1. BACKGROUND AND OBJECTIVES

Oregon Department of Environmental Quality (DEQ) and Partners commissioned the Cascadia Consulting Group (Cascadia) team to conduct research on materials, recycling collection, and sorting and processing infrastructure as part of a statewide process to reset Oregon's recycling systems. Partners include members of Oregon's Recycling Steering Committee and other industry and government recycling stakeholders. The Cascadia Consulting Group team includes industry experts from Circular Matters LLC, Bell and Associates, Drennen Consulting, Moore & Associates, and MORE Recycling.

Based on strategic guidance from DEQ and Partners, the Cascadia team analyzed current (2017) solid waste materials generation, including annual disposed and recovered quantities. Focus materials for this effort were:

- Paper
  - Corrugated Boxes
  - Newsprint
  - Paperboard
  - Printing-Writing Paper
  - Gable-Top Cartons & Aseptic Packaging
- Glass
  - Glass Containers
- Metal
  - Aluminum
  - Tinned Cans
  - Accepted Other Steel
  - Scrap Metals
- Plastics
  - PET Bottles & Jars
  - PET Tubs
  - PET Thermoforms
  - HDPE Bottles & Jars
  - HDPE Tubs and Pails
  - PP Bottles & Jars
  - PP Tubs
  - PP Rigid Packaging & Products
  - All Polystyrene
  - PE Film
  - Plastic Pouches

The Cascadia team then determined which individual materials to recommend prioritizing in the following collection and processing research (Phase II), considering industry expert input for each material's relative contribution based on the following evaluation criteria:

- Estimated potential reduction in environmental impacts associated with recycling (using E.P.A.'s Waste Reduction Model for avoided greenhouse gas [GHG] emissions).
- Projected future quantities and growth rates (i.e., annual tons generated in 2025 and compared to 2017).
- Anticipated strength of recycling end market demand.
- Contamination potential in a materials recovery facility accepting commingled materials.

DEQ supported this analysis by providing the most recently available Oregon materials disposal and recovery data. DEQ also provided baseline growth factors.

This document is the Phase I deliverable for the recycling infrastructure research study contracted by DEQ and supported with funding by Metro. It is organized into the following five sections:

1. **Background and Objectives** – provides context and understanding of project goals and background.
2. **Methodology** – summarizes process steps for Phase I data analysis and materials recommendations.

3. **Findings** – highlights key results of the data analysis, including relative GHG impact, relative tonnages, anticipated market demand, and MRF contamination potential for each material.
4. **Recommendations** – recommends which material to prioritize in Phase II research.
5. **Additional Detail:**
    5.1 Material Definitions
    5.2 Summary matrix provided to DEQ & Partners

2. METHODOLOGY

This section summarizes the process steps, data sources, and assumptions utilized in the Phase I data analysis and materials recommendations.

Baseline Quantity and Composition Estimates

Cascadia developed baseline material quantity and composition estimates using tonnage data provided by Oregon DEQ including Oregon's 2016-2017 waste composition study and Oregon's 2017 material recovery survey, combined with disposal data from landfills in Oregon and exporters of Oregon wastes for 2017. Data included quantities by material stream, geographic location, and generator type.

To isolate the sources of recyclable materials, the boundary for materials tonnages used to define generation was limited as follows:

- Baseline disposal tons excludes tons originating from C&D loads (as defined by the survey data) and MRF residuals.
- Baseline recycling is reported as outbound and excludes MRF residuals. Recycling excludes HHW, recovered C&D materials, and special wastes.
- Organics includes food and yard waste but excludes wood waste.

Material composition for the baseline year is based on data sets provided by DEQ. No other datasets were included in the baseline model (which present data using DEQ's original material categories).

- Disposal composition was based on the 2016-2017 DEQ waste composition results. While Mixed Route Trucks include commercial waste, these compositions were used as the proxy for multifamily disposal. Approximately 41.6 percent of Mixed Route Trucks loads were multifamily compared to 54.1 percent commercial and 4.3 percent single-family residential.
- The inbound recycling composition combined the following data sets: materials tons reported by region, the 2009/2010 inbound recycling composition study results, and the 2009/2010 MRF residual composition.

Projections

Cascadia developed projections by multiplying sector-specific per-capita generation rates by relevant demographic projections provided by DEQ: single-family households, multifamily units, employees, and population. Three methods were assessed for projecting per-capita rates:

1. Applying an annual growth rate based on the historic annual per-capita growth in waste generation from 2010 to 2017 for each of the streams.
2. A rolling average of the per-capita waste generation rate from the preceding eight years.

3. A static per-capita waste generation rate based on the aggregate average waste generation rates from 2015-2017.

Methods varied by sector and region and were selected based on the best match for trends observed in the historic data. Projected tons of generation were allocated by stream based on the average recovery rates from 2013-2017.

