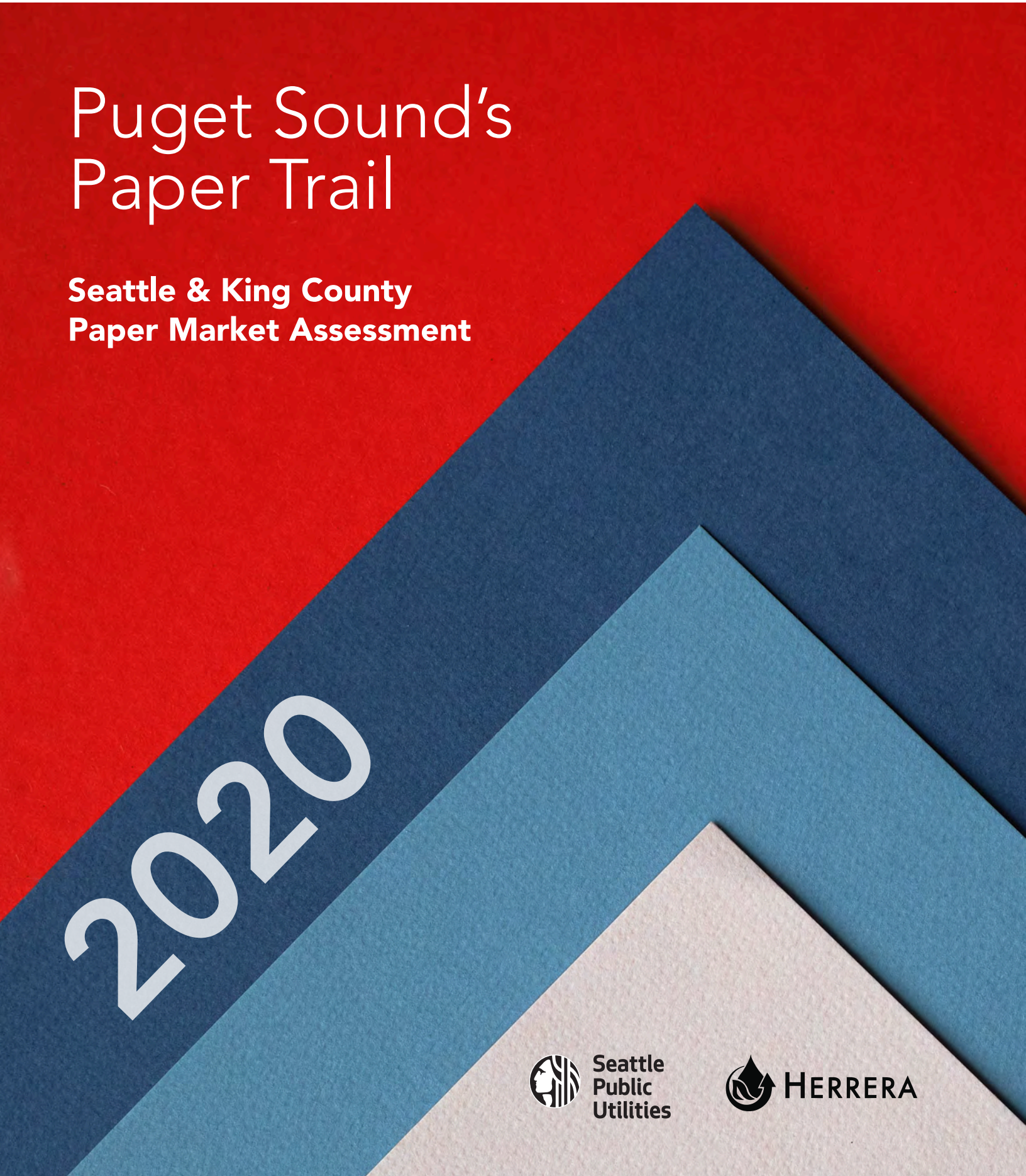
King County Linkup

Puget Sound's Paper Trail

Seattle & King County Paper Market Assessment



Seattle Public Utilities

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Executive Summary

King County is committed to Zero Waste of Resources, meaning that products and materials of value in the waste stream today, including paper products, should not be entering the landfill by 2030. As a result, in 2020, the King County Solid Waste Division's LinkUp program is placing added focus on supporting and developing the use of post-consumer recycled (PCR) paper in regionally produced paper products. This report summarizes data analysis on existing King County and Seattle PCR paper supply; research, and outreach to paper manufacturers and other relevant industry professionals to characterize existing paper market demand and conditions; and to research market approaches relevant to expanding end markets available for PCR paper.

Supply

Based on annual tons of mixed municipal solid waste disposed and collected for recycling, and waste composition data provided by King County Solid Waste Division, Seattle Public Utilities, and Washington Department of Ecology (Ecology), Table ES-1 shows estimated current and forecasted total and recoverable paper[1] supplies in recycling and in disposed waste for 2020-2040 for King County and Seattle, categorized as paper and cardboard.

Table ES-1. Estimated Total and Recoverable Tons of Paper Supplies in Recycling and Waste, 2020-2040

KING COUNTY AND SEATTLE - TOTAL	2020		2025		2030		2035		2040	
TOTAL	Low	High	Low	High	Low	High	Low	High	Low	High
Paper in Collected for Recycling										
Cardboard	340,000	410,000	390,000	480,000	440,000	540,000	510,000	620,000	590,000	720,000
Paper	250,000	290,000	280,000	350,000	320,000	390,000	370,000	450,000	420,000	520,000
Paper in Disposed Waste										
Cardboard	40,000	40,000	40,000	50,000	40,000	50,000	50,000	60,000	50,000	60,000
Paper	140,000	170,000	160,000	190,000	160,000	200,000	170,000	210,000	180,000	220,000
Subtotal	*770,000*	*910,000*	*870,000*	*1,070,000*	*960,000*	*1,180,000*	*1,100,000*	*1,340,000*	*1,240,000*	*1,520,000*
RECOVERABLE										
Recoverable Paper in Collected for Recycling										
Cardboard	340,000	410,000	390,000	480,000	440,000	540,000	510,000	620,000	590,000	720,000
Paper	240,000	280,000	280,000	340,000	310,000	380,000	370,000	440,000	420,000	510,000
Recoverable Paper in Disposed Waste										
Cardboard	40,000	40,000	40,000	50,000	40,000	50,000	40,000	50,000	50,000	60,000
Paper	70,000	80,000	80,000	90,000	70,000	90,000	70,000	100,000	80,000	110,000
Subtotal	*690,000*	*810,000*	*790,000*	*960,000*	*860,000*	*1,060,000*	*990,000*	*1,210,000*	*1,140,000*	*1,400,000*

While there are substantial changes taking place in packaging and other waste stream components that will alter the future composition and types of paper in the waste stream (e.g., decreases in Old Newspapers (ONP), increases in old corrugated cardboard/containers (OCC)

[1] Paper is defined as an aggregate of materials identified as paper by King County and Seattle in waste composition studies, including unwaxed OCC/kraft paper, plain corrugated cardboard, waxed corrugated cardboard, newsprint, newspaper, mixed low-grade paper, low-grade recyclable paper, high-grade paper, polycoat containers, aseptic containers, single-use food service compostable, grocery/shopping bags, phone books, shredded paper, other compostable paper, and other paper.

and paperboard), steady overall supplies for recovered paper purchasers over the last decade are likely to continue in the coming decades.

Processing Post-Consumer Recycled Fiber

No processors of recovered paper were interviewed during research for this report. However, King County's 2020 *Materials Recovery Facility Assessment: Recyclables Characterization* (King County 2020) indicated that most processors agree there is generally enough capacity at material recovery facilities (MRFs) today to process current volumes of all recyclables collected from customers in King County. The report also indicates all MRFs could increase existing processing capacity by approximately 160,000 tons annually (or 68 percent) for all recyclables. Upgrades including equipment modernization, technological increases, and/or larger facility footprints may be needed in the future to expand beyond existing capacity. For comparison, the supply projection developed for this report (for King County and Seattle) indicates a potential need for an additional 500,000+ tons per year of processing capacity across all processors and sectors by 2030 based on existing assumptions for increases in recycling rates and waste generation.

Demand (End-Markets)

With the advent of the China Sword policy starting in 2017 and the Blue Sky initiative beginning in 2018[2], export market demand and overall pricing plummeted, particularly for mixed paper and OCC. More recently, the global COVID-19 pandemic has caused large-scale closures of commercial and retail businesses, limited commercial collection of OCC and other high-grades of recovered paper, and reduced demand for those materials. Pricing for mixed paper and OCC have recently ticked up from historic lows between 2017 and the advent of COVID-19 as markets for PCR paper adjust to the new supply and demand balances. Demand for ONP and printing and writing papers is down, while demand for OCC is up; mixed paper is still volatile.

Locally, there continues to be stable domestic demand for recycled fiber to produce a wide variety of products, from pulp to containerboard and molded fiber to paper bags. Current quantities purchased by the businesses interviewed for this report totaled over 1.3 million tons. Pricing, and prices paid for recycled feedstock are very dynamic and dependent on relationships, contracts, grade, mix, and the market - particularly after the China import ban and as influenced by the COVID-19 pandemic. Sourcing occurs over a wide area radiating out from Washington and Oregon.

Overall, research indicates that despite the fluctuations and volatility in the paper market, demand for PCR fiber is expected to continue to rise. Several domestic manufacturing projects that will use PCR are still moving forward, including a large project locally. Demand is being

[2] In January 2018, China implemented a policy called the "National Sword" or "China Sword" that banned the importation of mixed paper (including newspaper), cardboard, and all scrap plastic. They also enacted a stringent 0.5 percent contaminant limit for other recyclables that essentially eliminated the primary market for these recyclable materials. In March of 2018, aspects of China's National Sword policy were named Blue Sky 2018. Blue Sky refers to the actions taken by China's General Administration of Customs from March through December of 2018 to prevent the illegal import of scrap materials banned by the National Sword policy including the crack down on falsified import documents. For more information, refer to the report by King County's Responsible Recycling Task Force.

driven by consumer preferences for sustainable packaging, plastic bag bans, national brand influences, and in some cases, government regulations.

Interviewees cited capacity utilization across a range, from 30 percent to 100 percent, with most indicating capacity in the 50-70 percent range. While consumer preference and domestic (including local) capacity is increasing, as well as other export markets, research and feedback indicates that excess (and growing) supply may not be met by an equivalent demand in the future. Two challenges to using PCR fiber stood out for the companies interviewed: contamination in the feedstock contributing to yield loss, reduction in capacity, equipment damage, increased production costs, and increased disposal costs; and product quality concerns mostly from the degraded strength of recycled fibers (shorter fiber length) compared to virgin fibers.

Market Development Approaches

Research suggests several policy, programmatic, or financial approaches would form a basic suite of approaches for successful market development for recovered paper, some of which are already in use. They include:

- Policy to guide market development
- Improve sorting and processing infrastructure
- Improve and target public education
- Improve and target corporate education
- Implement funding options and incentives
- Provide technical assistance
- Conduct research
- Emphasize economic development
- Establish and support partnerships
- Improve standards and specifications
- Incorporate market development into extended producer responsibility (EPR) use

Conclusions

Key conclusions from the data analysis, research, and industry interviews can best be summarized as follows:

- The evolution of recycling collection practices, consumer knowledge, supply-side emphasis, and changes in the domestic pulp and paper market led to lower quality standards, an increase in low quality recovered paper unsuitable for domestic consumption, and an over-reliance on China's export market.
- China's National Sword and Blue Sky initiative and the global COVID-19 pandemic have disrupted the recovered paper market substantially, drastically reducing and potentially eliminating China's export market as a destination for mixed paper; and placed emphasis on the viability of domestic markets.
- King County's and Seattle's total supply of recycled paper of all grades is expected to increase between now and 2040, assuming continued focus on diversion, recycling

program innovation, and public education, despite anticipated changes in waste stream components.

- Increased demand for PCR fiber and expansion of national and regional end-use capacities to use recovered paper (including mixed paper) are positive developments for the recovered paper market. However, there continues to be finite capability nationally or regionally to absorb all low-quality recovered paper previously and currently exported to overseas markets.
- Containerboard, paperboard, and some tissue manufacturing sectors could be potential opportunities in our region for increased domestic use of OCC, ONP, and mixed paper.
- Improving MRF and end-market capability to improve sorting and processing capabilities to produce higher quality/less contamination in paper should be an emphasis.
- Improving the quality of mixed paper recovery in all sectors and mixed paper recovery from the residential sector in particular, at their source, would increase the potential for MRF performance and would create opportunities for use of this material.
- A fully integrated market development / economic development effort for recovered paper markets (and others) is warranted by King County and Seattle, with multi-state regional coordination and state participation.

Recommendations

Recommendations for work items for King County to undertake in 2020 through 2022 and beyond to support the market development of recycled paper in the region include:

1. Fill in existing data gaps, including recycling composition, destination data and measurement of contamination by pursuing and supporting policies at local and state level which require secondary material market reporting.

2. Work to improve recovery quality and standards, including evaluating alternative collection methods.

3. Work with local MRFs and end-markets to improve sorting and processing technology to lower contamination levels, including making investments, chain of custody documentation, and a fiber MRF re-sorting facility or other processing infrastructure.

4. Facilitate partnerships and working groups to support local pulp and paper businesses and material applications.

5. Continue local and regionally synchronized education efforts, for both consumers, businesses, and government stakeholders.

6. Invest in policy development, integrating recycling end market development into economic development and equity and social justice efforts, through technical assistance, research, financial support, and education.

7. Continue to conduct appropriate market research, across the value chain and focusing on identifying opportunities, barriers, and infrastructure needs.

Introduction

King County is committed to Zero Waste of Resources, meaning that products and materials of value in the waste stream today, including paper products, should not be entering the landfill by 2030. King County also has recycling rate targets and is developing commitments around the circular economy and what it means for climate change and communities.

Due to recent changes in international markets for recycled materials, end-markets for recycled materials are in flux. More recently, the global COVID-19 pandemic has caused large-scale closures of commercial and retail businesses, limited commercial collection of OCC and other high-grades of recovered paper, and reduced demand for those materials. The Responsible Recycling Task Force (RRTF) developed recommendations for creating a coordinated approach to improving the entire recycling stream. Action Item 2C of the RRTF recommendations calls on the cities, the County, and private sector companies to provide resources that will help to establish and sustain markets for recyclable materials including paper.

As a result, in 2020, the King County Solid Waste Division's LinkUp program is placing added focus on supporting and developing the use of post-consumer recycled (PCR) paper in regionally produced paper products. LinkUp staff, through their consultant contract with C+C, asked Herrera to provide outreach to paper manufacturers and other relevant industry professionals to characterize existing paper market supply, demand, and conditions; and to research market approaches relevant to expanding end markets available for PCR paper.

This memorandum provides a summary of the outreach and research conducted, and recommendations that will be used to guide the work planning process for King County's efforts to bolster the regional market for recycled paper.

Methods

Data Review

Herrera was provided a range of existing and past paper collected for recycling data, disposed waste data, and waste composition data from King County Solid Waste Division, Seattle Public Utilities and Washington State Department of Ecology (Ecology), including:

1. King County Data Sources:
    - 2020 King County Materials Recovery Facility Assessment: Recyclables Characterization
    - 2019 Waste Characterization and Customer Survey Report
    - King County provided recycling information for 2015 and 2016
    - King County June 2020 Disposal Forecast
    - Recycling Destination Report for 2017 (Ecology)

2. Seattle Data Sources:
    - Outbound - Buyer – Destination, Inbound - Collector – Origin information for 2015-2019
    - Overall Paper Recycling Rate for the City of Seattle, 2000 - 2018
    - 2018 Waste Prevention and Recycling Report
    - 2014 Residential Waste Stream Composition Report
    - 2018 Self-Haul Waste Stream Composition Report
    - 2016 Commercial Waste Stream Composition Report
    - 2015 Residential Recycling Stream Composition Report

Interviews

Between August 15th and September 9th, Herrera contacted paper manufacturing/handling facility owners or managers to characterize processing methods, manufacturing infrastructure, existing use barriers or constraints, potential technological advancements, and existing or innovative uses for paper that may currently be, or could have the potential to, affect regional recycled paper markets. Questions for the interviews were developed by Herrera and refined by King County staff. Most or all questions were asked of those interviewed, though some did not answer all questions. Those not interviewed either declined to participate, did not respond after multiple attempts to reach them, or were no longer in business. The responses represent all successful attempts in the allotted time available.

The questions, list of interviewees, and target contact list is included in Appendix A. The list of 79 individuals were targeted from an initial list of 260, with the 20 interviewees shaded in light blue. Raw results are presented after the list of organizations, and below each question, including a notation for the number and percentage successfully interviewed of those contacted.

Research

Herrera also conducted a brief literature review of industry publications, previous King County research, and other available information to characterize current market conditions, processing capacity and market demand for recycled paper feedstock from the King County and Seattle systems. Research also focused on documenting successful policy, programmatic, or financial approaches in other regions that could be employed in King County to improve the use of recovered paper. Our findings are based on a combination of this research and the interviews conducted.

Supply of Post-Consumer Recycled Fiber

Herrera analyzed available supply data to prepare an estimate of recent and current paper recycling (2015-2019) available from within King County and from within the City of Seattle. Supply estimates are based on annual tons of mixed municipal solid waste disposed and collected for recycling, and waste composition data. Table 1 shows total and recoverable paper

supplies in recycling and in waste for 2015-2019 for King County and Seattle, categorized as paper and cardboard.

Table 1. Total and Recoverable Tons of Paper Supplies in Recycling and Waste, 2015-2019

KING COUNTY - TOTAL	*2015*	*2016*	*2017*	*2018*	*2019*
TOTAL					
Paper in Collected for Recycling					
Cardboard	164,667	150,686	191,273	183,878	181,091
Paper	203,083	170,367	148,772	143,021	140,853
Paper in Disposed Waste					
Cardboard	27,909	35,945	36,303	34,640	33,861
Paper	113,457	127,024	128,288	122,410	119,658
Subtotal	*509,116*	*484,022*	*504,637*	*483,949*	*475,463*
RECOVERABLE					
Recoverable Paper in Collected for Recycling					
Cardboard	164,667	150,686	191,273	183,878	181,091
Paper	203,083	170,367	145,347	139,728	*137,610*
Recoverable Paper in Disposed Waste					
Cardboard	26,112	33,365	33,697	32,153	31,430
Paper	50,820	61,987	62,604	59,735	58,392
Subtotal	*444,682*	*416,405*	*432,921*	*415,495*	*408,523*
SEATTLE - TOTAL	***2015***	***2016***	***2017***	***2018***	***2019***
TOTAL					
Paper in Collected for Recycling					
Cardboard	173,023	184,234	192,744	191,199	191,199
Paper	120,437	125,548	129,757	127,621	127,621
Paper in Disposed Waste					
Cardboard	8,632	8,713	9,412	9,416	9,416
Paper	45,588	45,839	46,651	46,841	46,841
Subtotal	*347,681*	*364,334*	*378,564*	*375,077*	*375,077*
RECOVERABLE					
Recoverable Paper in Collected for Recycling					
Cardboard	173,023	184,234	192,744	191,199	191,199
Paper	118,468	123,499	127,640	125,540	*125,540*
Recoverable Paper in Disposed Waste					
Cardboard	7,643	7,727	8,422	8,431	8,431
Paper	16,556	16,683	17,023	17,149	17,149
Subtotal	*315,691*	*332,143*	*345,829*	*342,319*	*342,319*

Usable/recoverable supplies in paper collected for recycling include unwaxed old corrugated cardboard (OCC)/Kraft paper, newspaper (ONP), mixed low-grade paper[3], phone books, and shredded paper; polycoat containers and aseptic containers are excluded due to current lack of regional end-use markets. Usable/recoverable paper supplies in disposed waste include plain

[3] May include insignificant quantities of polycoat containers and aseptic containers.

corrugated cardboard (OCC), newspaper (ONP), low-grade recyclable paper, high-grade paper, and grocery/shopping bags. Single-use food service compostable, other compostable paper, other paper, and waxed OCC are excluded. Complete estimates for both King County and Seattle, and in total, are provided in Appendix B.

