



The Recycling Development Center (Center) advisory board spent three board meeting discussing issues related to recyclable paper. Notes and slides from those three meetings (December 2020, January 2021, and April 2021) are available at the advisory board [website](#). This document provides:

- Center recommendations and goals
- A synopsis of the current paper market
- A summary of available paper data

Recommendations and Goals

The purpose of this report on recyclable paper is to summarize information and challenges in the current market, and identify where the Center could take actions or support actions by others. The following recommendations and goals for recyclable paper were established by the Center advisory board.

Center recommendations:

- Identify companies in Washington that make paper products that could use recyclable paper as feedstock or where use could be increased.
- Identify how processing of recyclable materials could be improved (like reducing contamination); identify needs, barriers, and opportunities.
- Research and report where increased recycled fiber content in paper product categories would be beneficial or detrimental.
- Update and expand on existing recyclable paper data, starting with the annual reports to Ecology.
- Obtain additional information about end market use and users of recyclable paper.

Center paper market goals:

- Decrease the volume of recyclable paper in disposed municipal solid waste; reported in 2017 at 7.5% of MSW.
- Increase domestic processing capacity for use of recyclable paper, especially in Washington, there are currently 8 pulp/paper mills using recyclable paper as incoming feedstock.
- Reduce non-fiber residuals at recyclable paper end market users (like pulp and paper mills) by reducing contamination in the collected, sorted and processed paper.
- Increase recyclable paper fiber use by manufacturers in Washington, currently 12 known companies.

Current system and challenges

The following provides a summary of the recyclable paper market in Washington using available information and data.

Summary of the current system

Washington's paper industry: In 2017, a total of 389,553 tons of paper/fiber materials were reported to Ecology as delivered to specific companies manufacturing paper packaging and paper products. The companies using recyclable paper are shown in Figure 1. Ecology does not currently have information that

identifies all Washington businesses that use recyclable paper to manufacture new paper packaging or paper products.

