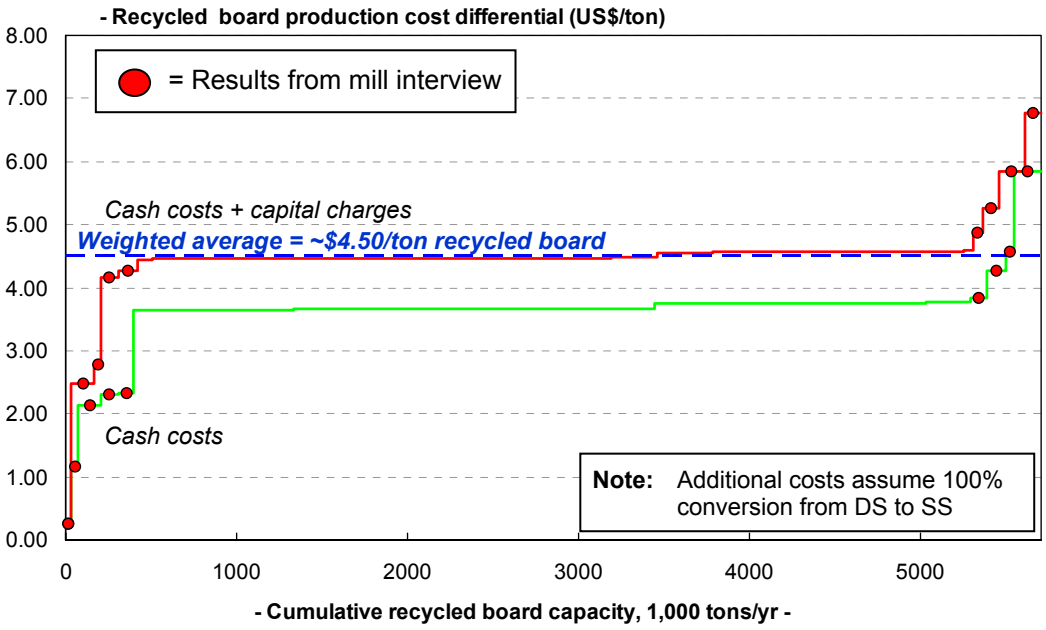
The following chart shows the incremental cost that a range of mills incur when using SS as opposed to DS recovered paper as a fiber source.

Additional Recycled Board Industry Costs for SS over DS – Per ton of ONP / RMP



When additional costs to use SS over DS are measured per ton of product produced, the impact varies depending on the amount of recycled fiber in the finished sheet coming from curbside collection programs, as opposed recovered fiber coming from other collection sources. Estimated additional manufacturing costs to use SS recovered fiber over DS are $4.50/ton recycled board.

Additional Recycled Board Industry Costs for SS over DS – Per ton of Recycled Board



D. Estimated SS Impact to U.S. Paper Industry

Assuming 100% conversion from DS to SS, the estimated annual impact to the U.S. paper industry would be roughly $50 million. This impact, when measured on the basis of finished paper or board, amounts to a manufacturing cost increase of roughly $3.50 to $4.50/ton with outliers above and below this "average."

	Level of Recovered Fiber Content	*ONP/RMP Used*	*Capacity (1000 st/a)*	*Cost Impact ($/st product)*	*Total Impact ($ per year)*
Recycled-Content News	56%	3,600	4,300	$3.50	$15 million
Recycled Board	100%	3,500	5,700	$4.50	$26 million
Tissue	51%	1,800	Estimated impact – difficult to measure within this study		$7 - $10 million
Other Grades	Varies	1,900			
Total		10,800			$48 - $51 million

Although difficult to measure within this study, limited interviews would suggest that the effects in tissue and other grades using ONP and RMP would be similar in many ways to those seen in the

newsprint and recycled board industry. Using AF&PA's statistical summary of recovered fiber consumption, the cost impact is estimated based on the consumption of ONP and mixed paper within these grade segments. Since mixed paper includes many grades outside of RMP, the residentially collected portion of mixed paper was assumed to be 2-5% for tissue, and 10-40% for other grades. These assumptions lead to the annual cost impact range of $7-10 million.