Annual tons of waste disposed and recycled (and therefore, generation), as well as recycling quantities by material type and sector for 2015 and 2016, were provided by King County Solid Waste Division (KCSWD). King County waste composition data from 2019 were applied to 2015-2018 tons disposed to estimate quantities of total and recoverable paper in the waste stream. King County Total Generation and Total Recycling for 2017-2019 are based on Total Disposal/Total Generation ratio for 2016. The ratio of each paper category to Total Recycling in 2016 was applied to Total Recycling tonnage for 2017-2019 to generate category tonnage for those years.

Seattle waste composition data from the latest sector-specific waste characterization were applied to total disposal and total recycling data from 2015-2018 to estimate quantities of total and recoverable paper in the waste and recycling streams for 2015-2018. 2019 data was assumed to be the same as 2018.

Projected Supply

Herrera analyzed available supply data to prepare an estimate of future paper recycling available from within King County and from within the City of Seattle. Supply estimates are based on annual disposal and recycling tons, disposed tonnage projections[4], and waste composition data. Data sources and assumptions are included in Appendix B.

King County recycling data from 2016 and waste composition data from 2019 were applied to the April 2020 disposal forecast to estimate quantities of disposed and recycled paper through 2040. King County's overall recycling rate is assumed to increase by one percent each year. Seattle total disposal and total recycling data from 2015-2018 and waste composition data from the latest sector-specific waste characterization were applied to projected waste generation to estimate quantities of disposed and recycled paper through 2040. Seattle's overall generation and overall recycling rate are assumed to increase by one percent each year.

Certain gaps in available data required a series of assumptions to be made to complete projections. Assumptions are shown in Appendix B. All data are in tons by broad paper category and for King County exclude Seattle; all data for Seattle exclude King County.

Table 2 shows total and recoverable paper supplies in recycling and in waste for 2020-2040 in five-year increments for King County and Seattle, categorized as paper and cardboard. Complete annual estimates for both King County and Seattle, and in total, are provided in Appendix B.

[4] King County disposed waste projections are based on a regression model that forecasts future values for per capita disposal based on forecast values for population growth and economic activity (proxied by retail sales, price, and employment). Seattle uses a similar approach.

Table 2. Estimated Total and Recoverable Tons of Paper Supplies in Recycling and Waste, 2020-2040

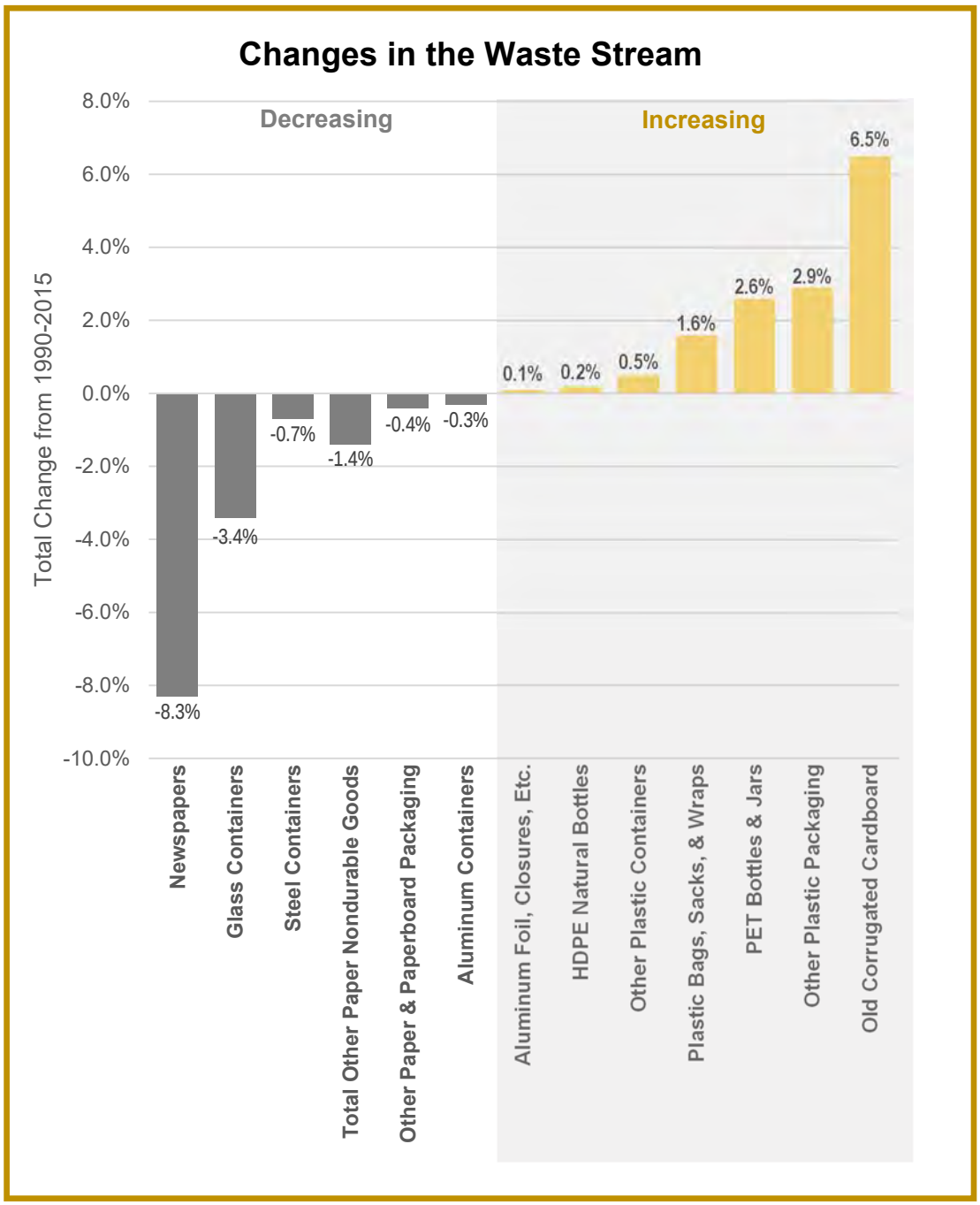
KING COUNTY - TOTAL	2020		2025		2030		2035		2040	
TOTAL	Low	High	Low	High	Low	High	Low	High	Low	High
Paper in Collected for Recycling										
Cardboard	160,000	200,000	200,000	240,000	230,000	280,000	270,000	330,000	330,000	400,000
Paper	130,000	150,000	150,000	190,000	180,000	220,000	210,000	260,000	250,000	310,000
Paper in Disposed Waste										
Cardboard	30,000	30,000	30,000	40,000	30,000	40,000	40,000	50,000	40,000	50,000
Paper	100,000	120,000	120,000	140,000	120,000	150,000	130,000	160,000	140,000	180,000
Subtotal	*420,000*	*500,000*	*500,000*	*610,000*	*560,000*	*690,000*	*650,000*	*800,000*	*760,000*	*940,000*
RECOVERABLE										
Recoverable Paper in Collected for Recycling										
Cardboard	160,000	200,000	200,000	240,000	230,000	280,000	270,000	330,000	330,000	400,000
Paper	120,000	140,000	150,000	180,000	170,000	210,000	210,000	250,000	250,000	300,000
Recoverable Paper in Disposed Waste										
Cardboard	30,000	30,000	30,000	40,000	30,000	40,000	30,000	40,000	40,000	50,000
Paper	50,000	60,000	60,000	70,000	60,000	70,000	60,000	80,000	70,000	90,000
Subtotal	*360,000*	*430,000*	*440,000*	*530,000*	*490,000*	*600,000*	*570,000*	*700,000*	*690,000*	*840,000*
SEATTLE - TOTAL	**2020**		**2025**		**2030**		**2035**		**2040**	
TOTAL	Low	High	Low	High	Low	High	Low	High	Low	High
Paper in Collected for Recycling										
Cardboard	180,000	210,000	190,000	240,000	210,000	260,000	240,000	290,000	260,000	320,000
Paper	120,000	140,000	130,000	160,000	140,000	170,000	160,000	190,000	170,000	210,000
Paper in Disposed Waste										
Cardboard	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Paper	40,000	50,000	40,000	50,000	40,000	50,000	40,000	50,000	40,000	40,000
Subtotal	*350,000*	*410,000*	*370,000*	*460,000*	*400,000*	*490,000*	*450,000*	*540,000*	*480,000*	*580,000*
RECOVERABLE										
Recoverable Paper in Collected for Recycling										
Cardboard	180,000	210,000	190,000	240,000	210,000	260,000	240,000	290,000	260,000	320,000
Paper	120,000	140,000	130,000	160,000	140,000	170,000	160,000	190,000	170,000	210,000
Recoverable Paper in Disposed Waste										
Cardboard	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Paper	20,000	20,000	20,000	20,000	10,000	20,000	10,000	20,000	10,000	20,000
Subtotal	*330,000*	*380,000*	*350,000*	*430,000*	*370,000*	*460,000*	*420,000*	*510,000*	*450,000*	*560,000*

One interviewee expressed their perception that after 2020, there would be a gross oversupply in scrap relative to demand, particularly for commodity (i.e., widely produced, non-specialized) grades.

Future Considerations

The estimates projected above through 2040 assume the waste stream composition stays the same as 2019. However, we know that there are substantial changes taking place in packaging and other waste stream components that will alter the composition and types of paper in the waste stream.

The 2020 Clean Materials Report (CSI 2020) provides an excellent summary of recent and current trends. The CSI report indicates that the increase in web-based news, information and shopping has reduced print, newspapers and phone books, while OCC and plastic packaging have grown (CSI 2020). Figure 1, below, summarizes these trends between 1990 and 2015.



Source: CSI 2020 and Resource Recycling Systems, Inc.

Figure 1. Changes in the Waste Stream

The trends are reflected in King County and Seattle historical data. King County's 2019 waste characterization report reports paper as 17.7 percent of the overall waste stream (153,518 tons), while in 2002 paper represents 23.2 percent (218,453 tons). Newspaper (0.3 percent (2,721 tons) in 2019 from 2.7 percent (25,362 tons) in 2002) follows the same trend. OCC shows a slight decrease from 4.6 percent (43,338 tons) in 2002 to 3.9 percent (33,860 tons) in

2019. That being said, OCC is still the largest part of the recycle stream by weight and percentage except for yard waste, and it's likely that trend is also consistent with the CSI report.

In 2018, paper market research by Seattle University students for KCSWD (Albers 2018) found the overall generation of waste categorized as paper had decreased slightly between 2006 and 2016 (from 84.1 million tons overall and 40 million tons of packaging in 2006 to 67.9 million tons overall and 39.1 million tons of packaging in 2016), with the decrease anticipated to continue. However, that study also indicates that recovery of packaging paper, which includes OCC, is projected to rise 0.5 percent annually from 2016 volumes through 2021. In fact, OCC has grown to represent about two-thirds of all global recovered paper collected, making it an important focus for many recyclers (ISRI 2020). As a result, despite decreases in ONP, increases in OCC and paperboard supplies indicate steady overall supplies for recovered paper purchasers over the last decade are likely to continue. Certainly, the anticipated waste and recovery volumes in King County and Seattle shown above indicate this likelihood[5].

Processing

Facilities processing paper generated from within King County and Seattle include:

- Recology's Materials Recovery Facility (MRF), Seattle.
- Republic's 3rd & Lander, Seattle.
- Waste Management's Cascade Recycling Center, Woodinville.
- Waste Management's JMK Fibers, Tacoma.
- International Paper, Kent.
- Sea-Dru-Nar, Seattle.
- Iron Mountain, Seattle.
- Waste Management - Recycle Northwest, Auburn.

No processors of recovered paper were interviewed during research for this report, with prioritization for interviews focused on end-market manufacturers; therefore no recent capacity information was obtained. However, King County's 2020 Materials Recovery Facility Assessment: Recyclables Characterization (King County 2020) indicated that most processors agree there is generally enough capacity at MRFs today to process current volumes of recyclables collected from customers in King County.

All MRFs suggested they could increase processing capacity by adding more processing shifts, and that current MRF operations have the potential to process additional material – on the order of 160,000 tons annually. However, the processors interviewed for that report also indicated that upgrades are needed in the future to expand beyond existing capacity, and to modernize and keep pace with the changing recycling stream; additional future capacity increases may require technological increases (e.g., optical sorting and screens) or larger facility footprints. All would require substantial capital investments (King County 2020). For comparison, the supply

[5] Modeling changes in potential composition into the future projection is beyond the scope of this analysis.

projection developed for this report (King County and Seattle) indicates a potential need for an additional 500,000+ tons per year of processing capacity (from approximately 1.4 million tons collected for recycling in 2020 to 1.9 million tons in 2030) across all materials, processors, and sectors by 2030 with existing assumptions for increases in recycling rates and waste generation. See Appendix B for detailed projections.

There is ample evidence locally that increased quality requirements (see Demand section) have forced processors to slow down sorting lines to try to meet higher standards, lessening capacity and forcing them to upgrade or consider upgrading equipment to clean up paper supplies. The Institute of Scrap Recycling Industries (ISRI) reports that many processors believe the new demand for high quality recovered paper is permanent, which has or will justify equipment investments (ISRI 2020).

Demand (End-Markets)

Market Overview

Recovered paper flows and pricing in the Pacific Northwest, and the Puget Sound area specifically, are driven by a combination of local factors amidst a national and global framework. Local factors include existing user-supplier relationships, paper grade, whether paper is collected as mixed recyclables or is source-separated (i.e., contamination level) and further, the source sector - commercial versus residential. National and global factors include export demand (particularly from China and Asia), domestic end-user demand, grade and quality standards, general economic conditions, consumer preferences for recycled content, and finally, the COVID-19 pandemic.

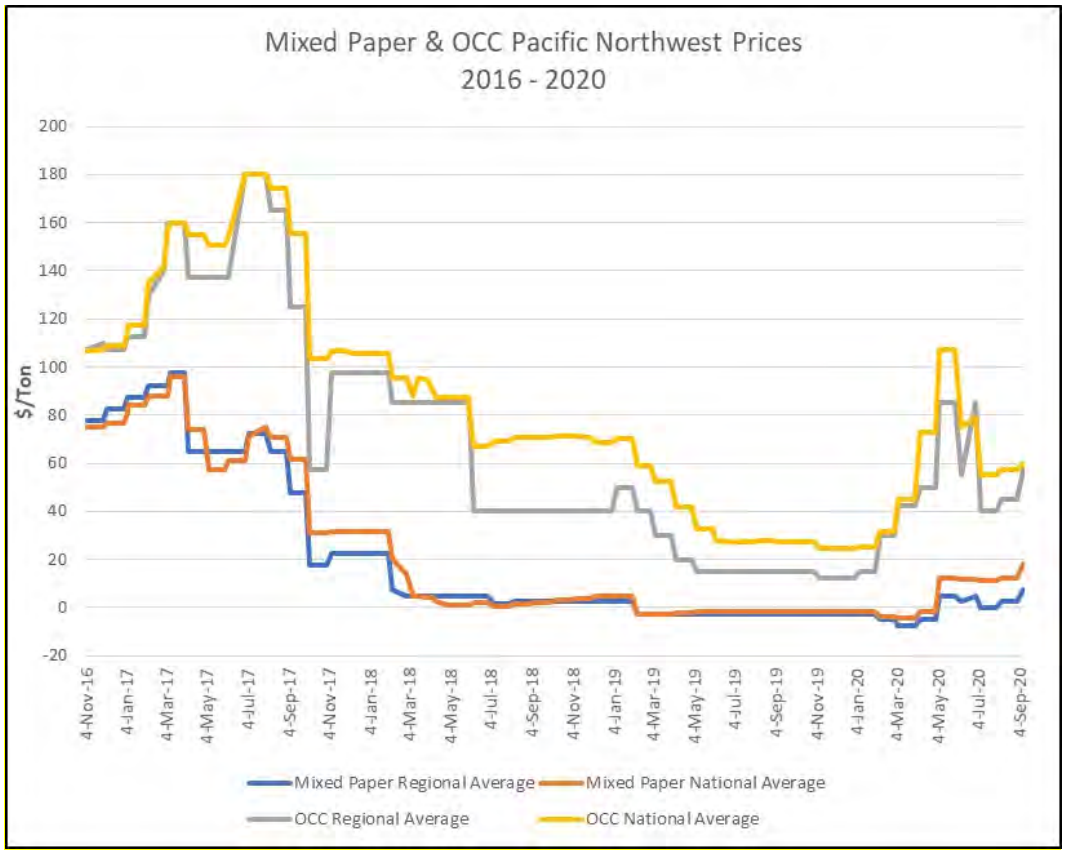
Leading up to 2017, several trends affected recycled paper markets:

- A shift toward online shopping and increased use of electronic documents, leading to growing overall demand for packaging and tissue papers, and a reduction in demand for printing and writing paper in the last decade.
- An increase in the perceived benefits of recycled materials and an increase in consumer demand for recycled products, and consequently an increase in the price of recycled fiber.
- More aggressive municipal recycling policies regarding recovered material.
- A reduction in the quality of recovered material due to a combination of single-stream recycling, inconsistent acceptable material policies and resulting consumer outreach and messaging, and a shift in consumer habits toward wish-cycling or throwing everything in the bin and hoping it will be recycled.
- High levels of export to China for mixed paper, OCC, and other paper grades U.S. mills were not taking. (MIT 2018)

China National Sword

With the advent of the China Sword policy starting in 2017, export market demand and overall pricing plummeted, particularly for mixed paper and OCC. According to the Institute of Scrap Recycling Industries (ISRI), in 2016, about three out of every four tons of exported OCC were shipped to China. In 2019, only four out of every 10 tons of exported OCC were shipped to China. In 2021, that number likely will be zero, and about 4 to 5 million tons of North American OCC that were exported to China in 2020 will need to find new markets (ISRI 2020). Drops in mixed paper shipments were even more pronounced. The RRTF estimated that about 14.7 percent of all 2017 King County and Seattle recyclables were affected by the import ban, including 117,000 tons of mixed paper and 88,000 tons of ONP. These export factors continue to affect overall demand and pricing and will likely intensify.