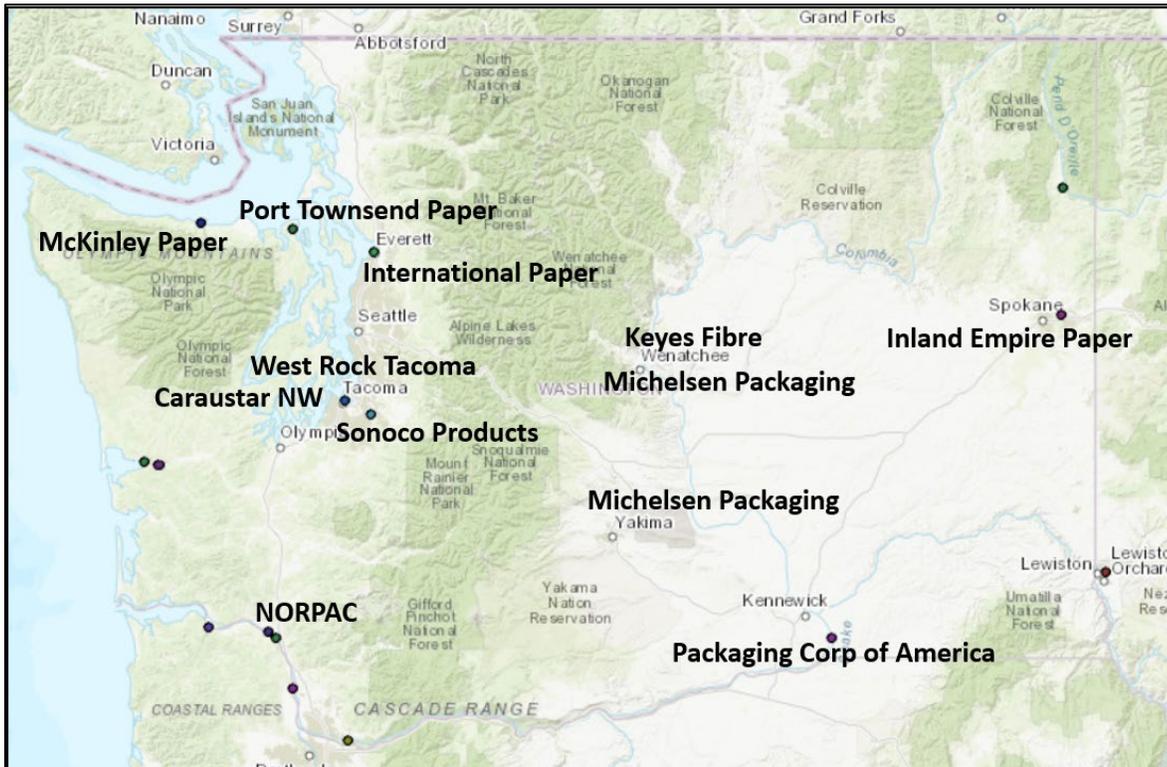


Figure 1 – Washington facilities known to use recyclable paper/fiber

In the February 10, 2021 presentation to the Recycling Development Center advisory board, the American Forest and Paper Association (AF&PA) reported¹ that there are 10 pulp and paper mills and 69 related facilities processing paper in Washington. AF&PA reported that those facilities employ 8,000 workers with an annual payroll of \$790 million; providing \$4.5 billion in product sales.

The 2019 Recycling yearbook by ISRI provides an overview of recovered paper and fiber in the US²:

- Recycling one ton of paper saves 3.3 cubic yards of landfill space.
- Manufacturing paper and paperboard with recycled materials uses up to 68% less energy than using virgin materials.

Recovered paper and fiber is classified in several broad categories:

- Old corrugated cardboard – two layers of linerboard with a rippled middle layer
- News grades – printed newspaper and other newsprint
- Mixed paper – discarded mail, telephone books, paperboard, catalogs, and magazines
- High grade paper – letterhead, copier paper, envelopes, and printer scrap
- Pulp substitutes – shavings or clippings from high grade paper used in paper mills or print shops

¹ https://www.ezview.wa.gov/Portals/_1962/Documents/rdcab/2021-02-Slides.pdf (slide 76)

² <http://www.scrap2.org/yearbook/34/>

Paper Demand: Since 2017, prices for recycled fiber plummeted due to overseas restrictions on exported paper materials which limited contamination to less than 0.5 percent³. This loss of export markets reduced the value of recycled paper materials. Figure 2 shows the change in recycled fiber prices in the Pacific Northwest from April 2015 to April 2021. The Pacific Northwest area includes Washington, Oregon, Idaho, and British Columbia.

Recyclable paper/fiber is known to have lower strength than virgin wood fiber. Paper companies include recyclable paper in their feedstock to supplement virgin fiber availability, recyclable paper has a lower cost, and some customers demand recycled content in the packaging or products.

Recovered paper demand is expected to grow in the near-term⁴, based on data from Fastmarkets RISI. This projection is based on demand from China for brown recycled pulp and domestic consumption. Over the past year, the paper industry has undergone many changes: adjusting to the increased demand of the at-home market and the minimizing of the away-from-home markets. This has resulted in new and announced capacity for some markets and a reduction of capacity for other markets. The ever-changing international laws and trade agreements continue to influence the paper industry too.