VIII. OVERALL RESULTS AND IMPLICATIONS

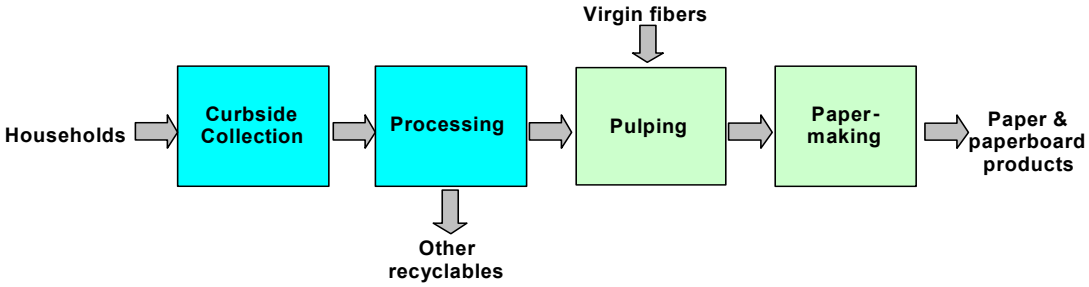
A. Comparison of Impacts Across the Three Stages

Single stream collection programs have a clear impact on all stages of the recycling process. The volume and per-ton cost differences are:

- An increase of 2-5 percentage points of community curbside recycling rates (20% increase in gross recycling tons collected).
- Net increase of 1-3 percentage points in community curbside recycling rates after removal of contaminants during processing.
- Further removal of contaminants at the mills reduces recovered fiber available by about 1%, based on the results of a previous AF&PA study.
- Costs of $10-20 per ton less to collect.
- Costs of $5-15 per ton more to process.
- Costs of $5-$13 per ton of recovered fiber more to address problems at the mills.

The figure below summarizes the results and shows that a net, system wide, cost of about $3 per ton of recovered fiber.

Net Cost Impact – Total Value Chain



Avg. Costs Differences by Value Chain Segment –US$/ton of ONP/RMP				
	Collection	Processing	Pulping / Papermaking	System Net
Cost **savings** with SS	**$15 (10-20)**			
Cost **increase** with SS		**$10 (5-15)**	**$8 (5-13)**	**$3 (0-8)**

B. Cost and Benefits Valuation across the Three Stages

Assuming that 6-7 million tons of recovered fiber from curbside is used at U.S. mills, total impacts for complete conversion to SS across the three stages are as follows:

- Communities save $90-105 million in paper related collection costs.
- Processing costs increase by about $60-70 million.
- The cost to mills increase $48-51 million.
- A net cost across the value chain of $18-$21 million. This includes savings for communities, but significant additional costs to processors and mills.

C. Summary

Single stream has been a controversial issue in recycling for several years. Significant commitments by waste haulers behind this system have increased the number of SS facilities and programs nationwide.

Single stream saves money at the curb (about $15/ton), but costs more at processing (about $10/ton) and mill stages (about $8/ton) for a net cost through the value chain of $3/ton. It is estimated there was a net increase of all materials recovered in curbside recycling programs of 1-3 percentage points, however a study conducted by R.W. Beck for the AF&PA also found that residues at the mill level increased.

Communities, with their focus on cost-cutting and collection, see savings and an increase in tons, providing a chance for budget-strapped cities to increase recycling rates and improve cost-effectiveness. Processors see increased costs; older facilities see increased residues, but investment in new facilities by these actors continues, and contamination at new facilities is more comparable with (and in some cases better than) older DS facilities.

Mills, which are finding it very difficult to earn their cost of capital and are facing increased global competition, see increased costs and gain no offsetting rewards, making their situation further challenging. On the other hand, haulers and processors may not be fully aware that SS increases mill costs and, therefore, have not taken steps to assure consistent high quality of SS materials.

Glossary

Dual Stream: (DS) Fiber and containers are placed in separate truck compartments.

Material Recovery Facilities: (MRF) Facility in which material collected for recycling is separated or processed into various streams for further use. Material which cannot be recycled or has no recycling value is also removed.