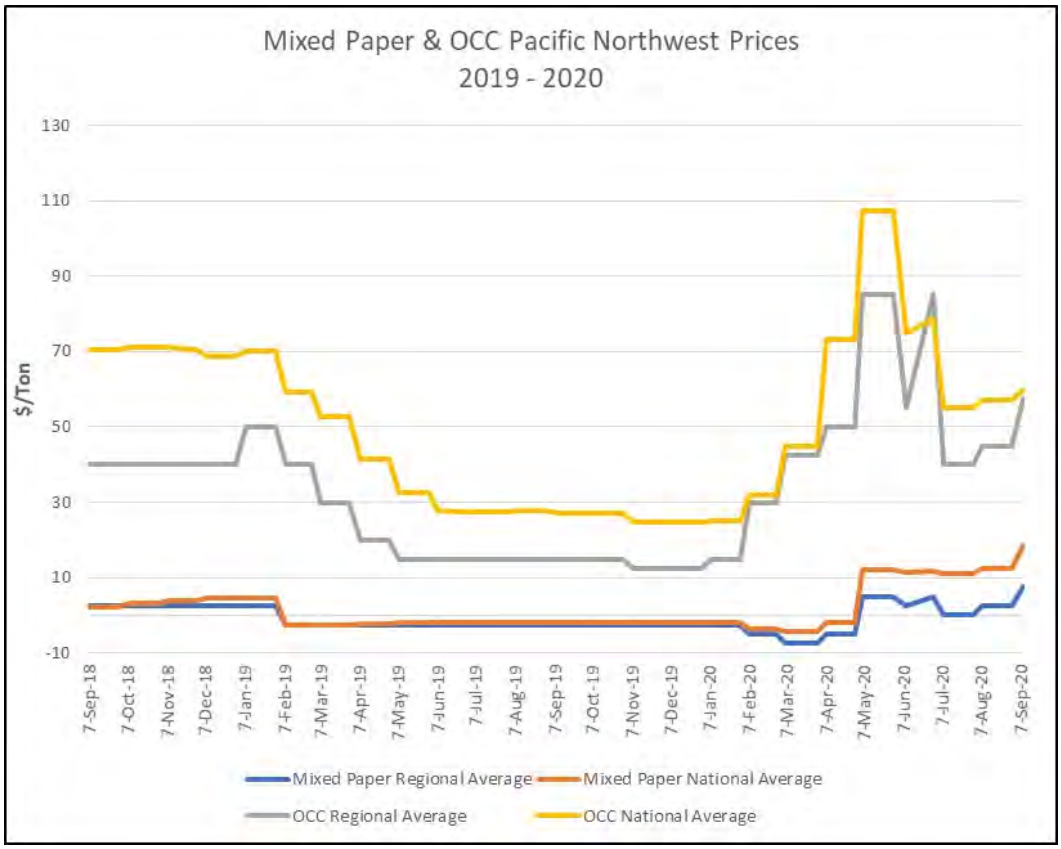
Figure 2 shows recent and historical prices for Pacific Northwest recovered paper (2016 – 2020) for OCC and mixed paper.



Source: Recycling Markets Limited

Figure 2. Pacific Northwest Prices – Mixed Paper & OCC, 2016 – 2020

Between March of 2017 and March of 2019, prices for mixed paper dropped from a high of $97 per ton (Freight on Board (FOB) seller)[6] to negative $2.50 per ton. Between March of 2017 and March of 2019, prices for OCC dropped from a high of $160 per ton (FOB seller) to $30 per ton. During the same period between March of 2017 and March of 2019, though continuing to be down overall, market conditions were slightly better for OCC. Online sales have benefited from the pandemic, increasing demand for OCC. However, residential recovery of OCC (where more OCC is now ending up) is generally at a lower level than in the commercial sector, so collections have been unable to make up for the reduction in commercial recovery (WasteExpo 2020).



Source: Recycling Markets Limited

Figure 3. Pacific Northwest Prices – Mixed Paper & OCC, 2019 – 2020

As a result, the reduction in commercial generation combined with increased demand from online sales helped to raise OCC prices slightly in the spring of 2020 (RISI 2020). Pricing dropped off in July and August and appears stable as of mid-September. In the longer term, even as commercial recovery comes back after the pandemic, the OCC supply likely will tighten

[6] FOB is a common shipping term to indicate whether the seller or buyer will pay shipping/trucking expenses. In addition, FOB also represents the agreement between a seller and a buyer to determine when the ownership of goods is transferred. So, FOB Seller indicates the buyer is paying shipping, whereas FOB (or Freight Along Side [FAS]) Buyer indicates the Seller is paying shipping. Since transportation costs are pivotal in recycling pricing, it is an important caveat when stating recycled material pricing.

because residential collection of this material is weak by comparison to commercial collection (WasteExpo 2020). Figure 3 shows pricing since September 2018. In addition, there have been some higher prices from the China export market due to higher import quotas, though once that demand subsides, prices will likely go back down. Overall, Exports of recovered fiber declined 24 percent in the first half of 2020 compared with the same period in 2019; domestic demand increased by 6 percent (RISI 2020).

Other Export Markets

Despite the curtailment of mixed paper demand from China, other export markets continue to purchase material from the U.S. India has taken up some of the recovered mixed paper purchases left by China, purchasing triple the volume of this material than it did in 2018 and 2019. (RISI 2020).

Other Asian countries are also increasing their purchases of recovered fiber, including Indonesia, South Korea, Malaysia, Taiwan, Thailand and Vietnam. These countries have added about 5.5 million metric tons of containerboard capacity in recent years to supply China's containerboard needs. (ISRI 2020). Continued export to this range of countries is likely to be a part of the mix for the foreseeable future for material from King County and Seattle, though it continues to raise equity and environmental justice concerns.

Other Market Trends

Other market trends noted from Herrera's research and interviews includes:

- ONP generation in the U.S. has been declining since 2005, as has ONP demand, and is likely to continue to decline. ONP largely has become an export grade.
- Mixed paper supply continues to be in excess of demand, though when OCC prices are up, mills tend to seek more mixed paper. The higher percentage of OCC in mixed paper also makes it more attractive to the mills (RISI 2020).

Current Demand

ISRI reports that current paper demand trends include:

- Newsprint demand declined 47 percent between 2010 and 2019.
- Printing and writing paper demand declined 21 percent between 2010 and 2019.
- Containerboard demand increased by 17 percent between 2010 and 2019.
- Boxboard demand increased 5 percent between 2010 and 2019.
- Tissue demand increased 34 percent between 2010 and 2019 (ISRI 2020), though one local interviewee said that COVID-19 is affecting the recycled material supply, and they recently witnessed the crash of the tissue market from COVID-19. Orders were cancelled due to a shortage of white recycled material. They were estimating price reductions in the future as a result.

Comments by several interviewees supported the perception that demand was increasing domestically. ISRI also reported that the global paper industry is being supplied by about 60

percent recycled fiber, which could grow in the future with increasing consumer preference for recovered fiber (ISRI 2020).

Market Participation

Locally, there continues to be stable domestic demand for recycled fiber. Most interviewees surveyed indicated use of PCR paper in their product manufacturing, with ranges from “a very small portion” up to 100 percent, and one pointing to the specifications provided by customers. Responses included both primary manufacturers buying feedstock, and secondary manufacturers buying finished paper. Some interviewees indicated the use of both virgin and recycled fiber, including post-industrial scraps from box plants. One interviewee indicated they were in the process of converting to the use of recycled fiber.

The grades mentioned most by interviewees included mixed paper, OCC (“a lot of pressure on the brown fiber part of the market”), ONP (“getting harder to find”), sorted office paper (SOP), and office/hard pack. One interviewee mentioned using a recovered OCC/mixed paper blend and magazine grade. There was a general preference for commercially sourced material versus residentially sourced material.

Among the products made by the businesses interviewed, interviewee cited the following:

- Tree free papers. Post-industrial cotton fibers.
- Printing and writing and book paper.
- Natural kraft package material (light weight). Third machine is making a mix of printing and writing grades.
- Unbleached softwood kraft pulp, liner board medium, some numbers of specialty kraft papers.
- Tissue product, towels, napkins etc.
- Various sizes of paper bags primarily used in retail grocery stores.
- Twist ties in various shapes and sizes used for bunching up leafy greens.
- Paperboard, paper for carpet core, brown trays/boxes, and construction paper.
- Edge protectors
- Newsprint and some bags.
- Finished corrugated boxes.
- Containerboard (virgin and with recycled content).
- Box partitions and tube converting (inside rolls used for large paper rolls).
- Pulp.
- Various bags and food containers.
- Molded fiber products for furniture packaging, nursery trays, and especially wine packaging.
- Folding cartons and boxes.
- Industrial grade products from finished paper such as wraps for pallets for customers who do not use plastic wrap.

Of those interviewees that do not use PCR fiber, several said it was due to costs, product quality, or feedstock contamination. One indicated they were testing capacity to use recycled fiber. One indicated that because their products carry Forest Stewardship Council (FSC) certification, they would not use PCR fiber unless their customers pushed for it.

Paper Carryout Bags

Several interviewees indicated they produced paper carryout bags. All those that indicated they produced paper carryout bags use PCR content, with content ranging from 30 percent to 100 percent. One interviewee said none of the products have specifications for recycled content, but they use it because it is the most economical fiber source available. Some indicated that they experienced limits on the percentage of recycled fiber they could use (i.e., up to 40 percent) before strength was compromised, though several mentioned the ability to go to 100 percent from their current fraction. One manufacturer indicated they mixed post-consumer fiber with residual sawdust to maintain strength properties.

In March 2020, the Washington Legislature and Governor Inslee established Chapter 70A.530 of the Revised Code of Washington (RCW). The law prohibits the use of single-use plastic carryout bags; requires a pass-through charge on recycled content paper carryout bags and reusable carryout bags made of film plastic, kept by retailers, to encourage shoppers to bring their own reusable carryout bags; and requires that paper carryout bags provided by a retail establishment contain a minimum of 40 percent postconsumer recycled content and reusable carryout bags made of film plastic ultimately contain a minimum of 20 percent post-consumer recycled content. The law is a clear example of policy that helps market development.

Generally, plastic bag bans decrease demand for plastic carryout bags and increase demand for paper carryout bags, with or without a fee. To counteract that increased demand, use of a fee on paper bags helps to diminish the switch from plastic to paper and incentivizes the use of reusable bags over any type of single-use bag, and helps grocers/retailers cover their increased costs of the more expensive paper bags.

The recycled content requirement will likely create market demand for PCR as paper carryout bag demand increases in Washington. With a plastic bag ban that includes a paper bag fee, demand for paper carryout bags is likely to increase less than it otherwise would with a plastic bag ban without a fee on paper bags. One interviewee indicated that their company does not support any fees on paper bags because of the potential to reduce paper bag demand. They said there is a lack of bag converting facilities – a key shortage in the supply chain. After 30 years of retail moving to plastic bags, the paper bag converting facilities have been closing domestically. While many plastic bags are made outside the U.S., paper bags are typically made domestically. It's likely that carryout bag policies that emphasize banning single-use plastics, while keeping recycled-content and recyclable paper bags as an option, would help to increase demand for recovered fiber for that purpose and incentivize investment in the supply chain. Still, the interviewee indicated that given that some are increasing fees on paper bags and some want to ban paper bags entirely, they do not want to invest in manufacturing capacity for bags in the short term. Without knowing the long-term demand, companies will not make the large investments required for converting facilities.

Current Demand Quantities

Current quantities of all recycled fiber purchased by the businesses interviewed totaled over 1.3 million tons. Several large buyers cited 200,000 to more than 400,000 tons annually across their northwest facilities. Some responses specified air dry short tons (ADST) which would translate

to fewer tons of post-consumer fiber when moisture is factored in. The mix of OCC, mixed paper, and other paper grades was not cited to break out the quantity provided.

Additional research showed that one local manufacturer is sourcing about 12,000 tons of post-consumer mixed paper, mostly from Portland due to its superior quality. They expanded their purchases from the Puget Sound area and British Columbia in the first half of 2019 to 144,000 air dry short tons and in the second half to 300,000 air dry short tons. The expansion came with quality issues (see the Challenges/Barriers section).

Sourcing Process/Pricing

Interviewees indicated that their recycled fiber sourcing process includes focusing on fiber sources that are consistent, provide the best quality for total delivered cost, and sometimes cost outweighs other factors. Quantities of PCR purchased and the timing of those purchases correlate with manufacturing need according to customer demand. One respondent indicated that purchasing is yield related (their percentage of feedstock that reaches final production after initial processing), so they may need to buy more when yield is down. One respondent explained that who they buy from depends on paper mill dynamics and which suppliers align with their timing. They typically work with about six providers of recycled fiber; some customers will specify certain levels of PCR fiber, which narrows who they can buy from. The sophistication of the sourcing process is variable, though one interviewee described a process that included bale sampling for contaminants and tracking product quality from recycled fiber source through production to individual buyers. The higher the quality of paper being produced (i.e., bright white), the higher the standard for contamination and homogeneity of feedstock.

Pricing, and prices paid for recycled feedstock are very dynamic and dependent on relationships, contracts, grade, mix, transportation costs, and the market, particularly after the China import ban and as influenced by the COVID-19 pandemic. Prices reported by interviewees generally correlate with the prices cited in the Market Overview section and range from $0 per ton to $140 per ton (FOB Seller), with recent pricing relatively stable.

Some interviewees noted that prices had been generally increasing over the past year, but that the very recent trend was down (again) and were paying about $80 to $100 more per ton to purchase OCC than East Coast purchasers. Some anticipated that pricing for ONP would increase due to decreasing supplies. Some anticipated pricing for mixed paper and OCC to continue to trend down or stay depressed in the near term (next few quarters), and that trends were now more market-driven while still within the context of China's impact on the market. One large buyer mentioned that the Resource Information Systems Inc. (RISI) pulp and paper pricing index and other industry indexes provide guidance on what they pay for PCR. Several interviewees indicated that pricing had never been negative for them, but some did take material (likely mixed paper) at $0 per ton at the start of China's National Sword in 2017 and are still paid to receive it. One interviewee mentioned the negative impact of tariffs on pricing.

Northwest material users purchase their feedstocks from a wide area. Many of the interviewees cited their sourcing geography as the northwest in general, with specific focus on Washington (King and Pierce counties were mentioned specifically), Oregon, British Columbia/Canada, or "as close as possible to the mill." One interviewee indicated sourcing within the region helps to

manage cost, but they also balance that with quality and consistency of supply. Several others mentioned Alberta, Edmonton, Idaho, Utah, Colorado, Nevada, Ohio, California, Montana, and Wyoming. Several interviewees mentioned purchasing "nationwide," "anywhere in North America," and "anywhere" because not enough was available locally [presumably of the correct grade and quality]. Responses about the reliability of the supply were variable, with some saying there is lots of supply to choose from and others saying it is not easy but not difficult to maintain a continuous supply. As China's demand for recovered paper subsides, domestic markets are becoming more volatile, and several mentioned their desire to address domestic supply chain issues (quality and quantity reliability).

The standards and specifications used by the interviewees varied widely. Some cited standard publication or industry-standard specifications (e.g., ISRI) requirements by grade, or Paper Stock specs); some indicated their suppliers knew their needs specifically regarding contamination limits. Many interviewees rely on internal programs that make known their desire to purchase from suppliers who minimize contamination (e.g., less than 3-5 percent targeted, depending on price), and track quality to communicate with suppliers. At least one indicated they ranked suppliers for quality and select based on least contamination. One large buyer indicated that variability in recyclable collection from market to market contributes to the inconsistency in supply. Knowing and having good relationships with their suppliers helps them with consistency of supply and managing the supply chain, but it remains an issue. Contaminants mentioned included color, garbage, plastic, non-fiber, and moisture. Several mentioned they specifically avoid any curbside material due to contamination. More discussion on this topic appears under Challenges/Barriers, below.

Manufacturing Process

Manufacturing processes vary widely for the various products produced, though some similarities exist across platforms. Many interviewees mentioned they use some or all of the following equipment to further process their recycled fiber:

- Screens to remove tape, plastic, containers, bottles, and other larger contaminants.
- De-inking
- Cleaners to remove sand, grit, metals; a reverse cleaner for light contaminants like Styrofoam
- Hydrocyclones
- Magnets to remove metals

Most product manufacturers also employ pulping and/or re-pulping as part of de-contaminating and production before completing the process to form specific products. Two respondents indicated they did not do additional processing and only removed baling wire prior to moving material into their pulper – a key reason they track and ensure material quality.

A common consideration voiced by interviewees is the notion of pulper yield – the percentage of feedstock that makes it into the final pulp product after decontamination and any associated production losses. The higher the contamination of incoming fiber supplies, the lower the yield

and the higher the resulting product costs and disposal costs. One respondent indicated that small changes in contamination can have significant impacts on yield.

During an April meeting of the Washington Recycling Steering Committee (WARSC), a representative of North Pacific Paper Company (NORPAC) described the challenges to pulper yield when using residential mixed paper. They indicated that the company had experienced a drop in pulper yield from about 85 percent in the first half of 2019 to about 71 percent in the second half after expanding their use of mixed paper. Their sourcing area for mixed paper in the second half of the year included: 20 percent from Washington; 60 percent from Oregon; 12 percent from British Columbia, and 8 percent from Idaho. They also noted that Oregon MRFs typically have less glass (due to Oregon's Bottle Bill and common source-segregated glass collection practice) and less non-fiber than Washington MRFs (WARSC 2020). Further, the company expects to spend over $4 million per year to dispose of non-fiber waste from mixed paper (WARSC 2020). More discussion on this topic appears under Challenges/Barriers, below.

While three sectors, containerboard, paperboard, and tissue (specifically primarily the away-from-home segment of the tissue sector - commercial and industrial products that serve markets such as hospitals, restaurants, schools, businesses and other institutions), all currently use mixed paper, the potential of individual product sectors to incorporate more mixed paper is significantly different.

The paperboard sector is segmented between different recycled grades of products. There are only a few U.S. paperboard mills that produce products made mixing both virgin and recycled fiber. The rest of the mills produce products made of either 100 percent recycled fiber or 100 percent virgin fiber. The industry has communicated that 0 percent-recycled and 100 percent-recycled converted products are actually very different in terms of their uses and that they do not compete for the same type of demand.

For example, there is a limit to using recycled fiber in the products for food containers due to performance and aesthetic qualities. Increasing the use of mixed paper mostly results in replacing other lower grades such as boxboard cuttings or ONP rather than replacing the use of virgin fiber.

The tissue sector (primarily the away-from-home sector) also has limited room to take additional mixed paper. The average recycled content of the tissue-primarily away product is already very high, up to 90 percent and its total production volume is only about 6 percent of the production volume of containerboard in 2016. Unless there is a decrease in demand from tissue-primarily home products and an increase in demand from tissue-primarily away products, there is only limited room to increase the recycled content in the tissue-primarily away products.

The containerboard sector used about 1.4 million short tons of mixed paper in 2016. However, a significant portion was consumed by mills only producing 100 percent of recycled product (recycled mills). Opportunities to increase the use of mixed paper in the containerboard sector include substituting it for virgin fiber or higher yield OCC grades, subject to the critical technical constraints of these mills and specifications of the finished products. (MIT 2018)

Challenges/Barriers

Two challenges to using PCR fiber stood out for the companies interviewed: contamination and product quality:

- Contamination in the feedstock contributes to yield loss (see above), reduces capacity, harms equipment, increases production costs, and increases disposal costs. Several interviewees targeted single-stream collection methods as the primary source of the issue and suggested that better consumer education, source separation, multi-bin collection (or at least glass separately), alternative collection schedules, or better sorting at MRFs would be helpful.