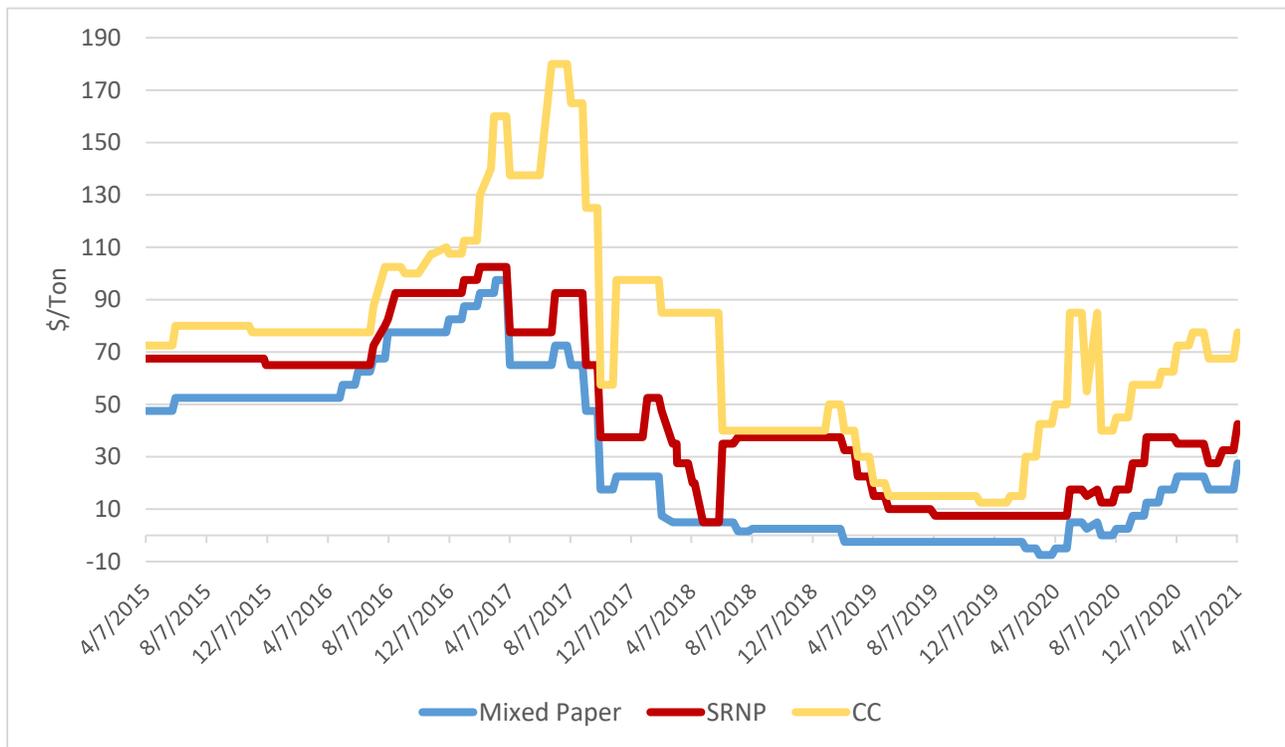


Figure 2 - Recycled fiber prices in the Pacific Northwest

The material categories in Figure 2 defined by RecyclingMarkets.net⁵:

- Mixed paper (blue line) consists of all paper and paperboard of various qualities not limited to the type of fiber content, sorted and processed at a recycling facility. Prohibitive materials (items that damage processing machinery) may not exceed 2%. Outthrows (materials the processor would prefer to not receive) may not exceed 3%.

³ <https://recyclingmarkets.net>

⁴ <https://www.recyclingtoday.com/article/isri2021-recovered-paper-demand-rising-2021/>

⁵ <https://recyclingmarkets.net/secondarymaterials/prices.html?cid=3&city=Pacific+Northwest#null>

- Sorted residential papers and news (SRPN: red line) consists of sorted newspapers, junk mail, magazines, printing and writing papers and other acceptable papers generated from residential programs (such as residential household and apartment collections and drop-off centers) sorted and processed at a recycling facility. Material should be free of containerboard and brown grades (old corrugated containers, Kraft bags, boxboard and Kraft carrier board⁶). Prohibitive materials may not exceed 2%. Outthrows may not exceed 3%.
- Old Corrugated Containers (CC: yellow line) consists of corrugated containers having liners of either teste liner or draft. Prohibited materials may not exceed 1%. Outthrows plus prohibitives may not exceed 5%.
- Carton price data is not included in Figure 2. Cartons include aseptic packaging and gable-top cartons consists of liquid packaging board containers including empty, used, polyethylene (PE)-coated, printed one-side septic and gable-top cartons containing no less than 70% bleached chemical fiber and may contain up to 6% aluminum foil and 24% PE film. Prohibitive materials may not exceed 2%. Outthrows plus prohibitives may not exceed 5%.

Fluctuations in paper prices result from a variety of complex impacts including economic and global changes. The Center advisory board discussions identified a few examples:

- Reduced paper demand as China and other overseas countries restricted imports of recyclable paper.
- Increased domestic demand can increase the paper price: an example would be North Pacific Paper Company's (NORPAC) increased capacity demand for mixed paper in 2018 and 2019. That demand will continue with NORPAC's addition of more packaging processing equipment that will be online by 2022.
- Decreased demand for newspaper, office paper, junk mail, and other paper consumption as online technology replaces paper demand.
- Covid-related reductions in restaurant, conferences, hospitality, and travel reduced demand for paper materials used away from home (graphic paper, tissue products) at restaurants, conference venues, hotels, and airports.
- Covid-related increases in demand comes from online shopping (delivery packaging), working from at home (tissue products), increased home cooking (grocery purchases – paper bags), and increased take-out orders (food packaging).
- Bans on single-use plastics increase demand for paper replacement packaging and products: single use plastic bag ban (Chapter RCW 70A.530); expanded polystyrene food packaging and void filling materials restrictions (Senate Bill 5022).