Table 1. Growth Projection Methods by Sector and Region

Sector	Metro	Marion	Lane	Rest of Oregon
Single-family	3	2	2	2
Multifamily	3	2	2	2
Commercial	2	2	2	2
Self-haul	3	3	3	3
Bottle bill	2	2	2	2
Other	3	2	2	1

Oregon DEQ's existing data did not provide estimates for the some of the detailed materials that DEQ and Partners selected as focus materials for projections. Cascadia modeled these detailed material splits using the following data methods and sources:

- **Detailed paper categories** were modeled using up to 46 studies published since 2015 (including generator-specific waste composition data) contained in Cascadia's in-house waste composition compiling model.
- **Detailed plastics categories** were modeled using three primary sources based on availability and prioritized in the order listed:
  - Oregon Plastics Recovery Assessment, published in 2015 for Oregon DEQ.
  - Forty-six studies published since 2015 (including generator-specific waste composition data) contained in Cascadia's in-house waste composition compiling model.
  - The 2013 New York City residential disposal composition study.
  - A 2019 detailed study of residential recyclables conducted by Metro (Oregon)

Industry Trends and Market Demand

Based on research conducted in May-June 2019, Cascadia's industry expert team members (Moore & Associates, MORE Recycling, and Circular Matters) provided recommendations for adjusting projections of focus materials, including paper, cartons, and plastic materials, based on their industry expertise and additional research, into industry trends for those materials. Where available, they considered factors such as industry-specific consumption projections; consumption patterns in the Pacific Northwest compared to the United States; trends in consumer preferences and packaging types; impending federal, state and local legislation; China's Blue Skies Policy; supply and demand for recycled content; costs of feedstock materials; and impacts of tariffs or other trade barriers. Research also addressed anticipated market demand.

Data sources and analysis from industry experts are described below. Cascadia integrated this industry expert feedback from team members to adjust projections for focus materials. Industry-trend adjustments were not made for glass or metals, based on direction from DEQ and Partners.

Industry and Market Trends for Paper

Moore & Associates' proprietary database, covering all paper and board grades as defined by ISRI, was used as the basis for the forecast. The forecast was performed based on material volume in short tons for total U.S., with residential and commercial combined, consistent with other data sources in this sector. Volume data was then cross-checked with other relevant data sources and with accounts of paper and board usage in the media, in order to ensure accuracy.

Volumes in the national forecast were factored down to reflect that Oregon accounts for 1.27 percent of people and 1.31 percent of jobs in the U.S. The volume forecast was linked to expected population growth in Oregon which is almost double that of the U.S. through 2030. Total volume for Oregon was then divided between residential and commercial, based on sector rules of thumb (i.e., approximately 80 percent of corrugated is generated commercially; 20 percent by residential).

Data on age, income, race, housing, computer usage, education and the economy were examined to determine where Oregon is similar or different than the U.S. In summary:

- Oregon has a very similar economic base to that of the U.S. as a whole, so we assumed commercial consumption will approximately match that of the U.S.
- Oregon's population is slightly older with 1 percent fewer residents under 18 years of age and with 1 percent more seniors versus the U.S. as a whole. Education and computer usage are higher; percent with no health insurance is lower. Median income, retail spending per-capita, and home ownership are slightly lower than the U.S., while home prices are significantly higher. Given minimal differences when compared with the U.S., growth/decline rates derived from the national forecast were adjusted to accommodate Oregon for only two paper grades under residential (and for no grades under commercial). The decline in newspaper readership was moderated to reflect that older age groups are much more likely to read newspapers. The decline in coated mechanical paper was also moderated as this category includes most magazines and magazine readership skews older, although not as heavily as newspaper readership.

Industry and Market Trends for Plastics

Industry Trends Data Sources and Research Methodology

MORE Recycling researched industry trends using the following methodology:

- Identified key data sets including the U.S. EPA's MSW Facts and Figures, Plastics Industry Producers Statistics, and other proprietary industry data that include historical waste generation and demand projections.
- From the key data sets, highlighted projected movement in various applicable plastic packaging categories that provide insight.
- Identified key industry segments (e.g., converters, resin producers, industry experts) and companies to interview for insights.

- Contacted and conducted interviews with identified contacts regarding plastic-use trends (particularly for plastic packaging) for the next five years. Interviews covered converters in top five largest producers for most categories with a focus on non-bottle rigid plastics and flexibles.
- Documented interview responses including general industry knowledge and reactions to the projected growth or decline in various plastic packaging categories.
- Aligned projected percentage from data segments input from the interviews.

Industry and Market Trends for Cartons and Metals

Circular Matters interviewed producers of carton board stock and packaging machinery. Circular Matters cross-referenced data against national cartons trends (sales growth over time and per-capita quantities) from the U.S. EPA, the Carton Council, and CalRecycle. Circular Matters also developed market trends for metals.

Environmental Benefits

The greenhouse gas (GHG) impact of recycling the projected focus materials was estimated using emissions factors from the E.P.A.'s Waste Reduction Model (WARM). National averages and default values were used for all assumptions related to waste transportation, virgin material percentages, and landfill characteristics. Electricity estimates were based on Oregon-specific grid attributes (Table 2).