  Another interviewee cited their ability to consistently secure quality fiber as their biggest challenge, with specific focus on consumer awareness, and the vast inconsistencies in what is accepted market to market that adds to the confusion.

- Product quality concerns arise mostly from the degraded strength of recycled fibers (shorter fiber length) compared to virgin fibers, according to several interviewees. They indicated that there is a limit to the number of times fiber can be recycled before quality decreases too much. Some interviewees mentioned using a combination of post-industrial material to dilute the contaminated mixed paper material.

Other challenges mentioned by interviewees and revealed in research include:

- Maintaining high production with lower-quality mixed paper (OCC was preferred by this interviewee to maintain capacity).
- Inconsistent supplies and prices of PCR fiber,
- Tariffs,
- Environmental, water, and air quality/greenhouse gas requirements, though one interviewee suggested that increased regulations/requirements or consumer demand could drive demand for recycled content products.
- Lack of availability of ONP,
- Using old newspaper makes a product that is harder to print on.
- Lack of suitable end markets for paper milk and juice cartons; aseptic cartons.
- Polychlorinated biphenyls (PCBs) in post-consumer waste from the ink. One interviewee said their company had invested $10 millionm in water treatment.

Future Demand

Overall, our research indicates that despite the fluctuations and volatility in the paper market, demand for PCR fiber will continue to rise. Several domestic projects are still moving forward, including:

- Crossroads Paper is expected to begin operations of a paper mill in Utah to consume OCC and residential mixed paper to make boxes by the second quarter of 2022.

- NORPAC in Longview is pursuing financing to expand their capacity to consume mixed paper by more than 600,000 tons per year. Material would be sourced outside the northwest after the region's capacity for on-spec material is exhausted. They cautioned that if mixed paper contamination levels remained as they are now, it would force the company to spend $8 to $10 million per year on waste disposal, and that could significantly alter the economics of the project.
- McKinley Paper is investing over $6 million in the old Nippon Paper Industries plant in Port Angeles to manufacture containerboard and packaging-grade brown paper using only recycled OCC. Its goal is to manufacture 300,000 tons of containerboard annually.
- Other significant new domestic capacity is coming online in the next five years to consume OCC and mixed paper: an additional 1.2 million tons of OCC and mixed paper combined in 2020; an additional 350,000 tons per year of OCC capacity at Packaging Corporation of America in Wallula in 2020-21; 1.9 million tons in 2021; 0.3 million tons in 2022; and 0.6 million tons in 2023. These numbers include the NORPAC project, and three are speculative and may not materialize.
- With China's outright ban on recovered fiber imports anticipated in 2021, Nine Dragons has announced plans to produce recovered fiber (RCF) pulp in the U.S. for shipment to its board mills in China.

Most interviewees agreed and suggested that demand for PCR fiber had been and would continue to increase, with the second most indicating it would stay the same. One interviewee concurred with the expected increase in future PCR demand and indicated also that there would always be a need for virgin fiber. There was no clear consensus on the time period for the demand increase. No interviewees suggested demand was declining and one cited a high degree of uncertainty for future demand. Several reasons were cited: consumer demand; bans on expanded polystyrene packaging; and whether new recycled content minimum laws would act to increase demand.

Some interviewees suggested that brands could have an influence on demand for PCR fiber, mentioning Home Depot and Walmart as examples of brands requesting recycled content products. Several expressed confidence in general about continued future demand and strong markets, with a focus on consumer interest on both use of recycled fiber and recyclability of products. One responder indicated they were "100 percent confident in the voluntary approach" except for toilet paper – demand remains strong for toilet paper that is softer and stronger than an increase in PCR can provide. One interviewee suggested if not from brand actions (which tend to take longer), government action could provide a quicker social impact on a shorter timeframe. Finally, one interview expressed the opinion that brand action was not necessary. They said what is driving demand is the cost savings over virgin pulp (which can vary from under $500 to over $1,000 per ton), if it can be processed and decontaminated. They thought that in the containerboard industry, additional regulations would not change the cost savings incentive.

Capacity

Regarding the use of recycled content, interviewees cited capacity utilization across a range, from 30 percent to 100 percent recycled content, with most indicating capacity in the 50-70 percent range and the ability to increase use of PCR. Planned additional local capacity is indicated in the previous section.

A 2018 study conducted by the Massachusetts Institute of Technology (MIT 2018), working with the American Forest & Paper Association (AF&PA), quantified the volume of recovered fiber potentially affected by the China import policy, and identified which U.S. manufacturing sectors could theoretically consume additional recovered fiber that would otherwise be exported to China. Their conclusion was that if all sectors (containerboard, paperboard, tissue, printing and writing papers, and non-China exports) maximized their consumption of recovered paper, there would still be an oversupply on the order of nine million tons annually using 2018 conditions.

So, while consumer preference and domestic (including local) capacity is increasing, as well as other export markets, it is prudent to say that excess (and growing) supply may not be met by an equivalent demand with the status quo and given the challenges cited.

Added Infrastructure/Investments

Generally, increasing the use of PCR fiber, particularly mixed paper, would require additional cleaning equipment at many manufacturer sites, or just general equipment updates. Some interviewees suggested their facilities would require large investments, while others suggested more constrained investments (or none at all), while others did not know and did not speculate. One interviewee indicated that one of the best investments is in new technologies for infrastructure that increase recyclability or improve the ability to capture materials that currently are not being captured.

Equipment mentioned included: wastewater treatment; screening equipment; pulpers for removing poly-coated film from paper. No respondents indicated a value or cost of investments that could be required. Several indicated that they were self-funded and corporate strategies dictated when and where investments were made. One mill indicated it was asking for funding for machine upgrades to process recyclable materials and that it would pay for itself very quickly, an indication of adequate demand, lower risk, and favorable market conditions. At least one interviewee said they would love to see more government grants or business mechanisms that support the types of investments that may be necessary. The interviewee acknowledged the difficulty in providing public capital to private corporations, pointing to the perception that most funding in the state now goes toward public programs or collection infrastructure. Another interviewee indicated they see partnerships as a valuable and effective way to fund initiatives and bring different capabilities to the table to build and/or deploy solutions.

Future Activities, Potential Technological Advancements, R&D, Emerging Markets and Opportunities

Our brief research indicates a few technological advancements, research and development, and emerging markets may produce genuine opportunity in the recycled paper market.

The Clean Materials Report cited new optical scanning and automation technologies for MRFs may be able to dramatically drop contamination rates. With new technologies installed at its largest MRF in San Francisco, Recology is achieving contamination rates at or close to Chinese requirements in its paper bales (CSI 2020). The company reports it is in the process of installing and optimizing its system in Seattle, but uncertainty about paper raises the risk for the large investment. They indicated a large recovered paper mill in Oregon or Washington would help. (CSI 2020) Certainly, the NORPAC facility, including the investment discussed earlier, could be a viable outlet for on-spec material produced by Recology's updated process.

Other noteworthy advancements that provide a model for future industry adaptation that could continue to drive demand for recycled fiber include:

- Georgia-Pacific is now accepting mixed paper bales that contain single-use polyethylene-coated paper cups at its recycled paper mills in Green Bay, Wisconsin, and Muskogee, Oklahoma after working with the Foodservice Packaging Institute, Starbucks, and McDonalds. The facilities have installed repulping technology and recycled fiber processing equipment. (RT 2020)
- Georgia-Pacific is also now manufacturing paper-padded mailers for use in e-commerce applications; the mailer is fully recyclable in most curbside programs and is made from Kraft paper and other non-plastic expansion material (RT 2020b).
- Some packaging companies are developing ways to use recovered paper as an alternative to plastic in packaging. For example, WestRock is using recovered paper for paper-based ring holders for beverages, and other companies are testing paper-based beverage bottles.
- Smart packaging could also help to ensure recyclability of both paper and plastic packaging. Some packaging will likely contain invisible embedded codes, embedded at the manufacturer, that could enable automated scanning, classification, and sortation of these materials in recycling operations.

Interviewees indicated that some research and development projects are planned for the end of 2020 and 2021. They mentioned an emphasis on investment in resources to improve the capture and use of recyclable and recycled fiber; products that would use PCR material; and an innovation team focused on developing the "greenest products on the market." One interviewee cited the value to their business and their customers in continuing to invest in research and development (R&D). Among the projects interviewees mentioned:

- Advancements in processing on the front-end of their manufacturing process that would provide an option for recycling that doesn't require changing the behavior of consumers and instead streamlines the process to improve recycling. This technology (called Juno) takes commercial waste that currently isn't being recycled without additional sorting and feeds it into their processing unit where it is sanitized, paper fiber is extracted, and other recyclable materials are fed back into their respective recycling streams. The company's initial testing indicates they can divert up to 90 percent of the material processed. Construction on its first commercial unit in Oregon is nearly complete and expected to be in operation in the first half of 2021.

- Paperboard applications to displace plastic packaging. One firm is working with Procter and Gamble on this application but needs additional funding to improve collection/recycling of all materials.
- Using by-products from mill sludge[7], to be used by farmers, or as kitty litter. Plastics removed can be recycled into benches/tables.
- Paper research to make lighter weight papers while maintaining performance strength.

Many of the interviewees did not know of such projects or indicated that no R&D was planned until demand for products with recycled content increased further, or until policies preventing more demand for paper bags were addressed. One indicated that no R&D was planned for use with curbside until it was substantially cleaner

Many of the interviewees were not knowledgeable about emerging markets for recovered fiber, but cited RISI as one of several industry resources they rely on for information on emerging markets. Others indicated some potential for increased packaging applications and using boiler ash as a substitute for calcium lime for pH balance in agricultural soil amendment.

Market Development Approaches

One interviewee that commented on market-based mechanisms cited the mature markets for fiber recovery as evidence of a successful system, with "paper recovery...consistently...at approximately 65-68 percent and OCC recovery for reuse...at approximately 90 percent for several years." They also expressed the need to be open to new processes and technologies where there are gaps, citing their Juno technology as a "good example of a market-based solution that captures material that currently goes to landfills or incinerators because of contamination or coatings and requires no change on the part of the commercial business or its customers and employees, nor does it impact current recycling streams."

Herrera also conducted brief research to document policy, programmatic, or financial approaches in other regions of the U.S. that could be employed to stimulate additional use of recycled fiber generated from within King County and Seattle. The focus of the research was on stimulating domestic use, recognizing the volatility of the current export market and the potential for ongoing equity, pollution, and human health issues associated with export. Establishing stable domestic capacity to accept recyclable paper supplies from King County and Seattle, two jurisdictions with aggressive recycling policies, is an essential part of creating the economic benefits of, and justification for additional investment in, all phases of zero-waste infrastructure.

Rather than parse the research, we present a bulleted list of the approaches suggested by various research efforts, including one done by King County in 2015 where it is still relevant. Many of these approaches would form a basic suite of approaches for successful market development, some of which are already in use.

RCW 70A.240 initiates a good framework. The law creates a Recycling Development Center to promote research and development, identify markets, and develop policies to grow the industry.

[7] Pulp and paper mills typically generate significant quantities of non-hazardous solid waste removed after primary mechanical treatment, resulting in a sludge that contains large quantities of fibers, papermaking fillers, or both.

It brings together the Departments of Ecology and Commerce along with public and private stakeholders. An amendment to RCW 70A.240 also mandates a statewide plan to help reduce contamination in recyclables and provides financial assistance to help local jurisdictions clean up their recycling streams.

The market conditions described earlier and the local conditions in and around central Puget Sound will need to be considered to optimize these strategies for maximum effect on King County's and Seattle's post-consumer recyclable paper supply.

Policy to Guide Development

- Use a comprehensive package of policies that facilitate circular economy approaches, extended producer responsibility (EPR), economic development, public/private partnerships, and local market adaptation and growth paired with programs such as technical assistance, market development research, recycling grants, tax credits and education. (Carton 2014)
- Combine multiple recycling policies to orient and develop appropriate recycling infrastructure development and create incentives for businesses to use recycled fiber feedstocks. (Carton 2014)
- Develop a position on preferred end markets for paper generated in King County. Northwest paper mills cite lack of quality supply as the biggest barrier they face to expanding their recycling operations and, in some cases, to their survival as companies. (King County 2015)
- Support the use of recycled mixed paper in green building products as it has the potential to displace high volume and high-performance virgin materials. Products could include drywall or flexible packaging inputs as fibers. (Evans 2019)
- Reduce regulatory hurdles where appropriate to allow the markets themselves to react to current opportunities. (WD 2019)

Improve Sorting and Processing Infrastructure

- High-quality processed materials are in demand and capable of being used in more end-product applications than low-grade materials. Dedicate resources to fighting contamination. (WD 2019)
- Increase the capacity to process mixed paper, particularly material intended for the packaging sector. One factor that acts as a constraint on using more of the mixed paper available in the U.S. is the mill capacity to process mixed paper. Increasing capacity can allow the industry to take advantage of the relatively low cost of using additional mixed paper in products. The effect of increasing processing capacity will be particularly significant in the containerboard sector because of the large production volumes and supply needs as well as mill configuration.
- Improve the collection and processing system from the residential sector. The current recovery system in the U.S. generates significant quantities of mixed paper that can be neither domestically consumed under current U.S. mill capabilities without finding new

export markets after China's new trade policy. However, we expect continued demand from China for other high-grades (and virgin fiber). The U.S. paper mills also prefer higher level grades of recovered paper. Therefore, an option to improve the current recovery system must be considered, given the current circumstances.

The most relevant collection sector to improve the quality of mixed paper would be the residential sector since the bulk of wastepaper recovered from the residential sector is mixed paper. Recovering additional mixed paper will not generally be cost-effective at a MRF due to the declining price of the grade. Although some mills could take advantage of the reduced price of mixed paper and partially absorb the remaining volume of mixed paper calculated above, there are structural aspects of the current recycling system that will continue to generate significant volumes of mixed paper in the long-term. (MIT 2018)

- King County and Washington State could develop a MRF certification standard similar to the current initiative being pursued by Oregon State (Oregon 2020). These certifications would require standards such as specifying low levels of contamination on outgoing MWP and OCC bales; and conducting bale breaks and measurements on a regular basis. Enforcement would occur through periodic inspections.
- King County and Washington State should work with Oregon on developing standards that align for regional consistency. This certification system would necessitate investments by MRFs to improve the sorting system to maintain a commingled system.
- Invest in MRF technology, which can lead to improved standards of U.S. recovered fiber; increased prices for recycled fiber; increased recovery of wastepaper; increased MRF profitability; and decreased third party supply/collection in China and demand for virgin fiber (MIT 2018)
- Sorting and processing costs for mixed paper are the greatest barrier to the recycling of the material. [State and regional governments] should facilitate the siting of mixed paper re-sorting operations, as well as support or facilitate the establishment or update of paper mills to handle commingled, recycled paper. (Evans 2019)

Improve and Target Public Education

- Continue to emphasize "Recycle Right" campaign. Public education concerning appropriate materials to recycle and how to avoid contamination are crucial.
- Use an appropriate and consistent list of acceptable paper types. (Carton 2014)
- Emphasize the value of purchasing recycled content, and the economic and environmental benefits of doing so along the spectrum of other actions: purchase products with reusable or recoverable content; purchase or own fewer products or purchase products with less packaging; or repair, refurbish and reuse the products they own.

Improve and Target Corporate Education

- Cultivate demand to come from private industry. (WD 2019)

- Educate business and government stakeholders to change corporate policies to encourage reuse, recovery, and design for recyclability as well as use of recycled products. This can lead to improved purity of U.S. recovered fiber; increased collection of waste paper; decreased MRF profitability; and decreased third party supply/collection in China and demand for virgin fiber (MIT 2018)
- Focus across the value chain by developing a market development toolkit for governments, materials recovery facilities, and secondary processing facilities. Provide FAQs, guidance on how to conduct cost vs. benefit analysis for investments, incremental and major enhancements, planning for future materials, and contracting best practices to ensure the capability to meet current and future needs. (Lautze 2019)

Implement Funding Options and Incentives

- Research options for supporting local mills through offering financial subsidies. (King County 2015)
- Provide funding to support processing infrastructure development, and for technical and promotional assistance. (Carton 2014)
- Deploy supportive infrastructure investment and tax exemptions, low-cost financing where allowed by law (CSI 2020)
- Employ a loan program to support end-use business incubation. Similar to local government's key role in California's Recycling Market Development Zone (RMDZ) program. Include local government vetting of businesses, plus siting and permitting assistance, and "network marketing." (Lautze 2019)
- Promote competitive exemptions from sales tax on green manufacturing equipment (Lautze 2019)
- Develop and promote Recycling Incentive Fees that reward producers for making products with recycled materials on a pound-for-pound basis; requires a dedicated funding source. (Lautze 2019)
- Employ Market-, technology-, and material-based incentives that encourage manufacturers to use postconsumer content in a wide range of product and packaging designs. (Lautze 2019)

Provide Technical Assistance

- Deploy support services to help companies navigate and overcome roadblocks that can hamstring innovative enterprises. (CSI 2020)
- Create an accelerator program with the option to expand this program to include a business incubator in the long term. (Evans 2019)

Conduct Research

- Continue to conduct market development studies to inform state and local strategies and develop tools, such as tax credits, technical assistance and grants, that ensure recycling markets are available to handle increased materials recovery. (Carton 2014)
- Research strategies to attract manufacturing facilities using recycled feedstocks. (Evans 2019)
- Further research into infrastructure needs (e.g., material-specific processing; secondary processing; revised collection; manufacturer equipment) to determine current gaps. (Evans 2019)
- Invest in a mechanism to support open source and private research and development (Lautze 2019)

Emphasize Economic Development

- Devise a holistic market development strategy instead of one-off projects, in addition to integrating recycling end market development into economic development efforts. (WD 2019)
- Deploy a range of local economic development tools to encourage industry development. This includes making sure regulations are updated to reflect new technologies (CSI 2020)
- Change the public dialogue from measuring revenue from commodity materials sales to measuring benefits like the number of jobs created through local processing and manufacturing.

Establish and Support Partnerships

- Establish a regional market development alliance to pool dollars from multiple agencies to pursue ‘market transformation’ opportunities with the goal to achieve greater lasting impact and benefits for funder dollars than individual agencies could achieve on their own. Ultimately this could and should extend to the state and multi-state level. The Regional alliance could serve as a primary locus for research and development to make sure that initiatives provide tangible value for market transformation and innovation efforts. This may be able to leverage federal and state R&D funding. (CSI 2020)
- Partner with local governments, Northwest paper mills, and paper processors to assess options for increasing supply of recovered paper to Northwest mills. Depending on King County’s position on export of paper and other recyclable materials, the agency could launch a study and stakeholder involvement exercise to assess options for keeping recovered paper in the Northwest. Seattle Public Utilities may be a natural partner, as it is evaluating its recycling systems from an “asset management” perspective that considers economic, environmental, and social criteria. Since using local mills may have environmental benefits (shorter shipping distances and potential for reduced pollution) and social benefits (maintaining or increasing local jobs), using these criteria in recycling processor contracts could have benefits for local mills. (King County 2015)

- Establish a partnership with Washington State to develop a MRF certification standard which aligns with the Oregon State initiative. (Oregon 2020)
- Find and promote opportunities that connect industry segments. (WD 2019)
- Establish partnerships between state, local government, and (most importantly) private businesses. This is the California RMDZ model. (Lautze 2019)
- Establish a Markets Technical Advisory Group comprised of public and private industry stakeholders to discuss opportunities to improve and expand markets for recyclable materials generated in the region, and assure the continued viability and growth of business infrastructure.