CONTAMINATION AND OTHER CHALLENGES

Contaminated feedstock: In 2009, Ecology hosted meetings to identify and address contamination and material loss in single family residential commingled recycling systems⁷. Contamination remains a problem in Washington's recycling system for all collected recyclables.

A recent King County study in 2020⁸ reported an overall contamination rate of 12 percent for all recyclable materials processed at selected material recovery facilities (MRF). That same study reported a 7.5% contamination rate for mixed paper.

⁶ <http://cardboardhelp.com/what-are-the-different-cardboard-types-and-its-usage/>

⁷ <https://apps.ecology.wa.gov/publications/SummaryPages/1007009.html>

⁸ https://www.kingcounty.gov/~media/depts/dnrp/solid-waste/about/documents/MRF_assessment-2020.ashx?la=en

Facilities receiving post-consumer paper bales as incoming feedstock have reported contamination (plastic, broken glass, food debris, liquids, metal, including odd items like tennis shoes and tools) in the feedstock paper at rates as high as 20 percent. These contaminants come from the source (resident or commercial), pass through the processing facility, and end up in the bale of paper headed to the end user (paper mill or manufacturer).

This feedstock contamination results in damage to the paper processing equipment (called ‘prohibitives’ by RecyclingMarkets.net), impacts the quality of the end product, results in increased waste, and adds disposal cost to the end users.

Contamination increased since the advent of residential single stream recycling, where all recyclable materials are placed in one bin. Collection, processing, and sorting of single stream recyclable materials needs to improve or collection systems may need to change, such as to a two stream system – one for fiber packaging and paper and another for non-fiber packaging (like glass, metal, and plastic).

Material loss: A 2016 Ecology study⁹ reported ranges of system loss (material lost in the process of collecting, sorting, and processing) at material recovery facilities. For paper the system loss rates range from 7.4 to 19.1 percent. System losses occur from incomplete sorting of materials at the MRF and loss of recoverable material as it is processed by the end user. The study estimated paper utilization rates (material recycled into new products or reused) for paper of 80.9 to 92.6 percent, due to the system loss.

Other challenges: Additional issues that impact recycling of paper include the presence of toxic chemicals, compostable materials, multi-material paper, and coated paper. Processing and sorting of commercially sourced materials mixed with residential sourced materials results in lower quality end product paper bales.

Paper: Data

Ecology receives annual reports from facilities across the state of Washington that handle solid wastes, including businesses that handle recyclable materials. The most recent data available from those reports is for calendar year 2017. This data reflects the movement of waste and recyclable materials just before China implemented the ban on imports of solid waste, including paper, plastic, textiles, and other materials. This section provides a synopsis of the 2017 paper recycling data. The data reported to Ecology for 2017¹⁰ is shown in Figure 3.

Total waste generation includes recovered materials, municipal solid waste (MSW) disposed, and other disposed wastes. Recovered material includes those materials recovered for recycling (7,768,524 tons) and materials recovered for land application, anaerobic digestion, or energy recovered and materials landfilled and disposed (558,537 tons).

⁹ <https://apps.ecology.wa.gov/publications/documents/1607007.pdf>

¹⁰ <https://ecology.wa.gov/Research-Data/Data-resources/Solid-waste-recycling-data>