Table 2. Assumptions Used in WARM Emissions Factors Calculations

WARM assumption category	Assumption used in analysis
Locations (for electricity)	Oregon
Waste Transport Characteristics	Default Distance (20 miles)
Source Reduction	Current Mix
Landfill Type	National Average
Landfill Gas Recovery	Typical Operation (default)
Moisture Conditions and Decay Rates	National Average
Anaerobic Digestion Type	Wet Digestion
Digestate Curing	Cured (default)

Oregon DEQ's material descriptions were compared to WARM material descriptions to determine the most appropriate emissions factors to use for each DEQ material examined (see Table 3). Where DEQ materials differed substantially from available WARM materials (e.g., aseptic packaging, gable-top cartons, and printing-writing paper), custom emissions factors were calculated based on the component parts of the DEQ materials.

Table 3. DEQ Materials with WARM Proxy Material Choices

DEQ Material	WARM Material Proxy
Corrugated Boxes	Corrugated Containers
Newsprint	Newspaper
Paperboard	Mixed Paper (general)
Printing-Writing Paper	5% Corrugated Containers, 46% Magazines/Third-Class Mail, 49% Office Paper
Gable-Top Cartons & Aseptic Packaging	74% Office Paper, landfilled; 4% Aluminum Ingot and 22% LDPE landfilled
PET Bottles & Jars	PET
PET Tubs	PET
PET Thermoforms	PET
HDPE Bottles & Jars	HDPE
HDPE Tubs and Pails	HDPE
PP Bottles & Jars	HDPE
PP Tubs	HDPE
PP Rigid Packaging & Products	HDPE
All Polystyrene	Mixed Plastics
PE Film	HDPE
Plastic Pouches	Mixed Plastics
Glass Containers	Glass
Aluminum	Aluminum Cans
Tinned Cans	Steel Cans
Accepted Other Steel	Steel Cans
Scrap Metals	Mixed Metals

The GHG emissions per ton of material landfilled were added to the GHG emissions reductions per ton of material recycled to determine the quantity of GHG emissions that are avoided by recycling a ton of material rather than landfilling it. The avoided GHG emissions values were then multiplied by the 2025 material generation projections to arrive at the total avoided emissions that could be expected from recycling Oregon DEQ's focus materials in the future (assuming a 100 percent capture rate).

3. FINDINGS AND RECOMMENDATIONS

Notes: All information presented represents estimates and approximations developed using available information within the available research budget. Information represents high-level estimates, and there is a high degree of uncertainty in all materials – especially in plastics. Due to an extreme amount of uncertainty and lack of composition studies examining this material detail, we are not able to present estimates for polystyrene. Information is suitable for this project but should not be used for investment decisions. Data were gathered in spring 2019.

Table 4 below summarizes findings for individual materials, whether Cascadia recommends them as target materials in Phase II research, and their relative performance against each of the evaluation criteria.

- **Total Avoided GHG Emissions** represents the GHG benefits of recycling instead of landfilling all projected tons generated in 2025, using U.S. EPA's Waste Reduction Model (WARM). As a comparison, 1 metric ton of carbon dioxide equivalent emissions is equivalent to driving 2,445 miles with an average passenger vehicle or providing energy for an average home for 1 month and 13 days.[1]
- **Total Tons** represent the projected tons of the material generated in 2025.

[1] U.S. EPA, "Greenhouse Gas Equivalencies Calculator," December 2018 (https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator)

Table 4. Preliminary Assessment and Prioritization of Targeted Materials

Material	Recommendation	Avoided GHG Emissions if 100% Recycled	Total Generated Tons in 2025	Anticipated Future Market Demand
Paper		**2,720,000**	938,000	
Corrugated Boxes	Yes	1,560,000	542,000	Good long-term demand, so there would be markets if Oregon focused on increasing collection for these grades.
Newsprint	Yes	360,000	102,000	If clean: good demand, so there would be markets if Oregon focused on increasing collection for these grades as separate ONP. Curbside ONP/Mixed Paper has weak short-term demand, so there would not be good markets if Oregon focused on increasing collection quantities for them in the near term.
Paperboard	Yes	233,000	68,000	Weak demand, so there would not be good markets if Oregon focused on increasing collection quantities for them.
Printing-Writing Paper	Yes	559,000	221,000	Demand for or high-quality printing/writing paper is reasonable. With declining volume of these grades increasing collection quantities should be encouraged.
Gable-Top Cartons & Aseptic Packaging	Maybe, but GHG impact is small and no current West Coast markets	4,800	4,000	Aseptic and Gable-Top are combined in the same grade. Moderately growing market demand although no current West Coast markets. Strong stable export demand from Korea and Mexico (tissue), growing demand for building materials in the western U.S., or tissue markets in the eastern U.S.