Improve Standards and Specifications

- Explore use of quality standards for recycled fiber as a means of ensuring that paper is clean enough to be marketed to domestic mills. (King County 2015)
- Improve standards by working with municipalities to increase their standards and shift municipal targets. This would likely include consumer education and could lead to: increased quality of U.S. recovered paper; increased prices for recycled fiber; increased collection of waste paper; and decreased third party supply/collection in China and demand for virgin fiber (MIT 2018)

Extended Producer Responsibility (EPR) Use in Market Development

After identifying many of the key problems mentioned in this report —such as contamination, lack of sorting and processing capacity and lack of markets— the Oregon Department of Environmental Quality (DEQ) funded research which looked at potential frameworks for modernizing Oregon's recycling system, including market development, a MRF certification system, and establishing equity standards. The report provides an excellent summary of not only EPR in the context of Oregon's waste management system, but how market development for recovered fiber could work in the EPR systems analyzed.

The report considers five scenarios designed to offer different approaches to improvement:

1. Enhanced Government Managed
2. Enhanced Government Managed with MRF Contracts
3. Post-Collection Producer Responsibility
4. Producer Responsibility with Local Control
5. Full Producer Responsibility with Optional Local Involvement

The first two scenarios rely on enhanced government managed systems, while the other three utilize an EPR approach. (DEQ 2020).

According to the report in scenarios 3 through 5, producers would be required to set aside a portion of the producer responsibility organizations' (PROs) budget(s) and collected fees to invest in market development activities. Further, all EPR scenarios:

- Enhance system optimization, integration, and accountability by designating a responsible party for the post-collection segments of the recycling system (i.e., processing and end-market development).
- The systems facilitate responsible handling of materials as they flow downstream, increasing transparency of system costs and material flows and adding funding and technical support for end-market development.
- Producers of packaging and printed paper (i.e., brands and retailers) would be required to manage the recycling processing and marketing system. Producers would work through one or more producer responsibility organizations to meet their obligations. The PRO(s) would be required to implement research and development, infrastructure, and end-market development activities, as necessary.
- Producers would finance and coordinate the transportation, processing, and marketing of recyclables post-collection, as well as research and development, infrastructure, and end-market development, with research and development, infrastructure, and end-market development projects being financed by the PRO(s) through a set percentage of the PRO(s) budget. Producers would also fund litter prevention and control, waste reduction/prevention and upstream activities. The program plan might designate activities planned to utilize those funds, when implementation of those activities is the responsibility of the producers (e.g., upstream impact reduction activities). (DEQ 2020)

Finally, the report indicates the fees producers would pay into the PROs could be based on a formula that incentivizes design for environment considerations. The structure of these fees would incentivize the use of recycled content. To go a step further, the authorizing statute could specify mandatory minimum recycled-content targets for the products and packaging necessary to support struggling markets, or authorize the establishment of minimum recycled-content targets based on certain criteria, including strength of markets and market values. (DEQ 2020)

Conclusions

Key conclusions from our data analysis, research, and industry interviews can best be summarized as follows:

- The change in recycling collection practices, consumer knowledge, supply-side emphasis, and changes in the domestic pulp and paper market have led to lower quality standards, an increase in low quality recovered paper unsuitable for domestic consumption, and an over-reliance on China's export market.
- China's National Sword and Blue Sky initiatives and the global COVID-19 pandemic have disrupted the recovered paper market substantially, drastically reducing and potentially eliminating China's export market as a destination for mixed paper; and reinforce the need for stable domestic markets.
- King County's and Seattle's total supply of recycled paper of all grades is expected to increase between now and 2040, assuming continued focus on diversion, recycling program innovation, and public education despite changes in waste stream components.

The supply projection indicates a potential need for an additional 500,000 or more tons per year of processing capacity across all processors and sectors by 2030 with existing assumptions for increases in recycling rates and waste generation.

- Increased demand for PCR fiber and expansion of national and local end-use capacities to use recovered paper (including mixed paper) are positive developments for the recovered paper market. However, there continues to be finite capability nationally or locally to absorb all low-quality recovered paper previously and currently being exported to overseas markets.
- Containerboard, paperboard, and some tissue sectors could be potential opportunities in our region for increased domestic use of OCC, ONP, and mixed paper.
- Improving MRF and end-market capability to improve sorting and processing to produce higher quality/less contamination in paper should be an emphasis.
- Improving the quality of mixed paper recovery and residential recovery at their source would increase the potential for MRF performance and to create opportunities for use of this material.
- A fully integrated market development / economic development effort for recovered paper markets (and others) is warranted by King County and Seattle, with multi-state regional coordination and state participation.

Recommendations

Recommendations for work items for King County to undertake in 2020, and during 2021 and 2022 and beyond to support the market development of recycled paper in the region include:

1. **Fill in existing data gaps.**
   - Destination data - where is material going, specifically identify actual end-market businesses for untraceable destinations of reported material – third parties, brokers, out of state. Pursue and support policies at local and state level which require secondary material market reporting.
   - Enhanced measurements of contamination in the streams coming into and out of King County and Seattle material processors. Consider third-party assessment of outbound (post-MRF) bale quality.
   - Recycling composition – recent and more frequent characterization data for the recycling streams.

2. **Work to Improve recovery quality and standards.**
   - Work to increase standards and shift municipal targets; include consumer education.
   - Work across the industry to develop a standard for mixed paper consistent with Industry standards (e.g. ISRI).

- Evaluate the feasibility, costs, benefits, and logistics to promote or compel the establishment of a multi-stream recycling collection system. Consider providing alternative collection options for hard-to-recycle items.
- Evaluate methods of reducing glass and other materials that contaminate recycling streams (e.g., shredded paper, poly-coated paper, aseptic packaging.), including glass-only bins; alternating collection schedule based on material type; or intensify efforts at the state level to promote a beverage container stewardship system or deposit return system.
- Evaluate collection systems for new packaging materials not currently included in curbside recycling programs.

3. **Work with local MRFs and end markets to improve sorting and processing technology to lower contamination levels.**
   - Consider mechanisms to make investments (grants, incentives, tax breaks) in MRF technology.
   - Work with contracted processors to prioritize domestic end-markets for all paper grades (in parallel with quality improvements); Consider requiring documentation from sorting facilities to end markets.
   - Evaluate the feasibility and costs of a modernized fiber MRF re-sorting facility in King County, or other processing infrastructure on the front-end of manufacturing facilities.
   - In collaboration with Washington State, develop a MRF certification standard similar to the current initiative being pursued by Oregon State

4. **Facilitate partnerships and working groups to support local pulp and paper businesses and material applications.**
   - Include a cross-section of recycling managers and industry participants from the public and private sectors in Washington.
   - Include local brand leaders, such as Amazon, Costco, and Starbucks, and other interested regional businesses.
   - Consider financial mechanisms (grants, partnership funding) to improve manufacturer material processing equipment.
   - Focus on activities that increase information-sharing, gathering political support, refining strategies likely to overcome barriers, and leveraging existing resources efficiently.

5. **Continue local and regionally synchronized education efforts**
   - Focus on education to business and government stakeholders to change corporate policies to encourage use of recycled products and increase recycled content.

- Focus on consumers to enhance the Recycle Right message; economic and environmental benefits of recycled products; and the power of the consumer voice in changing corporate policies. Emphasize sustainable consumption.

6. **Invest in Policy Development**
   - Integrate recycling end market development into economic development, and equity and social justice efforts.
   - Use a comprehensive package of policies paired with programs that facilitate local market adaptation and growth, such as technical assistance, market development research, recycling grants, tax credits, and education.
   - Enforce standard for mixed paper consistent with Industry standards.
   - Advocate for a whole system approach, such as supporting EPR policies, that facilitate improved collection, sorting, processing and marketing of paper, that include recycled content standards for paper, and encourage additional investment in market development.

7. **Continue to conduct appropriate market research.**
   - Continue to monitor supply, recovery, processing, and demand trends and issues for recoverable paper, as well as identify opportunities to address recycling market development barriers.
   - Research strategies to attract manufacturing facilities using recycled paper feedstocks.
   - Continue research on developing infrastructure needs for the entire recycled material value chain (e.g., box and bag converters).

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APPENDIX A

Interview Questions, Interviewees, and Raw Results

Final Interview Questions

My name is [NAME] with Herrera Environmental and I am calling on behalf of King County and the City of Seattle. We are investigating current market processing capacity and market demand for PCR paper from the King County and Seattle systems. Herrera is surveying a range of companies involved in paper processing and manufacturing to determine existing manufacturing infrastructure and demand, existing use barriers or constraints, potential technological advancements, and existing or innovative uses for paper that may currently be, or could have the potential to, affect regional paper markets, with particular focus on King County, Seattle, and the Puget Sound region.

Any information collected will not be shared with any other private parties and will be presented by the County and City only in aggregated form.

Questions:

Market Participation

1. What products do you produce using fiber?
2. Do you use post-consumer recycled fiber in your products?

If No:

3. Have you used post-consumer recycled fiber in the past? What were the challenges in doing so? Why did you discontinue using post-consumer recycled fiber?
4. Do you plan to use post-consumer recycled fiber in your products in the future? Why or why not? If yes, how much and for what products?

If Yes:

5. How much post-consumer recycled fiber do you purchase/use annually?
6. What grades do you buy?
7. How do you determine who to purchase from, when to purchase, and how much?
8. From what area do you purchase? Is it difficult to maintain a consistent supply of fiber? If consistency is an issue, do you see any opportunities to reduce inconsistency or uncertainty in the supply chain?
9. What price range do you typically pay per ton? Have they been negative? OR what has the trend in pricing been? What do you see trending in the future? Does the current pricing offer any opportunities to your business?
10. What standards or specifications do you apply for acceptable material?
11. What type of additional processing do you apply to post-consumer recycled fiber before it is used in your manufacturing process?
12. Do you currently produce paper carryout bags? If not, do you plan to produce paper carryout bags?
13. Do you produce bags with post-consumer recycled content?
14. What is the range of post-consumer recycled content you produce? How will you meet the new requirement?

(6) For the purposes of this section: (a) A recycled content paper carryout bag must: (i)

Contain a minimum of forty percent post-consumer recycled materials; (ii) Be capable of composting, consistent with the timeline and specifications of the entire American society of testing materials D6868 and associated test methods that must be met, as it existed as of January 1, 2020; and (iii) Display in print on the exterior of the paper bag the minimum percentage of post-consumer content.

15. What post-consumer recycled content is feasible for bags with your current infrastructure?

Future Activities/Strategies

1. What are the current challenges to using post-consumer recycled fiber? What suggestions do you have to rectify them?
2. Do you anticipate your demand for post-consumer recycled fiber is increasing, decreasing or staying the same? Over what time period? How much of your capacity are you using now?
3. What added infrastructure or investments would be required to increase your capacity to use post-consumer recycled fiber? How would this infrastructure be funded or who would fund it? Is there systemwide investment needed?
4. Are you planning to do any research or development to use post-consumer recycled fiber in new products? When would you start purchasing post-consumer recycled fiber in the future?
5. What do you see as emerging markets for materials currently recovered or for materials that are currently disposed?
6. How confident are you that voluntary brand commitments will drive demand for PCR in the future?
7. Have you or do you expect to experience an increase or decrease in demand for recycled content products from your customers?
8. What market-based mechanisms do you view as working elsewhere – give examples if possible.

King County Linkup

Interviewees (highlighted in blue) and Targets

First Name	Last Name	Organization
Robert	Fike	Bagcraft
Peter	Bohocky	Caraustar Industries
Joe	Bouchard	Cascades Tissue Group Oregon
Laura	Lawton	File-EZ Folder Inc
Brian	Owen	Inland Empire Paper Co
Tana	Blair	International Paper Co
Cynnthia	Leon	International Paper Co
Steve	Frank	International Paper Co
Tracy	Walker	McKinley Paper Company
Jay	Simmons	North Pacific Paper Corporation (NORPAC)
Kevin	Graham	Of The Earth
Jeff	Petersen	Olympic Technology Resources
Dave	Demots	Package Containers Inc
William	Southard	Paper People
Paula	Stoppler	Port Townsend, Crown Password
Al	Bubond	Sonoco
Mark	Lindstrom	Tacoma Paperboard
Mel	Kelsey	Western Pulp Products Co
Patrick	Hartnet	Westrock
Erik	Wist	Georgia Pacific
Terry	Webber	American Forest & Paper Association
Lydia	Work	American Paper Converting
William	Southard	Asian American Fibers
		Belgravia Investments Inc
Daniel	Arnold	Boise White Paper now Packaging Corp of America
Chad	Demo	Bonita Packaging Products Inc
		Box Maker
Melissa	Snyder	Bristol-Myers Squibb
		Bunzl Distribution
Karla	Tacker	Cascade Paper Converting Inc
Linda K	Massman	Clearwater Paper Corp
Josh	Krusky	Core Pack LLC
Michael W	Entz	Cosmo Specialty Fibers Inc
Mike	Blazek	Cosmos Speciality Fibers 3605004647
Brian	Mennis	Domtar Paper Co LLC
Joshua	Martin	Environmental Paper Network
Chad	Allers	Georgia Pacific
Megan	Veriha	Georgia-Pacific Corp - Halsey
Eric	Hill	Graphic Packaging Intl
Benjamin	Smith	Graphic Packaging Intl
Bob	Britt	International Paper Co
Stephen	Brainard	International Paper Co
Terry	Bushnell	International Paper Co

First Name	Last Name	Organization
		International Paper Co
Chuck	Frary	International Paper Co
Sean	Hatcher	International Paper Co
Kirk	Jarrell	International Paper Co
Nathan	Langwell	International Paper Co
Jason	Pierzina	International Paper Co
Martin	Taylor	International Paper Co
Todd	Thompson	International Paper Co
Kathy		Kapstone Kraft Paper
Tim	Duran	Kapstone Paper & Packaging
		Kapstone Paper & Packaging Corporation
Mohamed	Merchant	Marsupial
Julio	Portalatin	Mercer International Inc
Amy	Dougherty	Nippon Paper
Kathy	Konopaski	Nippon Paper Industries
Greg	Allen	Nippon Paper Industries USA
Marysue	French	Nippon Paper Industries USA Co
Craig	Anneberg	North Pacific Paper Corp
Peter	Oullette	North Pacific Paper Corporation (NORPAC)
		Oasis Tissue LLC
		Pac Paper Inc
James	Bost	Pacific Fibreproducts
Peter	Gillies	Pacific Pier Inc
		Ponderay Newsprint Co
Colin	Fernie	Port Townsend Paper Corp
John	Northey	Port Townsend Paper Corporation
Derrick	Lindgren	Resolute Forest Products
Kishor	Jhala	Sonoco Products Co
Ken	Li	SP Fiber Technologies LLC
Becky	Bodenstab	Spicers Paper
Jan	Dominguez	Stoneyburn Gallery
James	Moody	Westrock
Tom	Rehder	Westrock
Ashley	Claussen	Westrock formerly Longview Fibre Co
Brian	Wood	Weyerhaeuser
Chris	Degnan	Weyerhaeuser Co
		Wrap Pack

Results

What products do you produce using fiber?

Responses: 19/20; 95 percent

- Only Old Corrugated Cardboard (OCC).
- 2500-3000 tons of paper today. Three world class paper machines. Biggest on the west coast. One machine dedicated to printing and writing and book paper. Second machine is natural craft package material (light weight). Third machine is making a mix of printing and writing grades (and high brights) and packaging.
- Unbleached softwood craft pulp, liner board medium, some numbers of specialty craft papers.
- Every tissue product, towels, napkins etc.
- Tree free papers. Post-industrial cotton fibers.
- Various sizes of paper bags primarily used in retail grocery stores. Twist ties in various shapes and sizes. Used for bunching up leafy greens.
- Produce big rolls of paper for industrial uses – such as paperboard, paper for carpet core, brown trays/boxes, and construction paper.
- Produce edge protectors from paper with recycled content, paper used in production comes from Tacoma Paperboard
- Mainly a newsprint facility and some bags.
- Internationally, everything from paper to cardboard, Tana sells finished boxes from Moses Lake and Yakima plants. Josh works in plant making corrugated boxes.
- Pulp fiber, make containerboard (virgin and with recycled content), make paper (virgin and with recycled content), make bags.
- Box partitions and tube converting (inside rolls used for large paper rolls).
- Pulp and paper.
- Make various bags and food containers.
- None. Printing shop.
- None. Business is with printer cartridges.
- No production, sells recycled paper/OCC.
- Molded fiber products company. Take cardboard trimmings from box plants and newspaper. Make furniture packaging, nursery trays, and especially wine packaging.
- Make folding cartons and boxes.
- Make industrial grade products from finished paper rolls, an example was wraps for pallets for customers who do not use plastic wrap.
- Mills in the Northwest make containerboard, tissue, towel and napkins.

Do you use post-consumer recycled (PCR) fiber in your products?

Responses: 18/20; 90 percent

- Planning to in the future - in the conversion process.
- Yes.
- Yes.
- A very small portion, Yes.
- Nothing is manufactured here. We sell post-consumer recycled fiber envelopes.
- Yes, both bag and tie products.

- 100 percent.
- Yes, because paper purchased to make edge boards has recycled content. Process is to use adhesives to bind together paper to make the edge boards.
- Yes.
- Yes, but we buy finished paper with the recycled material already in it.
- Yes.
- We received finished paper rolls and so do not directly use post-consumer fiber.
- Yes, at least 85 percent. Sometimes box cuttings as well, so some pre-consumer as well. Right now, at 100 percent post-consumer.
- Yes.
- Use both virgin and recycled paper. Takes a lot to clean the recycled paper. There was a big push for recycled paper, but it costs more. Now focused on Forest Stewardship Council (FSC) certified. Customers happy with FSC.
- Recycler, have bins in communities to collect just cardboard (Trader Joes, 7-11), and accept – pre pandemic paid, now for free - at door. Have converting side and get secondary rolls (damaged) and make into new rolls for industrial / commercial uses.
- 100 percent for newsprint; not yet PCR for cardboard since company uses scraps from box plants.
- Yes, estimates 60 percent.
- Some rolls they buy have recycled content.
- Recycled fiber is used in some products but not all. Our B2B products are made to customer specifications, and we offer a variety of consumer products to meet the varied preference of consumers.

IF NO: Have you used post-consumer recycled fiber in the past? What were the challenges in doing so? Why did you discontinue using post-consumer recycled fiber?

Responses: 5/20; 25 percent

- Yes. Testing capacity only.
- Yes. Cost-driven decision.
- Never used a lot because fell apart in press and wasn't as high quality.
- From work w/ WRRA, I know contamination is an issue.
- Too much contamination. Cannot use windowed envelops or magazine paper at all. Separation of paper is required.

IF NO: Do you plan to use post-consumer recycled fiber in your products in the future? Why or why not? If yes, how much and for what products?

Responses: 3/20; 15 percent

- Craft Paper and Grocery bag.
- 40 percent of products have post-consumer currently.
- Not with the FSC certified, unless some clients really push for it.

How much post-consumer recycled fiber do you purchase/use annually?