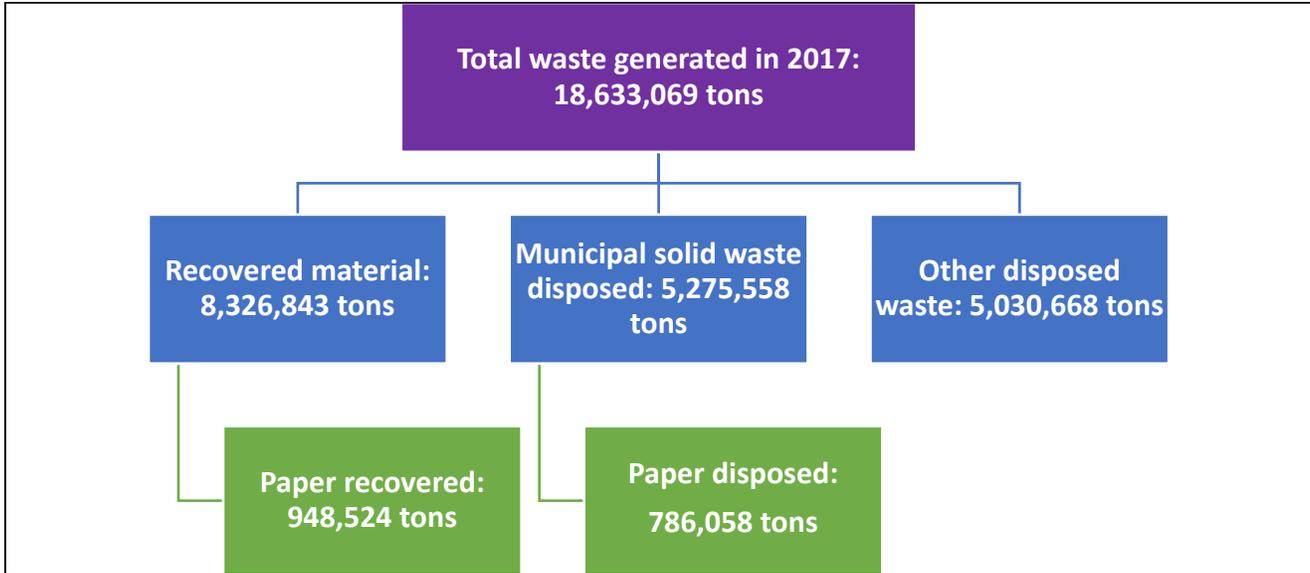


Figure 3 - Chart of solid waste generation, recovery, and disposal data

RECOVERED FOR RECYCLING: Of the 8.3 million tons of recovered material, a total of 7,768,524 tons of materials were collected for recycling. General categories of recyclable materials include: construction/demolition (46 %), metal (20%), organics (17%), **paper (12%)**, glass (2%), moderate risk waste (1.3%), plastic (0.9%), and other materials (0.7% - mattresses, textiles, tires).

Of the 7.7 million tons of recyclable material, 948,524 tons (12%) of paper was reported to Ecology as recovered for recycling. Figure 4 shows the mix of cardboard, newspaper, mixed paper, and high grade paper recovered in 2017. Mixed paper includes magazines, newspapers, and cartons. This data comes from 146 businesses submitting reports to Ecology, those businesses including material recovery facilities, waste haulers, drop boxes, recycling business, and paper manufacturers.

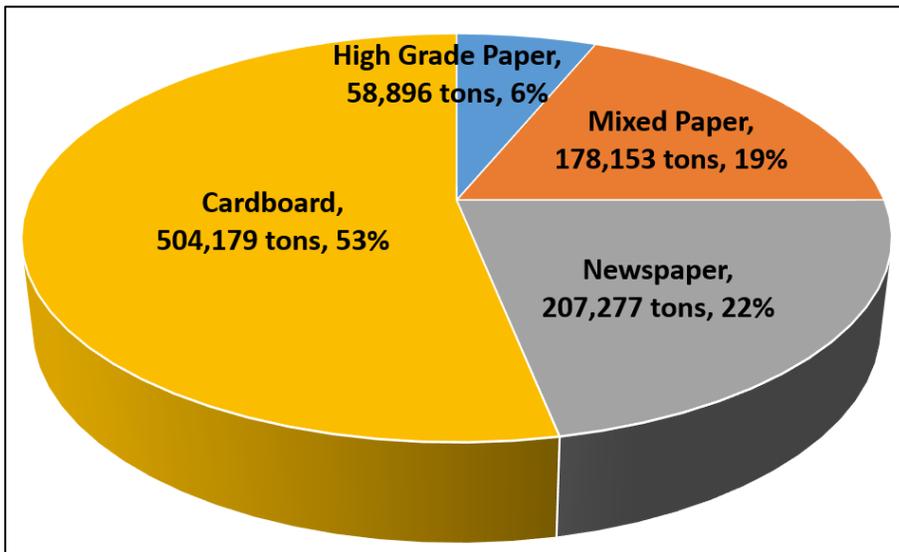


Figure 4 - Paper recovered for recycling in 2017

DISPOSED: The 10,306,225 tons of disposed waste material is separated into municipal solid waste (MSW, 51% or 5,275,558 tons) and other wastes (inert, contaminated soils, demolition, industrial, auto shred, wood - 49% or 5,030,688 tons). Paper from commercial and residential sources is in the MSW stream.

Every five years, Ecology conducts a waste characterization study of MSW from residential, commercial, and self-hauled sources. The amount of paper material in MSW in 2017 is estimated using the waste characterization study percentages of recoverable material in MSW¹¹.