Material	Recommendation	Avoided GHG Emissions if 100% Recycled	Total Generated Tons in 2025	Anticipated Future Market Demand
Plastics		176,000	172,000	Overall demand for recycled plastic is low due to low virgin pricing, and dependence on price makes the future very uncertain. High-quality, appropriately segregated material will be easier to move than mixed materials.
PET Bottles & Jars	Yes	46,000	41,000	Likely continued demand for PET Bottle commodity.
PET Tubs	Maybe, if targeting all plastics	3,400	3,000	Uncertain, depends on virgin pricing, markets may or may not emerge.
PET Thermoforms	Maybe, if targeting all plastics	7,600	6,800	Uncertain, depends on virgin pricing, markets may or may not emerge.
HDPE Bottles & Jars	Yes	15,000	18,000	Likely continued demand for HDPE bottle commodities.
HDPE Tubs and Pails	Maybe, if targeting all plastics	1,900	2,300	Uncertain.
PP Bottles & Jars	Maybe, but requires additional sorting	980	970	Likely continued demand for a combined PP small rigid commodity.
PP Tubs	Maybe, but requires additional sorting	8,500	8,400	Likely continued demand for a combined PP small rigid commodity.
PP Rigid Packaging & Products	Maybe, but requires additional sorting and market considerations	4,500	4,500	Smaller rigid can go with PP small rigid PP. Bulky PP would go to a mixed bulky rigid, which is dependent on virgin pricing.
All Polystyrene	No, due to small quantities and uncertain markets for curbside material	Unable to present figures due to extreme uncertainty		Uncertain, depends on virgin pricing, limited/still emerging markets for PS curbside commodities, densified clean white Foam PS, mostly commercial generated, has strong markets.
PE Film	Maybe, primarily source-separated or as contaminant concern	86,000	85,000	Uncertain due to virgin pricing, even for clean commercial film, but particularly for retail collected film and curbside MRF film.

Material	Recommendation	Avoided GHG Emissions if 100% Recycled	Total Generated Tons in 2025	Anticipated Future Market Demand
Plastic Pouches	No, except as contaminant – but quantities are small	2,200	2,200	Very uncertain.
Glass		43,000	169,000	
Glass Containers	Maybe, but curbside collection poses either labor/cost or sortation challenges	43,000	169,000	Stable when collected through bottle bill or on the side; market challenges if collected commingled.
Metal		2,660,000	600,000	
Aluminum	Yes	330,000	36,000	Increasing for aluminum cans demand due to high quality. One can-to-can market in Colorado, all other markets are in the eastern U.S. Weak demand for food cans and foil products at much lower prices than beverage cans.
Tinned Cans	Yes	48,000	26,000	Demand and pricing fluctuate based on the strength of the economy as recycled steel goes into discretionary purchases including construction and automotive.
Accepted Other Steel	Yes	49,000	27,000	Demand and pricing fluctuate based on the strength of the economy as recycled steel goes into discretionary purchases including construction and automotive.
Scrap Metals	Maybe, but most tons collected outside residential/ commercial system	2,230,000	510,000	Demand and pricing fluctuate based on the strength of the economy as recycled steel goes into discretionary purchases including construction and automotive.

4. RECOMMENDATIONS

Based on how materials performed against the evaluation criteria, the following materials are recommended for priority inclusion in Phase II of this project:

- **Paper**
  - Corrugated Boxes
  - Newsprint
  - Paperboard
  - Printing-Writing Paper
- **Plastics**
  - PET Bottles & Jars
  - HDPE Bottles & Jars
- **Glass**
  - Glass Containers (large tonnage but small GHG impact; glass-only curbside collection is more costly than commingled collection while commingled collection poses sortation challenges)
- **Metals**
  - Aluminum (particularly cans)
  - Tinned Cans
  - Accepted Other Steel

Other materials that Cascadia recommends considering for inclusion in Phase II are:

- **Paper**
  - Gable-Top Cartons and Aseptic Containers (total tons and GHG impacts are small, but there is stable or growing market demand.
- **Plastics**
  - PP Bottles & Jars (requires additional sorting but has continued demand)
  - PP Tubs (requires additional sorting but has continued demand)
  - PP Rigid Packaging & Products (requires additional sorting; continued demand for small PP; virgin-dependent demand for bulky PP)
  - PE Film (large tonnage but there are contamination concerns and virgin-dependent pricing even for clean commercial film)
  - PET Tubs (if targeting all plastics, but market is uncertain)
  - PET Thermoforms (if targeting all plastics, but market is uncertain)
  - HDPE Tubs and Pails (if targeting all plastics, but market is uncertain)
- **Metals**
  - Scrap metals (large GHG impact and tonnage, but most tons are collected outside the residential/commercial route-based system.

While data were not sufficient to develop tonnage estimates for polystyrene, total quantities are anticipated to be small. As a result, polystyrene is not recommended as a focus material for Phase II research. Plastic pouches are also not recommended as a focus material due to small impact, small quantities, and uncertain markets.

However, the consultant team also understands that DEQ and its Partners desire that Phase II research considers the resiliency of the system against product and market risks to some extent by highlighting options that would keep the system flexible to accommodate new accepted materials or types of contaminants.

5. ADDITIONAL DETAIL

5.1 Material Definitions

The following DEQ-approved material definitions were used to guide the Phase I research.

Paper

Corrugated Boxes means boxes made of three or more layers (unwaxed) of unbleached Kraft paper.

Newsprint means a lightweight paper, made mainly from mechanical wood pulp, engineered to be bright and opaque for the good print contrast needed by newspapers. Newsprint also contains special tensile strength for repeated folding. It does not include printing papers of types generally used for purposes other than newspapers such as mechanical printing papers for catalogs, directories, etc.

Paperboard means paper products that are heavier in basis weight, thicker, and more rigid than paper.

Printing and Writing Paper means any paper suitable for printing, such as book paper, writing paper, envelopes, etc.