Responses: 16/20; 80 percent

- Around 200,000-230,000 air dry short tons.
- Do not know. Used PCR - goes into all products except for unbleached craft pulp. Over 300 tons per day.
- The way it's headed they will be consuming about 45,000 tons.
- Referred to alternate contact.
- Don't know. But buying by the truckload every month.
- 50,000-55,000 tons.
- Purchase 5,000-6,000 tons of paper rolls for making edge boards.
- 48,000 tons.
- Varies from 5 percent to100 percent PCR in products (paper, cardboard).
- Declined to respond.
- 47-50k tons.
- 180-200 tons.
- Can't answer for sure, but low, maybe 1 ton.
- 14,000 tons.
- 350k tons.
- Do not purchase fiber, the plant uses finished paper rolls.
- Question for mills rather than this plant.
- Most post-consumer recycled fiber consumed by mills in the Northwest is used to make containerboard with a smaller percent used to make tissue, towel and napkin products. Annual consumption varies but is generally more than 400,000 tons combined.

What grades do you buy?

Responses: 13/20; 65 percent

- Mixed paper and OCC.
- Old Corrugated Containers (OCC).
- 11 and 12.
- Don't know exact quantity - hundreds of tons.
- Mostly OCC, don't like commingled paper, too much contamination.
- All.
- Sorted Office Papers (SOP), Old Newspapers (ONP) (getting harder to find), some magazine but do not like because of plastic.
- Use both pre-consumer and post-consumer materials. Not sure of grades but we use commercial, not residential because of contamination issues. We are meeting needs with just commercial.
- Buy and sell more than 40 fiber grades – mixed paper, OCC, used office paper.
- OCC w/ about 20 percent mixed office waste, basically grade 12, also hard pack.
- Don't know.
- Cardboard, various grades of paper including newspaper.
- Used newspaper 8 and 9. Cannot use mixed paper. The best newspaper source are overruns.
- Not applicable to business, they buy finished paper rolls.

- Buy paper grades of natural craft, chip craft, mill cartoon stock, and others finished paper rolls.

How do you determine who to purchase from, when to purchase, and how much?

Responses: 10/20; 50 percent

- Developed a scrap paper management program for different mills. Sample different bales (test the contaminants) implemented in 1991. That went into tracking product quality and which buyers to buy from and which no longer fit our needs. We sample now but we now have more brown and mixed paper. Historically we wanted to make bright white and needed more homogenous white feedstock.
- Purchase constantly as we are always using it. Fiber purchasers get the best value. Not sure of immediate sources. Purchasing is yield related, so we buy more when we are using more. 350 tons/300 tons used per day.
- We have a division that deals with all fiber procurement. Largely cost driven and then they evaluate quality.
- Combination - timing (when needed for order) and market need. Who to buy from depends on paper mill dynamics and which suppliers align with our timing. Typically work with about 6 providers of raw material. Some customers will specify certain levels of PCR - which narrows who we can buy from.
- Price.
- Don't purchase, the mill does that.
- OCC 11 & 12 (double sorted), tube scrap, commercial mixed paper (do not use residential curbside!).
- West coast paper is typical supplier.
- Purchase timing and amount based on need from customers. COVID-19 was good for business, especially wine shipping packaging because so many people had home deliveries.
- Buy paper rolls based on price and purchase based on demand
- Price and demand.
- [The company's] recycling entity purchases recovered fiber for its mills. Sourcing managers look for consistency of supply, total delivered cost, and quality.

From what area do you purchase? Is it difficult to maintain a consistent supply of fiber? If consistency is an issue, do you see any opportunities to reduce inconsistency or uncertainty in the supply chain?

Responses: 14/20; 70 percent

- Buy from the Northwest. Lots of supply to pick from. Some upsets in the chain from elsewhere in Oceana, but typically short-term. Especially in mixed paper market.
- Not an issue.
- Depends on demand from China. But as China demands less, the domestic market becomes more volatile. We aim to get it closest to the mill as possible.
- Anywhere in North America. It is not easy to maintain continuous supply, but not difficult. We would love to have more sources in the Northwest. I wish that we could improve supply chain issues. Fiber is becoming less reliable. Market is shifting to making board stock for Amazon, resulting in some market volatility.
- Mostly WA, little from OR, ID, MT.
- Purchase paper rolls from Tacoma Paperboard. Paper consistency isn't an issue.
- WA, BC, Alberta, ID, Utah, Co, Nevada, CA, WY, ID – not Midwest. Good relationship with suppliers, so collect from printing facilities. Do not get material from MRFs, we get post-industrial

material from newspaper overruns. We have our own trucking. So as the plant sends finished paper, the same truck brings back the overruns in what would have been an empty truck.

- No because use commercial sources.
- Nationwide.
- Open to public to drop off, near Sumner, WA and limited to WA.
- Majority is local – WA, mainly Pierce & King Counties, some from OR, little from Canada.
- WA & OR.
- Used to be just WA & OR, but now from anywhere because not enough locally, as far away as Edmonton for clean fiber.
- Tacoma, Los Angeles, Ohio
- Buy paper rolls from all over USA, depending on price and grade of paper.
- Sourcing within the region helps to manage cost, but that also has to be balanced with quality and consistency of supply. As a broker of recyclables, [the company's] recycling entity puts a high value on maintaining two-way relationships with our internal and external customers. That helps us manage through market fluctuations and to find alternatives when needed. The variability in recyclable collection from market to market contributes to the inconsistency in supply. Knowing and having good relationships with our suppliers helps us with consistency of supply and managing the supply chain, but it remains an issue.

What price range do you typically pay per ton? Have they been negative? OR what has the trend in pricing been? What do you see trending in the future? Does the current pricing offer any opportunities to your business?

Responses: 15/20; 75 percent

- Can't tell. Avoid discretions for pricing. Influenced by Resource Information Systems Inc. (RISI) index. Crash since China. Prices very dynamic. After 2020, there should be a gross oversupply in scrap. We make commodity grades. Pricing is not unique and watch costs of raw materials, minor changes can have huge impacts. Don't expect an upswing in the commodity grade market until 2020+.
- No idea.
- Depends on the grade and the mix that we need to run. The overall trend is going down…again. I am probably paying $80-$100 more per ton relative to East Coast prices. There is a lot of pressure on supply from the brown-fiber part of the market. Future trends? Tough to answer. Depends on how much different sectors evolve...paper bags, boxes, and COVID. COVID is affecting recycled material supply. Recently witnessed the crash of the tissue market from COVID. Orders cancelled. Shortage of white recycled material. We are estimating price reductions in the future as a result.
- Typically pay (depends on grade) $42-70 per pound. Trend has been relatively stable. Crystal ball - pulp prices are down and will continue to go down, near-term prices will go down.
- Off of "yellow sheet" with some factors for freight. Have they been negative? 1-2 year ago, approached $0, never negative. Been trending generally up since a year ago. Depends on what China is doing is how trends go. We can handle multiple fiber types, but do not like the low grade because it's too contaminated.
- Pay $450-500/ton for finished paper rolls. Price for finished paper has never been negative or trending down.
- Prices vary; currently about $20/ton - note this doesn't include freight. Prices have not been negative, but the trend is down. We think pricing will stay depressed for the next few quarters. Current market may or may not provide opportunities. Market is good for food trays without wood fiber, but bad for newspaper.
- Doesn't know.

- Depends on grade and contracts and markets, so fluctuates
  Generally down, but fluctuates
  Continued volatility.
- Varies by loose and baled and type, but between $25-125/ton. OCC most. Prices are currently market driven, whereas pricing used to have more to do with export pricing. Demand has been increasing domestically.
  Prices have not been negative, but we took material at $0 when China Sword started. Once COVID-19 started in March, prices went up, but lately they are a bit down, within $30 range. Trends are probably down, expect more waste paper produced late this year. Grades that use most of (OCC) not down enough for an impact.
- Do not know.
- Don't know. Don't see trend to use. Clients want best value and it's not good value to use recycled paper.
- Pricing is currently $0. With one of the paper grades, we are paid to take it. Also, we rent bins to some of our suppliers, so in a way we are paid to take that material. Pricing was high, but tariffs affected prices in a negative way. Lately way down. Election might have big impact. No clear opportunities for us.
- $100-140 for clean newspaper, not counting the freight. Likely to get more expensive because there is less newspaper now.
- Declined to answer how much finished paper rolls are
- Varies based on type of paper roll buying. In future might be up due to COVID.
- Refer to industry indexes for pricing.

What standards or specifications do you apply for acceptable material?

Responses: 15/20; 75 percent

- Standard publication specifications.
- Involved with State of WA recycling standards, but the system was designed for China not residential. We rank the suppliers for quality and select based on least contaminated. Yield runs between 70-80 percent.
- No idea. Industry standard.
- Internal program, software, avoid a certain percent of color and plastic that can be in the bales. We track questionable material and communicate with suppliers. We can validate the moisture content.
- All of our suppliers know what we need specifically. All natural craft or bleach Kraft. Lion's share is natural craft.
- We are able to handle multiple grades, but prefer better grades. 5-10 percent of what we buy we throw out because its considered contamination.
- Less than 5 percent is goal. Will accept with more, depending on pricing.
- Doesn't know.
- Depends on grade, follow Institute of Scrap Recycling Industries (ISRI) requirements
- Use paper stock specs as a guide. Use a consistent supply. Moisture is an issue and so check that loads are not higher than 12 percent. Again, no residential accepted so contamination is not usually an issue. 2-3 percent contamination is typical.
- Follow ISRI.
- Entirely digital shop so needs to be able to run through press without falling apart and compatible with ink.
- Only cardboard, if any garbage, rejected as garbage, only presorted accepted.

- Must be clean. Company has tighter restrictions than China, that is why we do not purchase from curbside collected materials.
- Mainly that it is FDA approved for direct food contact. They do "tons" of donut boxes and so the rolls they buy have to be ok to be in contact with food.
- As noted, important factors are consistency of supply and quality needed for the product being produced. We do look for material that meets ISRI specifications.

What type of additional processing do you apply to post-consumer recycled fiber before it is used in your manufacturing process?

Responses: 14/20; 70 percent

- Pulper, screen system, and cleaners. Hydrocyclones.
- We have an OCC plant, re-pulp them, send through series of screens to decontaminate. This operation was recently expanded.
- Nothing really at this mill.
- Take it off the roll and print. Sometimes adjust for size.
- Pulping, cleaning, screening (to remove tape, plastic, containers, bottles, etc., Starbucks cups are a nuisance), refining, then form sheet, dry and wind it up into roll
- Have a de-ink plant, screening for tape, plastics, etc.
- Don't know.
- Cleaning, screening, pulping.
- Material ready to consume when accepted so do not do any sorting. Remove baling wire. Then into pulper and screened.
- Separated by size and density by screening. Board cleaners get out heavy contaminants like sand, grit, metals, then a reverse cleaner for light like contaminants like Styrofoam.
- Needs to be coated paper to go through press.
- Baling.
- Have magnets to get staples in cleaning process. Pulping and forming.
- None because they buy finished paper rolls. That would be done at mills.
- Not applicable since buy finished rolls.
- Bales of fiber are fed directly into processing. That's one reason it's important to know we are getting quality material.

Do you currently produce paper carryout bags? If not, do you plan to produce paper carryout bags?

Responses: 15/20; 75 percent

- Yes, do produce the paper for bags. But don't make the actual bags themselves.
- No. We do not produce bags, though some of our paper goes into producing bags. Specialty bags not standard grocery bags. We did make bags historically.
- No.
- Yes.
- No.
- No.
- Yes. Make bags for Chick-Fil-A.
- No.

- Yes.
- No.
- Do not know.
- No.
- No.
- No.
- No.
- No.
- No, [the company] does not produce paper carryout bags.

Do you produce bags with post-consumer recycled content?

Responses: 6/20; 30 percent

- 100 percent post-consumer.
- NA.
- No.
- Yes.
- Yes, have at least 30 percent. With more recycled content, strength is lower and bags fall apart. 60 percent virgin fiber needs to be there for strength. We mix PCR with residual sawdust to maintain strength properties. Our equipment cannot accept wood chips.
- Yes.

What is the range of post-consumer recycled content you produce? How will you meet the new requirement?

Responses: 6/20; 30 percent

- 100 percent. We can't get any higher.
- Range 0-up to 70 percent in certain products. None of the products have specifications for recycled content. We use it because it is the most economical fiber sources available.
- 100 percent recycled, 60 percent post-consumer, run/consumption is 70 percent to assure customer satisfaction and provide a buffer. Moving forward, we want to buy more grade 11 but will still be 70 percent.
- Yes, up to 100 percent. No problem meeting new requirements. Some customers require more. We can do up to 100 percent.
- 30-40 percent.
- Meeting requirements. Averages 40 percent, do not want more because weakens bags.

What post-consumer recycled content is feasible for bags with your current infrastructure?

Responses: 5/20; 25 percent

- 100 percent.
- NA.
- NA.
- Up to 100 percent.
- Varies, but do not want to go more than 40 percent because quality is lower.

What are the current challenges to using post-consumer recycled fiber? What suggestions do you have to rectify them?

Responses: 15/20; 75 percent

- Yield loss is the biggest challenge. We are involved with state efforts to change the recycling programs so mills can have clean fibers to produce good materials.
- The waste in the rejects that come up are largely due to the collection methods due to the municipality - largely associated with mixed materials/not separating the cardboard. Curb-side segregation is the best way to do this.
- Contamination - and ways to deal with it, such as equipment to deal with it, which can cause damage. Currently we use a mix of post-industrial material to dilute the contaminated material. There used to be a surplus in post-industrial material, now post-consumer market is greater.
- Challenges - re-recycling resulting in degraded quality.
- Challenges are fiber is not as strong, so there requires some care in the production process. More consistent supply and lower costs could improve the market. As more regulations/requirements or consumer demand can drive demand.
- Contamination and price. More source separation, no single stream. Alternate weeks for picking up recyclables - paper/OCC and next week containers/cans/bottles.
- Contaminants. Inconsistences in markets. Toilet paper demand during COVID-19 sent prices high - so hard to count on prices.
- Using old newspaper makes a product that is harder to print on. WA and OR have environmental and air quality requirements that are hard to meet and so have moved some production outside these states. Don't know.
- Fiber can only be recycled so many times before quality decreases too much. Company is not supporting plastic bag bans that include charging for paper bags because would not be able to keep up with paper bag demand with current capacity. Need to be more converting facilities because that is the main shortage in the supply chain. After 30 years of retail moving to plastic bags, the paper bag converting facilities have been closing domestically. Plastic bags are made outside USA while paper ones are typically made domestically. Putting a fee on paper bags hurts demand and there are environmental groups that want to ban paper bags so do not want to invest in manufacturing bags because of disincentives. Without knowing the demand will be there long term, the company will not make investments in converting facilities. Focus on policies that impede paper bag use – cap and trade, fee on paper bags. Those need to be addressed before more fiber will be used.
- Once in a while a load of mixed paper is questionable but not much. Only get 2-3 percent contamination due to consist supply.
- Maintaining high production with mixed paper is difficult, prefer OCC, so we do not sacrifice capacity. Anything non fiber can harm equipment. There are no remedies that are easily accomplished. We would need updates to equipment and additional equipment would be needed to clean material. We recommend this should be done at MRFs to capture contaminants upstream of fiber users. Single stream is not ideal because of contamination.
- Typically, has been lack of structural integrity compared to virgin fiber.
- Tariffs and current pricing. No tariffs.
- Curbside comingled is contaminated and the sorting is “terrible” and doesn't remove contaminants.
- Not applicable since used finished paper rolls.
- The ability to consistently secure quality fiber is a challenge. Reducing contamination is a challenge we all face, and one of the biggest hurdles is consumer awareness. We support initiatives that provide reliable information, but the vast inconsistencies in what is accepted market to market adds to the confusion. More options for recycling that don’t require changing

the behavior of the nation's consumers and instead streamline the process to improve recycling would help.

[The company's] Juno® Technology is one example – we take commercial waste that currently isn't being recycled without additional sorting and feed it into our processing unit where it is sanitized, paper fiber is extracted for reuse and other recyclable materials can be fed back into their respective recycling streams. The results of our pilot processing unit indicate we can divert up to 90 percent of the material processed from landfills. Construction on our first commercial unit in Toledo, Oregon, is nearly complete and expected to be in operation in the first half of 2021.

Do you anticipate your demand for post-consumer recycled fiber is increasing, decreasing or staying the same? Over what time period? How much of your capacity are you using now?

Responses: 15/20; 75 percent

- Increase, and pursuing financing that would triple the amount of fiber we consume. We will source outside the Northwest after that point.
- Still coming up to speed on the market expansion. Steadily increasing our demand with a ways to go. It's not an issue of supply but the learning curve with new equipment and smoothing operations. Currently at 70-80 percent of our capacity.
- Hard to tell during COVID-19 as most materials go to airports, restaurants. Too much uncertainty. We are trying to adapt and move to more consumer materials used in cleaning. The machine that consumes recycled material is only at 30 percent capacity right now as a result.
- Around the same.
- Significant increase in last 12-18 months. Accelerated in last 6 months. We are currently at 50 percent capacity (can go up to double shifts).
- Staying the same, easier to grind up old paper than wood chips.
- Increasing recently, when CA passed paper had to be at least 30 percent content changed pricing.
  About a year. Currently using 100 percent of capacity.
- Going up. We used to never have customers ask about recycled content but now we do have customers asking about it.
- Don't know, it may increase based on demand for sustainable products. Not sure about the time period. We are meeting our own demand, for making products now and have adequate supply of fiber.
- Same, paper customer base is staying same over next 5 years.
  Do not know.
- Demand is increasing. Do not know the time period associated with demand increase. We produce per orders received rather than to capacity.
- Usually virgin because clients want value.
- Lost ability to ship overseas, want to have access to that market again. If we can only ship domestic, then pricing is an issue. We have very clean cardboard so can sell that, Depends on election. 60 percent.
- Increasing due to California bans on Styrofoam. As long as bans continue. Company is always trying to find ways to replace other packing materials in the marketplace. Concerned about to availability of newspaper. Need bigger share of newspaper or to find another source of clean fiber.
- Anticipate increasing due to recent fires. The plant is running under capacity.

- Do not know.
- In addition to our own proprietary data, we rely on many industry organizations and other widely available resources to evaluate demand. Fluctuations in the market for recycled fiber are normal, but we do believe overall there will continue to be an increase in demand for post-consumer recycled fiber.

What added infrastructure or investments would be required to increase your capacity to use post-consumer recycled fiber? How would this infrastructure be funded or who would fund it? Is there systemwide investment needed?