- Paper represented 14.9% of all disposed MSW or 786,058 tons.
- Paper packaging was 7.2% and paper products were 7.7%.
- 44% of paper in the MSW stream was from commercial sources, 34% from residential sources, and 22% self-haul which can be both commercial and residential.

The estimated 786,058 tons of all paper materials in the waste stream included:

- 36,929 tons of high grade paper, including high grade white or light colored bond and copy paper, continuous feed printer paper
- 52,756 tons of newspaper, including shredded newspaper packing material
- 152,991 tons of mixed paper, including colored papers, notebook or lined paper, envelopes with plastic windows, junk mail, non-corrugated paperboard packaging, cereal and cracker boxes and frozen food boxes
- 168,818 tons of cardboard, including cardboard boxes, Kraft paper bags and packaging paper

PAPER RECOVERED AND DISPOSED: Based on the reported recovery and estimated disposal of recyclable paper in 2017 (detailed above), Figure 4 compares the volumes collected and disposed for cardboard, newspaper, mixed paper, and high grade paper. There is an opportunity to increase recovery of these recyclable paper/fiber materials from disposed MSW.

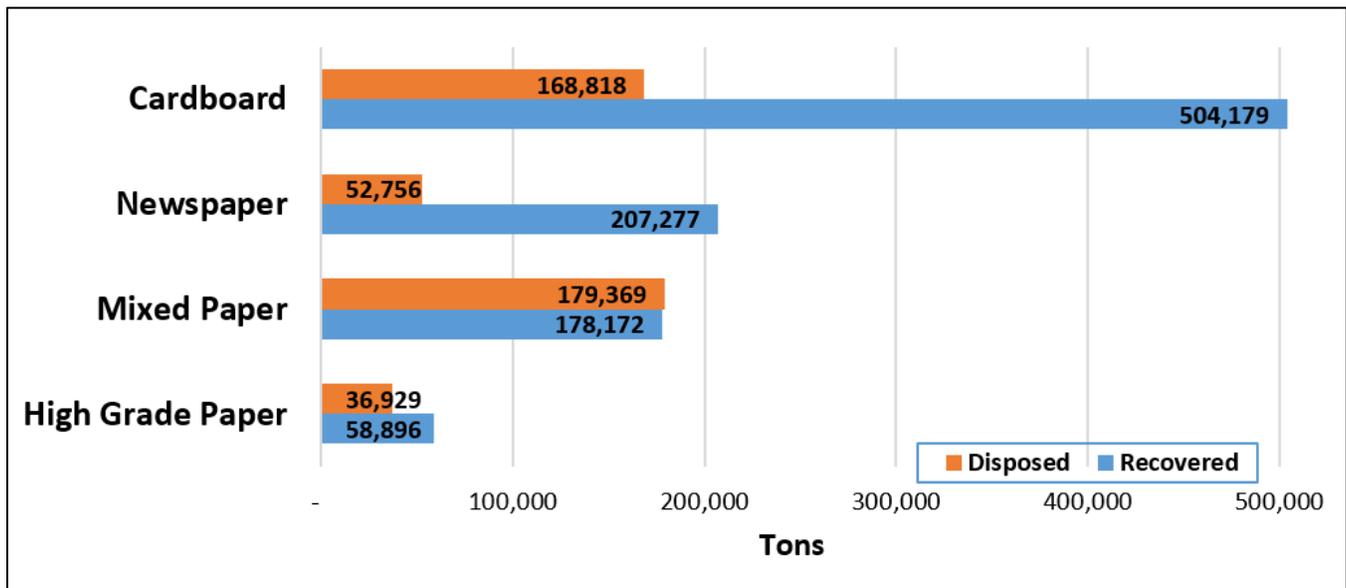


Figure 5 - Disposed and recovered paper in 2017, tons

PAPER EXPORTS: Figure 5 shows the exports of paper through Washington ports since 2015. The overall trends have been decreasing exports¹². In response to import restrictions, exports to China significantly

¹¹ <https://apps.ecology.wa.gov/publications/SummaryPages/1607032.html>

¹² <http://www.wisertrade.org/home/portal/index.jsp>

decreased in 2018. In 2020, the top five export countries for paper from Washington were (in descending order): China, Vietnam, Thailand, Taiwan, and South Korea. Overseas demand for paper, fiber, and pulp from the US, including Washington State, is to supplement the shorter fiber sources in the receiving country with the longer fibers from US pulp and paper. Several pulp mills operate in the US in order to export the pulp to China, for example, Nine Dragons operates mills in Maine, Wisconsin, and West Virginia.