Old Newspaper: (ONP) ONP #6, #7, & #8 are defined by the Institute of Scrap Recycling Industries, Inc.[17] as follows:

ONP #6 News:

Consists of newspaper as typically generated from news drives and curb-side collections.

Prohibitive materials may not exceed.....1%

Total Outthrows may not exceed.....5%

ONP #7 News, Deink Quality:

Consists of sorted, fresh newspapers, not sunburned, containing not more than the normal percentage of rotogravure and colored sections. May contain magazines.

Prohibitive materials.....None permitted

Total Outthrows may not exceed..... ¼ of 1%

ONP #8 Special News Deink Quality:

Consists of sorted, fresh newspapers, not sunburned, free from magazines, white blank, pressroom over-issues, and paper other than news, containing not more than the normal percentage of rotogravure and colored sections. This grade must be tare-free.

Prohibitive materials.....None permitted

Total Outthrows may not exceed..... ¼ of 1%

Outthrows: Material which must be removed from paper delivered to a mill before the paper is recycled / repulped.

Modified Single Stream: (MSS) A single stream program in which glass is kept separate from fiber, or glass is not collected.

Prohibitives: Any materials which by their presence in a packing of paper stock, in excess of the specification amount allowed, will make the fiber unusable as the grade specified. Or, any materials that may be damaging to equipment.

Recovered Fiber: All forms of paper fiber collected for recycling.

Residential Mixed Paper: (RMP) Mixture of various qualities of paper collected from residential sources, including newsprint, magazines, corrugated and paperboard containers, and other grades. RMP is usually viewed as being of lower quality than most other forms of recycled fiber.

Residue: Material disposed of as trash after all recyclable material is sorted from the stream.

Single Stream: (SS) Fiber and *all* rigid containers commingled in the same compartment in the collection vehicle.

17 "Scrap Specifications Circular 2003," Institute of Scrap Recycling Inc., 2003.

AF&PA Recovered Fiber Quality Study Executive Summary

Methodology

R.W. Beck worked with AF&PA's Paper Recycling Group to organize and guide a fiber quality field study (Study) with mill companies by collecting and analyzing paper samples obtained from 60 U.S. curbside recycling programs. Eight companies participated in sampling paper at 13 locations using procedures defined by R. W. Beck. Each 250-350 lb. sample was sorted into 27 paper and prohibitives categories and weighed. A total of 235 usable samples were obtained, representing four source categories: Single-Stream ONP, Dual-Stream ONP, Single-Stream RMP, and Dual-Stream RMP. R. W. Beck statistically analyzed the data to determine the mean composition of materials in each category at a 90 percent confidence level.

Results

Single-Stream vs. Dual-Stream ONP

ONP from single-stream programs is different compared to ONP from dual-stream program to a measurable level of statistical significance. Single-stream ONP contained:

- More ONP (79.9% vs. 75.6%)
- Significantly less OCC (1.2% vs. 2.7%)
- Significantly less other recyclable paper (15.6% vs. 19.8%)

Single stream ONP contained a noticeably higher percentage of prohibitives (3.3% vs. 2.0%):

- Twice as much non-recyclable paper (0.8% vs. 0.4%)
- Over twice as much plastics, by weight (1.1% vs. 0.5%) and over three times the bag points (173.9 vs. 47.9);
- Almost 40 percent more metal (0.5% vs. 0.3%)
- Slightly less glass and fines (0.5% vs. 0.6%)
- Twice as much other prohibitives (0.4% vs. 0.2%)

While both ONP categories contained #6, #7 and #8 ONP samples, the single-stream ONP was predominantly #7 while the dual-stream ONP was predominantly #8. Neither the #7 nor #8 ONP single-stream or dual-stream material sampled met the ISRI specification for those grades.