Responses: 14/20; 70 percent

- Funding - the cost of capital is typically paid for by the company. We are open to financial support. We would love to see more government grants of business mechanisms that support our investments. In the past it has been hard to develop funding program in the state of Washington for private corporations. The Washington mills used to be publicly traded then Weyerhaeuser split apart now owned by investment firm so less eligible for public funds. Most funding in State is for public programs or infrastructure to increase functionality - e.g. Go back to a duel stream method.
- No need. We are working on getting everything running to our demand.
- This mill would require a hefty investment to get there. The mill is self-funded based on priorities of the corporation and our corporate strategies. A lot of our machines that process recycled material are good, just not this mill. Those are located outside the Pacific Northwest. I am asking for additional investment for my mill. It would pay for itself very quickly.
- None. Already ready.
- If used low grade with more contamination, would need extra cleaning.
- Change based on requirements for wastewater. Trying to meet water quality standards are difficult. Invested $10 million in water treatment. Polychlorinated biphenyls (PCBs) are common in post-consumer waste from the ink.
- Don't know. These are mill questions.
- Do not need additional fiber so not looking at added infrastructure.
- Upgrades to cleaning systems and screening equipment. Sumner plant has two pulpers, used to run a “poly” line that could remove the film on paper. Would have to do that again, but energy usage goes way up for removing film so not ideal.
- Do not know.
- Not on radar.
- Access to overseas markets.
- Not applicable to this company, because we only want to buy clean materials. People need to get better about they are putting into carts. Corvallis collects glass separate which is better, as long as everyone does it. Plus, more sorters or equipment would need to clean comingled materials, not the end user. This company does not process. It needs to be clean when it gets here.
- Buying finished rolls so the use of recycled fiber happens upstream of making boxes.
- This would be done at mills making paper mills so not applicable.
- [The company] does have swing capacity to accommodate an increased use of post-consumer recycled fiber if that is desired by our customers. We believe one of the best investments at this point are in new technologies for infrastructure that increase recyclability or improve the ability to capture materials that currently are not being captured for reuse.

  In addition, as a company, we continue to invest in resources to improve the capture and use of recyclable and recycled fiber. Examples include paper research to make lighter weight papers while maintaining performance strength, our Juno Technology mentioned earlier, a previous

partnership with Starbucks to test paper cup recovery, and the recent announcement of our Green Bay, Wisconsin, and Muskogee, Oklahoma, mills being able to accept and recycle single use cups.

[The company] believes there is value to our business and our customers in this research and continue to invest in R&D. We also see partnerships as a valuable and effective way fund initiatives and bring different capabilities to the table to build and/or deploy solutions.

Are you planning to do any research or development to use post-consumer recycled fiber in new products? When would you start purchasing post-consumer recycled fiber in the future?

Responses: 15/20; 75 percent

- Probably by the end of 2020.
- Any product we develop at this point will be for post-consumer recycled material.
- Always looking for additional opportunities. Will use the capacity that we have not fully used. It's difficult to predict future needs.
- Our innovation team experiments with new products. Not aware of post-consumer content. The company vision is to make the greenest products on the market.
- Yes, for R&D/new products, associated with wire ties.
- No because everything we are using is already post-consumer. NA.
- Yes. First trial run is next week.
- No.
- No. Need more demand for products with recycled content and need to address policies preventing more demand for paper bags.
- No. Would not use curbside unless way cleaner. Needs to see improvement in how clean it is.
- Do not know.
- No.
- Not applicable.
- No.
- Yes, but nothing specific.
- No.
- We are continually researching and testing applications of recycled fiber and new products that would use recycled fiber as noted above.

What do you see as emerging markets for materials currently recovered or for materials that are currently disposed?

Responses: 14/20; 70 percent

- Not familiar enough to answer.
- Plastics sector. Green source recycling - replacing plastic packaging with paperboard packaging. Procter and Gamble is providing some support, but we need additional funding to improve collection/recycling of all materials.
- I am not as close to the dynamics of the supply chain to answer.
- We are working on using by-products from the sludge, that can be used by farmers, kitty litter. Plastics removed can be recycled into benches/tables.

- No emerging markets. People are going to the store more than the restaurants and demand is up as a result.
- Yes, increase in packaging so more demand. If price and contamination low, mills would switch to more use of post-consumer. Want to use more local but quality is poor. Too much contamination.
- Boiler ash mimics calcium lime and could be used for pH balance in agriculture.
- Don't know.
- Declined to respond.
- Unless cleaner, not going anyplace but landfill.
- Do not know.
- On a greater scale, bigger conversation than just paper. People need better education on what is recyclable and how to clean containers before putting in bin.
- Overseas markets when possible, India and Vietnam, additional countries other than China. As a consumer, no single stream.
- Do not know.
- Do not know.
- RISI is one of several industry resources we rely on for information on emerging markets in addition to our own proprietary research.

How confident are you that voluntary brand commitments will drive demand for PCR in the future?

Responses: 10/20; 50 percent

- Not familiar.
- Either by the brands or government mandates. Brands will likely have a quicker social impact but longer timeline. If governments picked it up, it would be different/faster timeline.
- Not necessary. What is driving demand is the cost savings over virgin pulp, as long as you can process and decontaminate. In containerboard industry, additional regulations won't change the cost savings incentive.
- 100 percent confident in the voluntary approach to drive to a new PCR level, except the toilet paper product. Demand remains strong for toilet paper that is softer and stronger than an increase PCR can provide.
- Fairly confident. Strong market. As our brand is focused on this consumer interest.
- I am confident in the future demand.
- Confident b/c already Home Depot, Walmart, etc. are requesting.
- Don't know.
- Don't know.
- Not confident.
- We have already seen consumer pressure on brands greatly increase their focus on both use of recycled fiber and recyclability of products, and we believe that will continue.

Have you or do you expect to experience an increase or decrease in demand for recycled content products from your customers?

Responses: 11/20; 55 percent

- It's only going to go up.
- Don't know. New to company.

- Customers in the area seem to be showing a decrease, driven by COVID-19 and not wanting recycled toilet paper.
- Highest demand is for recycled content. More demand for 100 percent recycled material
- Increase.
- Increase.
- Increase as customers become more interested in sustainability.
- Most want it to increase, but don't want to pay extra for it.
- Don't know.
- Less. Going out of business at end of September, with COVID-19 we are printing less and cannot compete with cartridge prices out of China.
- Have not experienced a change to date.
- Possible to increase but no customers have asked yet.
- Based on what we have seen over the past several years and the conversations we have with customers, we expect the demand for recycled content products to increase, but there always will be a need for virgin fiber.

What market-based mechanisms do you view as working elsewhere – give examples if possible.

Responses: 11/20; 55 percent

- Not sure. Depends on state-scale dynamics.
- Kroeger - last year they announced by 2021 they would be out of single use plastic bags. Estimated they would eliminate 500 million plastic bags annually but did not take into account the capacity of the alternative.
- Years ago, government required X percent of PCR in paper. In Canada, (government regulations) have ways to move the bar - that could be a driver here. The capital costs to reach these goals are large.
- No examples come to mind.
- Unsure of how to answer.
- End of check-out bags would increase demand due to fewer plastic bags.
- Do not know.
- Referred to The Recycling Partnership's State of Curbside report. In particular, page 23 (pdf page 30) has a section entitled "Community Actions to Address Contamination", Incoming contamination is a variable that local governments can influence, and TRP is an organization that can assist in that effort. Https://recyclingpartnership.org/stateofcurbside/
- Don't know.
- Don't know. Plants are different. Feedstock from one process varies on to another.
- Do not know.
- The current mature markets for fiber recovery are evidence of a system that works. Paper recovery has consistently remained at approximately 65-68 percent and OCC recovery for reuse has steadily held at approximately 90 percent for several years.

  We do, however, need to be open to new processes and technology where we currently have gaps instead of hoping our current systems improve. We believe our Juno Technology is a good example of a market-based solution that captures material that currently goes to landfills or incinerators because of contamination or coatings and requires no change on the part of the commercial business or its customers and employees, nor does it impact current recycling streams.

APPENDIX B

Complete Supply Estimates, Data Sources and Assumptions

TOTAL SUPPLY (tons)

TOTAL	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Collected for Recycling																										
Cardboard	*337,690*	*334,919*	*384,016*	*375,077*	*372,291*	*370,061*	*384,062*	*397,157*	*409,796*	*422,784*	*435,971*	*444,295*	*454,051*	*464,951*	*478,359*	*491,721*	*505,534*	*519,818*	*534,593*	*549,882*	*565,707*	*582,093*	*599,067*	*616,655*	*634,887*	*653,796*
Unwaxed OCC/Kraft Paper	337,690	334,919	384,016	375,077	372,291	370,061	384,062	397,157	409,796	422,784	435,971	444,295	454,051	464,951	478,359	491,721	505,534	519,818	534,593	549,882	565,707	582,093	599,067	616,655	634,887	653,796
Paper	*323,520*	*295,915*	*278,529*	*270,642*	*268,474*	*266,316*	*276,773*	*286,517*	*295,898*	*305,541*	*315,329*	*321,326*	*328,427*	*336,407*	*346,329*	*356,205*	*366,421*	*376,993*	*387,936*	*399,267*	*411,004*	*423,167*	*435,774*	*448,848*	*462,410*	*476,485*
Newsprint	26,249	26,872	45,028	43,691	43,435	43,416	44,891	46,287	47,645	49,040	50,456	51,430	52,539	53,758	55,212	56,666	58,166	59,714	61,312	62,961	64,665	66,426	68,246	70,127	72,073	74,086
Mixed Low-Grade Paper	294,432	266,105	227,046	220,687	218,826	216,736	225,476	233,599	241,405	249,431	257,577	262,461	268,288	274,865	283,104	291,297	299,778	308,557	317,650	327,070	336,832	346,953	357,449	368,340	379,643	391,380
Polycoat Containers	1,597	1,668	5,154	4,994	4,944	4,870	5,085	5,284	5,473	5,668	5,866	5,976	6,111	6,266	6,465	6,662	6,866	7,078	7,297	7,525	7,762	8,008	8,263	8,529	8,805	9,092
Aseptic Containers	372	381	389	380	380	387	395	403	411	419	428	436	445	454	463	473	482	492	502	512	522	533	543	554	565	577
Phone Books	655	666	688	670	670	683	697	711	725	740	755	770	785	801	817	834	850	867	885	903	921	939	958	977	997	1,017
Shredded Paper	216	223	224	220	220	224	229	233	238	243	248	253	258	263	268	273	279	285	290	296	302	308	314	321	327	334
Total Paper in Collected for Recycling	***661,210***	***630,834***	***662,546***	***645,719***	***640,764***	***636,377***	***660,835***	***683,674***	***705,693***	***728,324***	***751,300***	***765,621***	***782,478***	***801,358***	***824,688***	***847,926***	***871,955***	***896,811***	***922,529***	***949,149***	***976,711***	***1,005,260***	***1,034,841***	***1,065,503***	***1,097,298***	***1,130,281***
TOTAL COLLECTED FOR RECYCLING	**1,443,699**	**1,467,429**	**1,502,228**	**1,455,842**	**1,440,604**	**1,416,460**	**1,480,810**	**1,539,962**	**1,596,372**	**1,654,436**	**1,713,327**	**1,745,365**	**1,784,962**	**1,830,535**	**1,889,541**	**1,948,007**	**2,008,647**	**2,071,563**	**2,136,858**	**2,204,649**	**2,275,055**	**2,348,206**	**2,424,237**	**2,503,292**	**2,585,525**	**2,671,101**
Disposed Waste																										
Cardboard	*36,541*	*44,659*	*45,715*	*44,056*	*43,277*	*40,770*	*42,004*	*43,010*	*43,873*	*44,734*	*45,564*	*45,543*	*45,716*	*46,025*	*46,673*	*47,252*	*47,839*	*48,433*	*49,035*	*49,644*	*50,261*	*50,885*	*51,517*	*52,157*	*52,805*	*53,462*
Plain Corrugated Cardboard (OCC)	33,755	41,092	42,119	40,584	39,861	37,535	38,682	39,617	40,419	41,219	41,991	41,974	42,136	42,425	43,027	43,567	44,114	44,668	45,229	45,797	46,372	46,954	47,544	48,141	48,746	49,358
Waxed Corrugated Cardboard (OCC)	2,786	3,566	3,596	3,472	3,416	3,235	3,322	3,393	3,454	3,515	3,573	3,570	3,580	3,601	3,645	3,685	3,725	3,765	3,806	3,847	3,889	3,931	3,974	4,016	4,060	4,103
Paper	*159,045*	*172,863*	*174,939*	*169,252*	*166,499*	*157,597*	*161,912*	*165,417*	*168,413*	*171,394*	*174,264*	*174,123*	*174,660*	*175,675*	*177,880*	*179,840*	*181,821*	*183,822*	*185,843*	*187,886*	*189,950*	*192,034*	*194,141*	*196,268*	*198,418*	*200,589*
Newspaper (ONP)	16,319	6,277	6,341	6,245	6,182	5,972	6,062	6,133	6,191	6,249	6,303	6,287	6,287	6,296	6,332	6,361	6,389	6,417	6,445	6,472	6,498	6,524	6,550	6,574	6,598	6,622
Low-Grade Recyclable Paper	40,196	63,818	64,636	62,167	60,982	57,183	59,078	60,626	61,959	63,289	64,575	64,568	64,857	65,355	66,370	67,283	68,209	69,148	70,100	71,066	72,046	73,039	74,046	75,068	76,104	77,155
High-Grade Paper	9,822	7,527	7,593	7,403	7,307	6,993	7,138	7,254	7,352	7,449	7,542	7,529	7,540	7,566	7,634	7,692	7,751	7,809	7,868	7,927	7,985	8,044	8,103	8,162	8,221	8,281
Single-Use Food Service Compostable	15,126	13,564	13,681	13,247	13,050	12,408	12,714	12,961	13,171	13,380	13,581	13,565	13,598	13,664	13,815	13,949	14,083	14,219	14,355	14,493	14,631	14,771	14,912	15,053	15,196	15,340
Grocery/Shopping Bags	1,039	1,048	1,057	1,070	1,070	1,067	1,063	1,059	1,055	1,050	1,045	1,040	1,034	1,028	1,021	1,014	1,007	999	991	982	973	964	953	943	932	920
Other Compostable Paper	52,223	60,677	61,291	59,395	58,486	55,538	56,950	58,093	59,067	60,035	60,966	60,901	61,059	61,374	62,080	62,703	63,332	63,967	64,607	65,252	65,903	66,559	67,220	67,887	68,560	69,238
Other Paper	24,320	19,952	20,341	19,725	19,421	18,436	18,909	19,291	19,617	19,942	20,253	20,233	20,286	20,392	20,629	20,838	21,050	21,263	21,478	21,694	21,913	22,134	22,356	22,580	22,807	23,035
Total Paper in Disposed Waste	***195,586***	***217,521***	***220,654***	***213,307***	***209,775***	***198,366***	***203,916***	***208,427***	***212,286***	***216,127***	***219,829***	***219,666***	***220,376***	***221,701***	***224,553***	***227,092***	***229,660***	***232,255***	***234,878***	***237,530***	***240,210***	***242,920***	***245,658***	***248,426***	***251,223***	***254,051***
TOTAL DISPOSED WASTE	**1,172,269**	**1,230,379**	**1,275,098**	**1,234,834**	**1,214,853**	**1,150,218**	**1,181,521**	**1,206,935**	**1,228,653**	**1,250,263**	**1,271,072**	**1,270,013**	**1,273,875**	**1,281,210**	**1,297,174**	**1,311,360**	**1,325,692**	**1,340,171**	**1,354,797**	**1,369,572**	**1,384,496**	**1,399,572**	**1,414,801**	**1,430,182**	**1,445,719**	**1,461,411**
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL GENERATION	**2,615,968**	**2,697,808**	**2,769,541**	**2,675,763**	**2,633,510**	**2,566,678**	**2,662,331**	**2,746,897**	**2,825,025**	**2,904,698**	**2,984,398**	**3,015,378**	**3,058,837**	**3,111,745**	**3,186,716**	**3,259,368**	**3,334,339**	**3,411,734**	**3,491,656**	**3,574,222**	**3,659,551**	**3,747,779**	**3,839,038**	**3,933,474**	**4,031,244**	**4,132,512**
Recycle Rate	55%	54%	54%	54%	55%	55%	56%	56%	57%	57%	57%	58%	58%	59%	59%	60%	60%	61%	61%	62%	62%	63%	63%	64%	64%	65%

TOTAL USABLE/RECOVERABLE	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Total Recoverable in Collected for Recycling	*659,241*	*628,785*	*657,003*	*640,345*	*635,440*	*631,120*	*655,355*	*677,987*	*699,809*	*722,237*	*745,006*	*759,208*	*775,921*	*794,638*	*817,760*	*840,791*	*864,607*	*889,242*	*914,730*	*941,112*	*968,427*	*996,719*	*1,026,034*	*1,056,419*	*1,087,927*	*1,120,612*
Cardboard	337,690	334,919	384,016	375,077	372,291	370,061	384,062	397,157	409,796	422,784	435,971	444,295	454,051	464,951	478,359	491,721	505,534	519,818	534,593	549,882	565,707	582,093	599,067	616,655	634,887	653,796
Paper	321,551	293,866	272,987	265,268	263,150	261,059	271,293	280,830	290,013	299,453	309,035	314,913	321,870	329,687	339,401	349,071	359,073	369,423	380,137	391,230	402,720	414,626	426,967	439,765	453,040	466,817
Total Recoverable in Disposed Waste	*101,132*	*119,763*	*121,746*	*117,468*	*115,402*	*108,750*	*112,022*	*114,689*	*116,976*	*119,256*	*121,456*	*121,398*	*121,853*	*122,670*	*124,383*	*125,917*	*127,470*	*129,041*	*130,633*	*132,243*	*133,874*	*135,525*	*137,197*	*138,889*	*140,601*	*142,335*
Cardboard	33,755	41,092	42,119	40,584	39,861	37,535	38,682	39,617	40,419	41,219	41,991	41,974	42,136	42,425	43,027	43,567	44,114	44,668	45,229	45,797	46,372	46,954	47,544	48,141	48,746	49,358
Paper	67,376	78,670	79,627	76,885	75,541	71,215	73,341	75,072	76,557	78,037	79,465	79,424	79,717	80,245	81,356	82,350	83,355	84,373	85,404	86,447	87,503	88,571	89,653	90,748	91,856	92,977
TOTAL RECOVERABLE PAPER SUPPLY	**760,373**	**748,548**	**778,749**	**757,813**	**750,842**	**739,870**	**767,377**	**792,676**	**816,785**	**841,492**	**866,461**	**880,606**	**897,774**	**917,308**	**942,144**	**966,708**	**992,077**	**1,018,283**	**1,045,363**	**1,073,356**	**1,102,301**	**1,132,245**	**1,163,231**	**1,195,308**	**1,228,529**	**1,262,948**

Please note: 'TOTAL COLLECTED FOR RECYCLING' & 'TOTAL DISPOSED WASTE' includes all materials in the stream