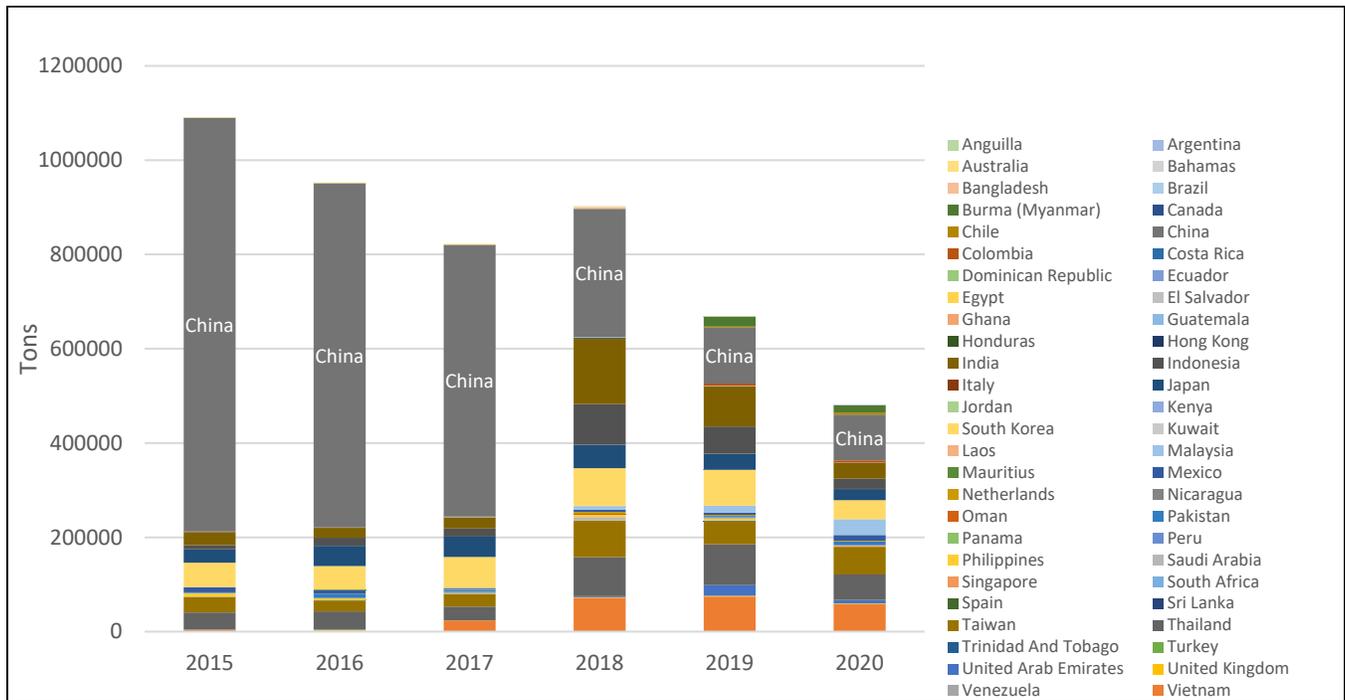


Figure 5 - Paper Washington State exported to other countries

More than 50% of recovered fiber exports are corrugated containers. China is the largest export market for US recovered fiber, followed by India, Mexico, Indonesia, South Korea, Canada, Vietnam, and Taiwan¹³.

As mentioned in the discussion on the value of paper/fiber materials, reductions in paper exports after 2017 could be a result of a combination of:

- Import bans from China and other overseas countries.
- NORPAC’s demand for mixed paper increased in 2018 to make packaging and that capacity increased in 2019. NORPAC recently invested in additional packaging processing equipment that will be online by 2022.
- Decreased demand for newspaper, office paper, junk mail, and other paper consumption as online technology replaces paper demand.

DATA GAPS:

Ecology’s data comes from facilities that submit required or voluntary annual reports for materials collected, delivered, processed, and disposed. Post-industrial waste paper or fiber is not reported to Ecology – an example of that material would be the paper or fiber materials generated by a company making a paper product that do not enter the regulated solid waste stream. Most commercial and

¹³ <http://www.scrap2.org/yearbook/36/>

institutional papers enter the regulated solid waste stream and are reported to Ecology by the collector, recycler, or landfill along with all other recyclables collected or waste landfilled.

Time lags caused by reporting delays and resource gaps to enter, compile and clean solid waste data have resulted in consistent delays of two-plus years to complete final datasets. The most recent data publically available is for 2017.