- Uncoated freesheet paper —papers in a process that removes lignin, commonly used for office reprographics (copy paper), books, paper and business form paper.
- Coated freesheet papers — paper made in a process that removes lignins that is a high gloss, high quality papers often used for high-end brochures, some magazines, and similar uses
- Coated mechanical papers — mechanical paper and coated with a material to have smooth surface and used for some magazines, catalogs and coupons.
- Uncoated mechanical papers — paper from groundwood often used for newspaper and flyer inserts, financial publications, directories, and paperback books

Cartons

Aseptic Packaging means shelf-stable packaging made up of five layers of separable material: Outer Polyethylene coating (liquid barrier), paperboard (for stability), middle Polyethylene coating, aluminum (for light, odor and oxygen protection) and inner Polyethylene coating (liquid barrier). Roughly 74% paper, 22% Polyethylene and 4% aluminum, aseptic packaging is typically used with juice, milks, soups and broths and wine.

Gable-Top Carton means a refrigerated carton product made of three separable layers: An inner and outer layer of Polyethylene with a layer of paperboard sandwiched in between. Roughly 80% paper and 20% Polyethylene, gable-top cartons are typically used with milks, juices, creams and egg substitute products.

Plastics

High-density Polyethylene (HDPE) Bottles and Jars includes:

- **HDPE Natural Bottle:** any blow-molded, high-density polyethylene bottle containing the ASTM D7611 "#2, HDPE" resin identification code that is unpigmented and has a neck or mouth that is smaller than the base.

- **HDPE Colored Bottle and Jars**: any whole, blow-molded, high-density polyethylene bottle or jar containing the ASTM D7611 "#2, HDPE" resin identification code that is pigmented and opaque.

HDPE Tubs means a whole container, with a #2 HDPE, resin code that has a neck or mouth similar in size to its base.

Polyethylene (PE) Film means polyethylene plastic bags and wrap, and other thin film plastic commonly marked HDPE #2 or LDPE #4. Examples include carry out bags, bread bags, tissue overwrap, air pillows, plastic only shipping envelops, and pallet wrap.

Polyethylene Terephthalate (PET) Bottles and Jars means any PET blow-molded bottle or jar with a screw-neck top that contains the ASTM D7611 "#1, PET or PETE" resin identification code.

Polyethylene Terephthalate (PET) Thermoforms means any PET package labeled with the ASTM D7611 "#1, PET or PETE" resin identification code, not including bottles and jars, but including and not limited to: egg cartons, baskets, clamshell containers, cups, lids, cake domes, covers, blister pack without paperboard backing, tubs, deli containers, trays, folded PET sheet containers.

Polypropylene (PP) Rigid Plastics includes:

- **PP Bottles**: a bottle with a #5 PP resin code has a neck or mouth that is smaller than the base.
- **PP Tubs:** a container, with a #5 PP resin code, that has a neck or mouth similar in size to its base such as ice cream tubs, margarine tubs, tofu tubs, yogurt cups.
- **PP Rigid Plastics**: container or product, with a #5 PP resin code, such as cold drink cups, dishwasher-safe storage containers, flip-type lids, prescription bottles, microwavable trays, and screw-type caps.

Plastic Pouches means flexible containers, many of which are stand up pouches, for food and non-food products. Focus is on those replacing other packaging types, such as rigid plastic packaging. Layers may be multi-resin and multi-material. The material is highly varied with polyethylene, EVOH, PP, PET, nylon, and metals.

Polystyrene (PS) includes:

- **Polystyrene Foam**: a polystyrene container or product injected with gas. Examples may include foam protective packaging, foam deli and takeout containers and clamshells, and foam drink cups and other food service items.
- **Solid Polystyrene** means any non-foam container or product, that may have a #6 PS resin code. Examples include yogurt cups and tubs, red party cups, CD "jewel" cases, disposable coffee lids, and clamshell containers.

Glass

Glass Containers means any color glass bottle or jar used to package food, beverages and other consumable liquids. Includes deposit bottles and containers not subject to Oregon's bottle bill.

Metals

Aluminum means aluminum beverage cans and food containers, aerosol and other non-food cans, aluminum foil, pans and trays, and scrap aluminum such as lawn furniture and screen doors.

Tinned Cans means steel food and beverage cans with a tin coating and may include other coatings.

Metal Containers means tin, steel and aluminum cans or containers used to contain products such as beverages, food or aerosolized products.

Other accepted steel cans and other accepted steel including tin and steel cans or containers used to contain products such as beverages, food or aerosolized products.

Scrap Metal is the combination of ferrous and non-ferrous waste metal, metallic material and any product that contains metal that is capable of being recycled from previous consumption or product manufacturing. For curbside collection programs, scrap metal typically cannot be longer than 30 inches and must weigh less than 30 pounds.

5.2 Additional Industry Trends and Market Demand Findings

Paper

Anticipated industry trends include the following:

- **Corrugated cardboard**: Increasing corrugated cardboard (and flexible packaging) generation due to substantial growth in e-commerce for next 10-15 years.
- **Newspaper**: declining, but the biggest drops have already occurred.
- **Printing-writing paper**:
  - Office/copy type paper: long, slow decline as improved computers/processes result in less paper.
  - Other printing-writing paper: there has been a gradual decline for the last 15 years as more reading, marketing, and information goes online.
- **Paperboard**: modest growth as paper is desirable packaging.