KING COUNTY SUPPLY (tons)																											
KING COUNTY - TOTAL		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
51%	**Collected for Recycling**																										
	Cardboard	*164,667*	*150,686*	*191,273*	*183,878*	*181,091*	*175,019*	*185,099*	*194,195*	*202,754*	*211,581*	*220,522*	*224,516*	*229,855*	*236,248*	*245,059*	*253,732*	*262,762*	*272,166*	*281,963*	*292,174*	*302,819*	*313,921*	*325,505*	*337,594*	*350,218*	*363,404*
36.2%	Unwaxed OCC/Kraft Paper	164,667	150,686	191,273	183,878	181,091	175,019	185,099	194,195	202,754	211,581	220,522	224,516	229,855	236,248	245,059	253,732	262,762	272,166	281,963	292,174	302,819	313,921	325,505	337,594	350,218	363,404
	Paper	*203,083*	*170,367*	*148,772*	*143,021*	*140,853*	*136,130*	*143,971*	*151,045*	*157,703*	*164,568*	*171,523*	*174,629*	*178,781*	*183,754*	*190,608*	*197,353*	*204,377*	*211,691*	*219,312*	*227,254*	*235,533*	*244,169*	*253,178*	*262,582*	*272,400*	*282,656*
3.3%	Newsprint	0	-	17,571	16,892	16,636	16,078	17,004	17,839	18,626	19,437	20,258	20,625	21,115	21,703	22,512	23,309	24,138	25,002	25,902	26,840	27,818	28,838	29,902	31,013	32,172	33,384
24.2%	Mixed Low-Grade Paper	203,083	170,367	127,776	122,836	120,974	116,918	123,652	129,728	135,446	141,342	147,316	149,983	153,550	157,821	163,707	169,501	175,533	181,815	188,360	195,181	202,292	209,709	217,447	225,523	233,956	242,765
0.6%	Polycoat Containers	0	-	3,425	3,293	3,243	3,134	3,315	3,478	3,631	3,789	3,949	4,021	4,116	4,231	4,389	4,544	4,706	4,874	5,050	5,232	5,423	5,622	5,829	6,046	6,272	6,508
	Aseptic Containers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Phone Books	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Shredded Paper	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total Paper in Collected for Recycling	***367,750***	***321,053***	***340,045***	***326,899***	***321,944***	***311,149***	***329,070***	***345,240***	***360,457***	***376,149***	***392,045***	***399,145***	***408,636***	***420,002***	***435,667***	***451,085***	***467,138***	***483,857***	***501,275***	***519,428***	***538,353***	***558,090***	***578,683***	***600,176***	***622,618***	***646,060***
	TOTAL COLLECTED FOR RECYCLING	**1,025,461**	**1,027,757**	**1,045,771**	**1,005,341**	**990,103**	**956,904**	**1,012,017**	**1,061,746**	**1,108,544**	**1,156,802**	**1,205,691**	**1,227,526**	**1,256,714**	**1,291,669**	**1,339,845**	**1,387,262**	**1,436,630**	**1,488,048**	**1,541,615**	**1,597,442**	**1,655,643**	**1,716,344**	**1,779,674**	**1,845,773**	**1,914,791**	**1,986,885**
	Disposed Waste																										
	Cardboard	*27,909*	*35,945*	*36,303*	*34,640*	*33,861*	*31,383*	*32,650*	*33,691*	*34,593*	*35,494*	*36,369*	*36,396*	*36,619*	*36,982*	*37,687*	*38,328*	*38,979*	*39,642*	*40,316*	*41,001*	*41,698*	*42,407*	*43,128*	*43,861*	*44,607*	*45,365*
3.6%	Plain Corrugated Cardboard (OCC)	26,112	33,365	33,697	32,153	31,430	29,131	30,306	31,273	32,110	32,946	33,758	33,783	33,990	34,328	34,982	35,577	36,182	36,797	37,422	38,058	38,705	39,363	40,033	40,713	41,405	42,109
0.3%	Waxed Corrugated Cardboard (OCC)	1,797	2,580	2,606	2,486	2,430	2,253	2,344	2,418	2,483	2,548	2,611	2,612	2,628	2,655	2,705	2,751	2,798	2,845	2,894	2,943	2,993	3,044	3,096	3,148	3,202	3,256
	Paper	*113,457*	*127,024*	*128,288*	*122,410*	*119,658*	*110,903*	*115,379*	*119,059*	*122,244*	*125,430*	*128,521*	*128,615*	*129,404*	*130,689*	*133,180*	*135,444*	*137,746*	*140,088*	*142,470*	*144,892*	*147,355*	*149,860*	*152,408*	*154,998*	*157,633*	*160,313*
0.3%	Newspaper (ONP)	12,962	2,889	2,918	2,784	2,721	2,522	2,624	2,708	2,780	2,853	2,923	2,925	2,943	2,972	3,029	3,080	3,133	3,186	3,240	3,295	3,351	3,408	3,466	3,525	3,585	3,646
5.9%	Low-Grade Recyclable Paper	31,132	54,679	55,224	52,693	51,508	47,740	49,667	51,251	52,622	53,993	55,324	55,364	55,704	56,257	57,329	58,304	59,295	60,303	61,328	62,371	63,431	64,509	65,606	66,721	67,856	69,009
0.5%	High-Grade Paper	6,726	4,418	4,462	4,258	4,162	3,858	4,013	4,141	4,252	4,363	4,470	4,474	4,501	4,546	4,633	4,711	4,791	4,873	4,956	5,040	5,126	5,213	5,301	5,391	5,483	5,576
1.0%	Single-Use Food Service Compostable	10,670	9,111	9,201	8,780	8,582	7,954	8,276	8,539	8,768	8,996	9,218	9,225	9,281	9,374	9,552	9,715	9,880	10,048	10,219	10,392	10,569	10,749	10,931	11,117	11,306	11,498
	Grocery/Shopping Bags																										
4.5%	Other Compostable Paper	33,530	41,913	42,330	40,391	39,483	36,594	38,071	39,285	40,336	41,387	42,407	42,438	42,699	43,122	43,944	44,691	45,451	46,224	47,010	47,809	48,622	49,448	50,289	51,144	52,013	52,897
1.5%	Other Paper	18,437	14,013	14,153	13,504	13,201	12,235	12,729	13,135	13,486	13,837	14,178	14,189	14,276	14,418	14,692	14,942	15,196	15,455	15,717	15,984	16,256	16,533	16,814	17,099	17,390	17,686
	Total Paper in Disposed Waste	***141,366***	***162,969***	***164,591***	***157,050***	***153,518***	***142,286***	***148,029***	***152,750***	***156,837***	***160,924***	***164,890***	***165,011***	***166,023***	***167,671***	***170,867***	***173,772***	***176,726***	***179,730***	***182,786***	***185,893***	***189,053***	***192,267***	***195,536***	***198,860***	***202,241***	***205,679***
	TOTAL DISPOSED WASTE	**869,802**	**922,000**	**931,177**	**888,513**	**868,532**	**804,984**	**837,476**	**864,184**	**887,305**	**910,428**	**932,865**	**933,551**	**939,279**	**948,603**	**966,684**	**983,117**	**999,830**	**1,016,828**	**1,034,114**	**1,051,694**	**1,069,572**	**1,087,755**	**1,106,247**	**1,125,053**	**1,144,179**	**1,163,630**
	TOTAL GENERATION	**1,895,263**	**1,949,757**	**1,969,163**	**1,878,941**	**1,836,688**	**1,761,887**	**1,849,493**	**1,925,930**	**1,995,849**	**2,067,230**	**2,138,556**	**2,161,077**	**2,195,993**	**2,240,272**	**2,306,529**	**2,370,379**	**2,436,460**	**2,504,876**	**2,575,729**	**2,649,136**	**2,725,215**	**2,804,099**	**2,885,921**	**2,970,826**	**3,058,970**	**3,150,515**
	Recycle Rate	54%	53%	53.1%	53.5%	53.9%	54.31%	54.72%	55.13%	55.54%	55.96%	56.38%	56.80%	57.23%	57.66%	58.09%	58.52%	58.96%	59.41%	59.85%	60.30%	60.75%	61.21%	61.67%	62.13%	62.60%	63.07%
			0.75%																								

Please note: 'TOTAL COLLECTED FOR RECYCLING' & 'TOTAL DISPOSED WASTE' includes all materials in the stream

King County Linkup

SEATTLE SUPPLY (tons)																									
SEATTLE - TOTAL		***2015***	***2016***	***2017***	***2018***	***2019***	***2020***	***2021***	***2022***	***2023***	***2024***	***2025***	***2026***	***2027***	***2028***	***2029***	***2030***	***2031***	***2032***	***2033***	***2034***	***2035***	***2036***	***2037***	***2038***	***2039***	***2040***
Collected for Recycling																									
Cardboard		*173,023*	*184,234*	*192,744*	*191,199*	*191,199*	*195,043*	*198,963*	*202,962*	*207,042*	*211,203*	*215,448*	*219,779*	*224,196*	*228,703*	*233,300*	*237,989*	*242,772*	*247,652*	*252,630*	*257,708*	*262,888*	*268,172*	*273,562*	*279,061*	*284,670*	*290,392*
42.4%	Unwaxed OCC/Kraft Paper	173,023	184,234	192,744	191,199	191,199	195,043	198,963	202,962	207,042	211,203	215,448	219,779	224,196	228,703	233,300	237,989	242,772	247,652	252,630	257,708	262,888	268,172	273,562	279,061	284,670	290,392
Paper		*120,437*	*125,548*	*129,757*	*127,621*	*127,621*	*130,186*	*132,803*	*135,472*	*138,195*	*140,973*	*143,806*	*146,697*	*149,645*	*152,653*	*155,722*	*158,852*	*162,044*	*165,302*	*168,624*	*172,013*	*175,471*	*178,998*	*182,596*	*186,266*	*190,010*	*193,829*
5.9%	Newsprint	26,249	26,872	27,457	26,799	26,799	27,338	27,887	28,448	29,020	29,603	30,198	30,805	31,424	32,056	32,700	33,357	34,028	34,712	35,409	36,121	36,847	37,588	38,343	39,114	39,900	40,702
21.7%	Mixed Low-Grade Paper	91,349	95,738	99,270	97,851	97,851	99,818	101,824	103,871	105,959	108,089	110,261	112,477	114,738	117,044	119,397	121,797	124,245	126,742	129,290	131,889	134,540	137,244	140,002	142,816	145,687	148,615
0.4%	Polycoat Containers	1,597	1,668	1,728	1,701	1,701	1,735	1,770	1,806	1,842	1,879	1,917	1,956	1,995	2,035	2,076	2,118	2,160	2,204	2,248	2,293	2,339	2,386	2,434	2,483	2,533	2,584
0.1%	Aseptic Containers	372	381	389	380	380	387	395	403	411	419	428	436	445	454	463	473	482	492	502	512	522	533	543	554	565	577
0.1%	Phone Books	655	666	688	670	670	683	697	711	725	740	755	770	785	801	817	834	850	867	885	903	921	939	958	977	997	1,017
0.0%	Shredded Paper	216	223	224	220	220	224	229	233	238	243	248	253	258	263	268	273	279	285	290	296	302	308	314	321	327	334
Total Paper in Collected for Recycling		***293,461***	***309,782***	***322,501***	***318,820***	***318,820***	***325,228***	***331,766***	***338,434***	***345,237***	***352,176***	***359,255***	***366,476***	***373,842***	***381,356***	***389,021***	***396,840***	***404,817***	***412,954***	***421,254***	***429,721***	***438,359***	***447,170***	***456,158***	***465,327***	***474,680***	***484,221***
TOTAL COLLECTED FOR RECYCLING		**418,238**	**439,672**	**456,457**	**450,501**	**450,501**	**459,556**	**468,793**	**478,216**	**487,828**	**497,633**	**507,636**	**517,839**	**528,248**	**538,866**	**549,697**	**560,746**	**572,017**	**583,514**	**595,243**	**607,207**	**619,412**	**631,862**	**644,563**	**657,518**	**670,735**	**684,216**
Disposed Waste																									
Cardboard		*8,632*	*8,713*	*9,412*	*9,416*	*9,416*	*9,386*	*9,354*	*9,319*	*9,281*	*9,240*	*9,195*	*9,148*	*9,097*	*9,043*	*8,985*	*8,924*	*8,860*	*8,791*	*8,719*	*8,643*	*8,562*	*8,478*	*8,389*	*8,296*	*8,198*	*8,096*
2.4%	Plain Corrugated Cardboard (OCC)	7,643	7,727	8,422	8,431	8,431	8,404	8,375	8,344	8,310	8,273	8,233	8,191	8,145	8,097	8,045	7,991	7,933	7,871	7,806	7,738	7,666	7,591	7,511	7,428	7,340	7,249
0.3%	Waxed Corrugated Cardboard (OCC)	989	986	990	985	985	982	979	975	971	967	962	957	952	946	940	934	927	920	912	904	896	887	878	868	858	847
Paper		*45,588*	*45,839*	*46,651*	*46,841*	*46,841*	*46,694*	*46,533*	*46,358*	*46,169*	*45,964*	*45,744*	*45,508*	*45,255*	*44,986*	*44,700*	*44,396*	*44,074*	*43,733*	*43,374*	*42,994*	*42,595*	*42,175*	*41,733*	*41,270*	*40,784*	*40,276*
1.0%	Newspaper (ONP)	3,357	3,388	3,424	3,461	3,461	3,450	3,438	3,425	3,411	3,396	3,380	3,362	3,344	3,324	3,303	3,280	3,256	3,231	3,205	3,177	3,147	3,116	3,083	3,049	3,013	2,976
2.7%	Low-Grade Recyclable Paper	9,064	9,139	9,412	9,473	9,473	9,444	9,411	9,376	9,337	9,296	9,251	9,204	9,153	9,098	9,040	8,979	8,914	8,845	8,772	8,695	8,614	8,529	8,440	8,346	8,248	8,145
0.9%	High-Grade Paper	3,096	3,108	3,131	3,145	3,145	3,135	3,124	3,113	3,100	3,086	3,071	3,055	3,038	3,020	3,001	2,981	2,959	2,936	2,912	2,887	2,860	2,832	2,802	2,771	2,738	2,704
1.3%	Single-Use Food Service Compostable	4,456	4,453	4,480	4,467	4,467	4,453	4,438	4,421	4,403	4,384	4,363	4,340	4,316	4,290	4,263	4,234	4,203	4,171	4,137	4,100	4,062	4,022	3,980	3,936	3,890	3,841
0.3%	Grocery/Shopping Bags	1,039	1,048	1,057	1,070	1,070	1,067	1,063	1,059	1,055	1,050	1,045	1,040	1,034	1,028	1,021	1,014	1,007	999	991	982	973	964	953	943	932	920
5.5%	Other Compostable Paper	18,693	18,764	18,960	19,004	19,004	18,944	18,879	18,808	18,731	18,648	18,559	18,463	18,361	18,251	18,135	18,012	17,881	17,743	17,597	17,443	17,281	17,111	16,931	16,744	16,547	16,340
1.8%	Other Paper	5,883	5,938	6,188	6,221	6,221	6,201	6,180	6,157	6,131	6,104	6,075	6,044	6,010	5,974	5,936	5,896	5,853	5,808	5,760	5,710	5,657	5,601	5,542	5,481	5,416	5,349
Total Paper in Disposed Waste		***54,220***	***54,552***	***56,063***	***56,257***	***56,257***	***56,081***	***55,887***	***55,677***	***55,449***	***55,203***	***54,939***	***54,656***	***54,353***	***54,029***	***53,686***	***53,321***	***52,934***	***52,525***	***52,093***	***51,637***	***51,157***	***50,652***	***50,122***	***49,566***	***48,983***	***48,372***
TOTAL DISPOSED WASTE		**302,467**	**308,379**	**343,921**	**346,321**	**346,321**	**345,234**	**344,045**	**342,751**	**341,348**	**339,835**	**338,207**	**336,462**	**334,596**	**332,607**	**330,490**	**328,243**	**325,862**	**323,343**	**320,683**	**317,878**	**314,924**	**311,817**	**308,554**	**305,129**	**301,540**	**297,781**
TOTAL GENERATION		**720,705**	**748,051**	**800,378**	**796,822**	**796,822**	**804,790**	**812,838**	**820,967**	**829,176**	**837,468**	**845,843**	**854,301**	**862,844**	**871,472**	**880,187**	**888,989**	**897,879**	**906,858**	**915,926**	**925,086**	**934,336**	**943,680**	**953,117**	**962,648**	**972,274**	**981,997**
Recycle Rate		58%	59%	57%	57%	56.5%	57.1%	57.7%	58.3%	58.8%	59.4%	60.0%	60.6%	61.2%	61.8%	62.5%	63.1%	63.7%	64.3%	65.0%	65.6%	66.3%	67.0%	67.6%	68.3%	69.0%	69.7%
						1%																					

Please note: 'TOTAL COLLECTED FOR RECYCLING' & 'TOTAL DISPOSED WASTE' includes all materials in the stream

Data Sources & Assumptions

1. King County Data Sources:
    a. 2019 Waste Characterization and Customer Survey Report
    b. King County provided recycling information through 2016
    c. 2015 Waste Characterization and Customer Survey Report
    d. 2020 King County Materials Recovery Facility Assessment: Recyclables Characterization
2. King County Assumptions
    a. All Blue shaded fields are calculated
    b. Projections are expressed in upper and lower boundaries, assuming +/- 10 percent from calculated estimates.
    c. Non shaded number fields are raw data from data sources
    d. Green-shaded fields designate usable recovered paper (according to 1a, above) and professional judgement
    e. King County recycling grades not specific, and assumed to fit into designated categories
    f. King County recycling tonnage for 2017-2019 calculated based on 2016 category percentage of Total Recycling
    g. King County tonnage for waste composition by grade for 2016-2018 based on 1a above.
    h. King County tonnage for waste composition by grade for 2015 based on 1c above.
    i. King County Total Generation and Total Recycling for 2017-2019 based on Total Disposal/Total Generation ratio for 2016.
3. Seattle Data Sources:
    a. 2018 Waste Prevention and Recycling Report
    b. 2014 Residential Waste Stream Composition Report
    c. 2018 Self-Haul Waste Stream Composition Report
    d. 2016 Commercial Waste Stream Composition Report

e. 2015 Residential Recycling Stream Composition Report

f. 2020 Oregon Metro Commercial Mixed Recyclables Composition Study (Yellow shaded fields)

4. Seattle Assumptions:

   a. Seattle Total tonnage is sum of Single-Family Residential, Multi-family residential, Commercial, and Self-Haul

   b. Seattle Single Family Recycling tonnage by category for 2015-2019 based on 3e, above

   c. Seattle Single Family Waste tonnage by category for 2015-2019 based on 3b, above

   d. Seattle Multi Family Recycling tonnage by category for 2015-2019 based on 3e, above

   e. Seattle Multi Family Waste tonnage by category for 2015-2019 based on 3b, above

   f. Seattle Commercial Recycling tonnage by category for 2015-2019 based on 3f, above

   g. Seattle Commercial Waste tonnage by category for 2015-2019 based on 3d, above

   h. Seattle Self Haul Recycling tonnage by category for 2015-2019 based on 75 percent of combination of 4b and 4c, above, and 25 percent of 4d, above.

   i. Seattle Self Haul Waste tonnage by category for 2015-2019 based on 3c, above.

   j. All Seattle 2019 tonnage assumed to be equal to 2018 tonnage.

5. Future Project Estimate Assumptions:

   a. Recycling Rates increase by 1 percent each year starting in 2020. This is a conservative assumption for market capacity, since it reflects growth in the supply and, therefore, causes us to think about what it would take to absorb it into the marketplace if recycling rates hit 70 percent plus (across all sectors).

   b. King County's disposal tonnage projection is based on the June 2020 tonnage projection from KCSWD.

   c. Seattle's disposal tonnage projection assumes 1 percent growth each year.

   d. Recycling paper category tonnage and Waste paper category tonnage for 2020-2040 are based on the existing percentages in 2019. Waste composition will

undoubtedly change but building in potential composition trending that might be expected is beyond the scope of this analysis.

e. Total Usable/Recoverable categories based on

f. In all cases, generation = disposal + recycling.

g. Assumes no major programmatic or policy changes – a continued emphasis on recycling.