Material that is brokered from one source to another is not reported to Ecology. In some instances, a broker is noted in the facility data reported to Ecology. However, the end user of the material is usually not included.

Most businesses that use recovered paper to remanufacture paper packaging or paper products do not report to Ecology, because these businesses are not handling solid waste as determined by state regulations. This adds to the knowledge gap in the overall understanding of the flow of paper from consumer to manufacturer.

Export data include materials that pass through Washington's ports. Some of that material may come from Oregon or Idaho. The value of paper/fiber materials are an average for the Pacific Northwest which includes Oregon, Idaho, and British Columbia.

RECOMMENDATIONS

The Center advisory board discussed a variety of issues and possible actions to improve the recycling of paper. Not all of these recommendations are intended for the Center to undertake.

Conduct more research:

Differentiate between paper types: Better understand the end uses of different types of paper – cardboard, mixed paper, newsprint, cartons (like polycoat, tetrapak). How recyclable are specific types of paper packaging or paper products? Which end users prefer which types of recyclable paper?

Toxics research to more clearly detail the problem, challenges, and potential solutions. This is different from contamination. What are the issues and implications of toxics in paper products and packaging (inks, coatings, metals, PFAS) and how does that affect recyclability and remanufactured paper products?

End market users are not clearly defined. Conduct more research into the paper facilities referenced by AF&PA in their presentation. What paper feedstock do they use, what do they make, how much recyclable material do they use?

Commercial versus residential paper collection is not clearly differentiated. Where is the best recyclable material (cleanest source)? Where can more education result in improved recycling? What about industrial and institutional sources?

Innovations in paper products could put new materials into the recycling system. If paper bottles replace cans or glass, how does that impact recycling? What is in the new paper products (internal liner in a paper bottle)?

Investigate other fiber sources, for example wheat straw, bamboo, sugar cane. Look into the research at Columbia Pulp and other innovations. Where are these other fibers appropriate for specific applications? What is the impact to the recycling system if these materials get combined into the paper recycling stream?

Plastic and paper issues do overlap, in the production of products and packaging and in the recycling of each material. How do the two material streams affect each other (manufacturing, recycling, pricing).

Cost of recycling is not clearly detailed. What's affecting the costs of collection, sorting, and repurposing? Are there significant regulatory barriers, labor costs, technology costs, and financing barriers?

Contamination:

Increase consumer education about the proper items allowed in the curbside recycling bin and drop box containers. Much of this education comes from cities and counties who either collect the materials or contract for collection of recyclables. Ecology and local jurisdictions are currently working together to write and implement Contamination Reduction and Outreach Plans (CROPs). Implementation of those plans and the Recycle Right campaign are expected to result in contamination reduction in recyclable materials collected curbside.

Change how paper is collected from the single residential curbside bin (for all packaging and paper products) to several bins. This could improve the quality of paper materials collected and processed (at the material recovery facility) for end market use. That change could remove glass from the single curbside bin or create a two-bin system, one for paper products and the other for containers.

Improved sorting and processing at the MRF would result in higher quality materials delivered to end users. Adding automated sorting to the process could include optical and/or robotic sorting. Those automatic systems have been reported to reduce contamination to less than one percent in the end process bales. What are the costs associated with adding optical and/or robotic sorting to a MRF? What is the return on investment and increase in end paper bale value (and other sorted materials)? Which current MRFs have optical/robotic sorting capability?

Pulp/paper mill impacts and added costs from the use of recyclable paper bales, from prohibited materials that cause equipment damage, added disposal costs from contaminants removed in the process (for example, glass, plastics, tennis shoes), added costs due to impacts on wastewater treatment or hog fuel boiler systems?

Impacts on high grade paper need to be considered. Mixing in other paper materials reduces the value and quality of high grade paper. What is the impact then on the market?

Policy changes:

Several policy approaches were discussed that could improve paper markets.

- Require increased recycled content in paper packaging and paper products.
- Expand on existing government purchasing requirements for recycled content.
- Restrict the disposal of and require recycling of fiber/paper packaging, for example ban landfilling of cardboard.
- Encourage clean streams of recyclable paper (for example, cardboard) from commercial, industrial, or institutional sources to be delivered directly to end users (through brokers).
- Add a bottle deposit return system to remove glass from the commingled collection system.
- Look into model contracts for industrial or institutional purchasing – to increase demand for recycled content in paper packaging and paper products.