Single Stream vs. Dual Stream RMP

Compared to dual-stream RMP, single stream RMP contained:

- Significantly less ONP (43.0% vs. 74.2%)
- More than twice as much OCC (25.5% vs. 12.3%)
- More than twice as much other recyclable paper (29.9% vs. 12.3%)

The single-stream RMP had more prohibitives than dual-stream RMP (1.8% vs. 1.1%):

- Over twice as much plastic, by weight (0.5% vs. 0.2%) and nearly twice as much by bag points (96.8vs. 58.1);
- Twice as much glass and fines (0.4% vs. 0.2%)
- The same amount of non-recyclable paper and metal (0.5% and 0.1%)
- Twice as much other prohibitives (0.2% vs. 0.1%)

Paper Recycling: Quality is Key to Long-Term Success

The U.S. paper industry has achieved great strides in its use of recovered paper. Domestic mills consumed 34.6 million tons of recovered paper in 2002, 59% more than they did in 1990. Moreover, they currently rely on recovered paper for 38% of their fiber needs, up from 27% in 1990.

But as impressive as these strides have been, significant further progress can be made, provided that conditions are favorable. That is why the paper industry recently increased its recovery goal from 50% to 55%.

The new goal can only be met if the industry has continued access to high quality recovered paper. Unfortunately, mills report that the quality of paper from curbside collection programs has declined during recent years. The deterioration is probably due to multiple factors, including tighter limits on the amount of money that communities can spend on educating their citizens about "Do's and Don'ts" of recycling.

Quality can also be significantly impacted by the manner in which the paper is collected. Placing all recyclables into one bin -- paper, metals, glass, and plastics—often results in cross-contamination that is difficult and costly to fix later in the process – i.e., at the MRF and mill stages.

A 2002 study conducted by R.W. Beck for AF&PA analyzed 235 recovered paper samples obtained from 60 U.S. curbside recycling programs. The study concluded that ONP from single-stream programs included 65% more prohibitives (3.3% versus 2.0%) when compared with ONP that came from dual stream programs.

Residential mixed papers (RMP) contained 64% more prohibitives (1.8% vs. 1.1%) when collected as part of a single stream program. Prohibitive materials, which include glass, plastics, and metals, can damage paper-making machinery, impair product quality, and, in the case of glass, injure workers.

The increased levels of prohibitives often associated with single-stream programs are costly to address. A recent study prepared for AF&PA by Jaakko Poyry Consulting (JP Consulting) and Skumatz Economic Research Associates (SERA) assessed the economics of curbside recycling on a system-wide basis.

The study found that costs were higher at the MRF and the paper mill when recovered paper came from single-stream programs. These additional costs more than offset the savings that single-stream programs provided at the collection stage. Measured on a system-wide basis, the study showed that costs were $0-8/ton higher in the case of single stream collection, with average per-ton incremental costs of $3/ton. The increased costs borne by paper mills—due to machine maintenance and damage, higher capital/operating costs, and increased landfill expenses associated with residues—range from $5-13/ton, with an average increment of $8/ton.

Cost increases of this magnitude can cause the economic balance to shift away from recycling, making it much more difficult for the industry to continue to expand its use of recovered paper. This is especially true since many recycling mills have been facing economic pressures during recent years. Indeed, 24 100% recycled paper/paperboard mills have permanently closed their doors since early 1998. Higher costs associated with reduced recovered paper quality may force additional recycled mills to close.

Other studies have shown that single stream may not be cost-effective after a full accounting has been performed. Assessing data spanning four neighborhoods (2,000 households) over a fourteen-month period, a study performed by Eureka Recycling concluded that single stream does not make economic sense for the City of Saint Paul, Minnesota.

The study concluded that, although more tons were collected under the single stream approach, this seeming benefit was more than offset by higher residual rates—i.e., more of what was collected was ultimately discarded. It also found that while single stream is less costly to operate, the cost differential was more than offset by lower revenue per ton and higher residual rates.

Is single stream really the correct answer for the long term? Collection costs may decline under single stream, but system-wide expenses increase. This makes recycling less viable and may lead to future reductions in recovered paper demand. Moreover, with single stream more residues need to be pulled out at the MRF and paper mill, which is expensive and results in more residues going to landfills.

In conclusion, the economics of recycling can only work if the recovered paper arriving at the mill is of good quality. And since quality begins at the point of collection, we urge local governments, haulers, and MRF owners to take the quality needs of their recovered fiber customers into account when organizing collection and processing programs for their communities.