Anticipated market trends (developed in June 2019):

- **OCC:** Short-term market glut, significant U.S. new recycled fiber-based containerboard capacity will move the market up. Next year: Very weak with strengthening. 1 - 3 Year: Strengthening. 3 - 5 Year: Strong
- **Mixed paper:** Chronic over-supply coupled with limited demand in the western U.S. make the market outlook not good**.** Next year: Very weak. 1 - 3 Year: Weak. 3 - 5 Year: Some strengthening.
- **Cleaner ONP grades - #9 OI & #58 SCN:** Limited supply coupled with good demand make the outlook for these grade, good. Next year: Flat, moderately strong. 1 - 3 Year: Strengthening. 3 - 5 Year: Stable to strong.
- **Curbside ONP - #56 SRPN:** Similar to Mixed Paper outlook. Next year: Very weak. 1 - 3 Year: Weak. 3 - 5 Year: Flat.
- **Sorted office paper:** Very limited western U.S. and export demand make the outlook in the short run weak. But over time constrained supply will cause the market to strengthen. Next year: Very weak with strengthening. 1 - 3 Year: Some strengthening. 3 - 5 Year: Flat.
- **Other high grades:** These grades move with pulp prices, currently declining. Next upward cycle is several years out. But supply of these grades is very limited, helping to keep the market in balance. Next year: Declining. 1 - 3 Year: Some strengthening. 3 - 5 Year: Additional strengthening.

Plastics

Plastics industry interviews suggested the following insights:

- An increase in consumer pressure to address plastic waste juxtaposed with brand goals to reduce their carbon footprint brings great uncertainty in the packaging space. The result is increased research and development (R&D) into materials that have a simpler composition, are more recyclable, and contain recycled content.
- Despite current recycling and plastic pollution challenges, over the next five years, the use of plastic packaging in many categories and formats will continue due to consumer demand, preferences, and cost.
- A continued focus on light-weight materials is leading to growth in plastic use for most categories (PET and olefins).
- Growth continues in the switch from rigid plastics to flexible plastics.
- Most of the converters interviewed said their focus is on plastic innovations but that one of their large customers could swing the trend to more wood-fiber-based packaging. Almost all converters mentioned R&D in fiber packaging innovation.
- Companies are exploring the use of paper and other compostable materials because biodegradable and/or compostable materials, as well as renewable materials, continue to rank high for consumers.

Material-specific anticipated industry trends include the following:

- **Polyethylene terephthalate (PET) bottles and jars**: Some projected data suggests an increase in PET food bottles, which includes jars.
- **High-density polyethylene (HDPE) bottles**: Overall HDPE bottle generation has been flat or had slight growth in recent years. Some data suggests an increase, but there is no industry feedback that this will be the case.
- **Polypropylene (PP) tubs:** Significant uncertainty remains in this category. PP cups and containers data shows growth since 2015, but that fell off in 2018. Industry contacts mentioned it would likely hold steady without shift to other resin or packaging formats, but some products have shifted out of tubs to pouches in recent years. Some data suggests growth over next 10 years, but there is a potential shift to pouches.
- **Polyethylene terephthalate (PET) thermoforms**: Continued growth is expected in PET thermoforms and less and less in PVC and PS.
- **Polystyrene (PS)**: Due to substantial uncertainty and limited data, the Cascadia team is not able to provide numerical estimates for the quantity of polystyrene generated; however, the quantity is assumed to be relatively small.
  - **Foam**: PS foam transport packaging shows a significant growth trend whereas Data and industry feedback suggests a decline for foodservice PS foam (replaced by PET or PP). Foodservice foam makes up a larger portion of generation. Decline estimates are conservative; bans and further deselection for foodservice use could enhance the decline.
  - **Solid**: Data and industry feedback suggests a decline in solid polystyrene. Decline estimates are conservative; bans and further deselection could increase this decline.
- **Polyethylene (PE) film** (food and non-food packaging and shopping bags): PE film food and non-food packaging segments are showing growth with retail bags declining. Growth comes from increased emphasis on lighting-weighting of heavier materials (e.g., rigid packaging and fiber) and extending shelf life. There is significant uncertainty in this space: while R&D is focused on single-resin flexibles, there is some pressure by major customers for fiber innovation, which may influence industry to remain more

heavily in fiber. There is downward pressure on retail bags due to bans and deselection. In commercial generation, historical and projected data as well as industry contacts suggest growth in this category.
- **Plastic pouches**: No specific data were readily available, but all interviewees confirm continued growth in pouches overall for food and non-food products, replacing rigid plastic and bag-in-box packaging.

Anticipated market trends (developed in June 2019):

- **Overall plastics**: Overall demand for recycled plastic is low due to low virgin pricing, dependence on price makes the future very uncertain. High quality, appropriately segregated material will be easier to move than mixed materials. More demand is needed in all plastic commodities if we are to increase recycling.
- **PET bottles & jars**: Likely continued demand for PET bottle commodity
- **PET tubs**: Uncertain, depends on virgin pricing, markets may or may not emerge
- **PET thermoforms**: Uncertain, depends on virgin pricing, markets may or may not emerge
- **HDPE bottles & jars**: Likely continued demand for HDPE bottle commodities
- **HDPE tubs and pails:** Uncertain
- **PP bottles, jars, & tubs**: Likely continued demand for a combined PP small rigid commodity
- **PP rigid packaging & products**: Smaller rigid can go with PP small rigid, PP bulky would go to a mixed bulky rigid, which is dependent on virgin pricing
- **Polystyrene**: Uncertain, depends on virgin pricing, markets may or may not emerge for PS curbside stream, stable for commercial collected material
- **PE film**: Uncertain due to virgin pricing, even for clean commercial film, but particularly for retail collected film and curbside MRF film
- **Plastic pouches**: Very uncertain

Cartons and Metals

Anticipated industry trends for cartons include the following:

- **Gable-top cartons and aseptics**: Increases are due to a growing market for plant-based beverages, dry food, soups and broths, prepared foods/sauces, and e-commerce. They are also anticipated to increase due to anti-plastics backlash and a shift to renewable packages.
- **Gable-top cartons**: increase due to growing market for plant-based beverages, dry food, and renewable packages as well as customer interest in alternatives to plastic packaging due to consumer backlash against plastics.
- **Aseptics**: increase due to growth in markets for sports and nutrition drinks, ongoing packaging substitution for soups, broths, prepared foods/sauces; ecommerce benefits due to no need for refrigeration; and customer interest in alternatives to plastic packaging due to consumer backlash against plastics.
-

Anticipated market trends for cartons and metals are:

- **Gable-top cartons and aseptics:** There is moderately growing market demand for this combined grade although no current West Coast markets. There is strong stable export demand from Korea (tissue), growing demand for building materials in the western U.S., or tissue markets in the eastern U.S.
- **Aluminum cans:** There is increasing demand due to high quality. One can-to-can market is in Colorado; all other markets are in the eastern U.S.

- **Other aluminum**: There is weak demand for food cans and foil products and much lower prices than beverage cans.
- **Steel cans, accepted other steel, and scrap metals:** Demand and pricing fluctuate based on the strength of the economy as recycled steel goes into discretionary purchases including construction and automotive.

\

5.3 Matrix Provided to DEQ & Partners

The tables on the following pages present an additional level of detail regarding:

- Baseline quantities of material generated, disposed, and recycled in Oregon in 2017.
  - Materials are presented in categories used by Oregon DEQ.
- Quantity projections for 2025 and evaluation against criteria for selected focus materials, including:
  - Recommendations for whether to target the material in Phase II
  - Estimated tons generated in 2017 and 2025; estimated percentage change between the periods. *Note: some materials have been modeled*
  - Notes on anticipated market demand.
  - Estimated avoided GHG impacts (comparing recycling to landfilling) using EPA warm, per ton and cumulatively if all material were recycled.
  - Notes on whether the material typically creates a contamination problem when sorted in a MRF.

2017 Baseline Composition Table

OREGON

Material	Overall				
	Disposal		Recycling		Recycling Capture Rate
	Est %	Est Tons	Est %	Est Tons	
Paper	**12.8%**	**339,094**	**49.0%**	**670,237**	
Corrugated cardboard	2.9%	76,059	30.7%	420,667	85%
Newspaper	0.5%	13,455	5.9%	80,091	86%
Paper recyclable with newspaper	2.7%	72,196	9.5%	130,207	64%
Paper not recyclable with newspaper	1.1%	28,429	2.8%	37,803	57%
Gable tops & Aseptics	0.1%	2,226	0.1%	1,469	40%
Polycoated containers & cups	0.9%	24,702	0.0%	-	-
Compostable Paper	3.2%	85,130	0.0%	-	-
Non-recoverable paper	1.4%	36,896	0.0%	-	-
Plastic	**10.2%**	**270,283**	**4.0%**	**54,552**	
Deposit plastic bottles	0.2%	5,897	0.9%	12,080	67%
Other bottles	0.5%	13,913	1.7%	23,498	63%
Accepted tubs & pails	0.3%	8,288	0.3%	4,221	34%
Other rigid plastic containers	0.6%	16,666	0.0%	-	-
Bulky rigids	1.7%	43,820	0.0%	-	0%
Non-recoverable plastic	3.1%	81,318	0.0%	-	-
Recoverable film	1.8%	46,719	1.1%	14,754	24%
Other film	2.0%	53,662	0.0%	-	-
Glass	**4.2%**	**111,144**	**35.0%**	**478,233**	
Deposit glass bottles	0.5%	13,392	5.4%	73,943	85%
Container glass	0.8%	22,244	3.3%	45,568	67%
Non-recoverable glass	1.4%	36,660	0.0%	-	-
Metal	**4.2%**	**111,144**	**35.0%**	**478,233**	
Deposit aluminum cans	0.1%	3,579	1.6%	21,805	86%
Accepted aluminum cans	0.0%	38	0.0%	54	59%
Accepted other aluminum	0.2%	4,171	0.3%	3,557	46%
Deposit steel cans	0.0%	75	0.0%	9	11%
Accepted steel cans	0.6%	17,128	0.5%	6,960	29%
Accepted other steel	0.8%	22,194	0.2%	2,640	11%
Scrap metals	0.9%	24,111	32.4%	443,208	95%
Non-recoverable metal	1.5%	39,850	0.0%	-	-
Other	**70.1%**	**1,859,283**	**3.3%**	**45,787**	
Food	19.2%	508,382	0.0%	-	-
Yard	2.8%	74,223	0.0%	-	-
Accepted Other Compostable	1.3%	33,794	0.0%	-	-
Clean Wood	6.3%	167,869	0.0%	-	-
Motor oil	0.0%	333	3.3%	45,787	99%
Recoverable C&D	11.3%	299,787	0.0%	-	-
Other non-recoverables	29.2%	774,895	0.0%	-	-
Commingled Recycling	10.1%	267,647	54.5%	745,061	74%
Separated Recyclable	5.7%	150,619	45.5%	623,259	81%
Compostable	32.8%	869,398	0.0%	-	-
Non-recoverable	51.4%	1,364,436	0.0%	-	-
Total	**100.0%**	**2,652,100**	**100.0%**	**1,368,320**	**77%**

*Recycling capture rate: tons of recyclables in recycling divided by the sum of recyclables in recycling and disposal. In this table, it excludes compostables.

2017 Baseline Composition Table

OREGON

Material	Single Family				
	Disposal		Recycling		Recycling Capture Rate
	Est %	Est Tons	Est %	Est Tons	
Paper	**14.0%**	**107,315**	**74.3%**	**157,897**	
Corrugated cardboard	1.8%	13,801	25.6%	54,395	80%
Newspaper	0.7%	5,671	18.8%	39,922	88%
Paper recyclable with newspaper	3.2%	24,744	22.5%	47,737	66%
Paper not recyclable with newspaper	1.4%	10,374	7.1%	14,993	59%
Gable tops & Aseptics	0.1%	830	0.4%	850	51%
Polycoated containers & cups	1.4%	10,787	0.0%	-	-
Compostable Paper	4.3%	32,710	0.0%	-	-
Non-recoverable paper	1.1%	8,398	0.0%	-	-
Plastic	**9.9%**	**76,153**	**5.3%**	**11,243**	
Deposit plastic bottles	0.3%	2,252	0.5%	1,104	33%
Other bottles	0.8%	5,802	3.5%	7,438	56%
Accepted tubs & pails	0.2%	1,826	0.7%	1,552	46%
Other rigid plastic containers	0.9%	7,066	0.0%	-	-
Bulky rigids	1.1%	8,433	0.0%	-	0%
Non-recoverable plastic	2.6%	20,106	0.0%	-	-
Recoverable film	1.5%	11,597	0.5%	1,148	9%
Other film	2.5%	19,072	0.0%	-	-
Glass	**3.3%**	**25,637**	**3.8%**	**8,114**	
Deposit glass bottles	0.9%	6,507	5.0%	10,710	62%
Container glass	1.8%	13,471	11.2%	23,697	64%
Non-recoverable glass	0.3%	2,309	0.0%	-	-
Metal	**3.3%**	**25,637**	**3.8%**	**8,114**	
Deposit aluminum cans	0.2%	1,490	0.2%	336	18%
Accepted aluminum cans	0.0%	11	0.0%	4	28%
Accepted other aluminum	0.3%	2,079	0.1%	228	10%
Deposit steel cans	0.0%	30	0.0%	5	15%
Accepted steel cans	1.2%	8,941	1.2%	2,522	22%
Accepted other steel	0.5%	4,147	0.8%	1,668	29%
Scrap metals	0.4%	2,816	1.6%	3,351	54%
Non-recoverable metal	0.8%	6,122	0.0%	-	-
Other	**69.8%**	**534,108**	**0.3%**	**739**	
Food	27.1%	207,826	0.0%	-	-
Yard	4.4%	34,060	0.0%	-	-
Accepted Other Compostable	0.3%	1,925	0.0%	-	-
Clean Wood	1.3%	10,070	0.0%	-	-
Motor oil	0.0%	49	0.3%	739	94%
Recoverable C&D	3.4%	26,198	0.0%	-	-
Other non-recoverables	33.2%	253,981	0.0%	-	-
Commingled Recycling	10.7%	81,999	81.3%	172,754	68%
Separated Recyclable	5.6%	42,873	18.7%	39,646	48%
Compostable	37.4%	286,589	0.0%	-	-
Non-recoverable	46.2%	354,039	0.0%	-	-
Total	**100.0%**	**765,500**	**100.0%**	**212,400**	**63%**

2017 Baseline Composition Table

OREGON

Material	Multifamily Disposal Est %	Disposal Est Tons	Recycling Est %	Recycling Est Tons	Recycling Capture Rate
Paper	**18.5%**	**50,801**	**78.2%**	**14,552**	
Corrugated cardboard	4.5%	12,269	34.1%	6,339	34%
Newspaper	0.5%	1,435	17.0%	3,168	69%
Paper recyclable with newspaper	4.7%	12,879	20.4%	3,788	23%
Paper not recyclable with newspaper	1.3%	3,553	6.4%	1,190	25%
Gable tops & Aseptics	0.1%	345	0.4%	67	16%
Polycoated containers & cups	1.1%	3,109	0.0%	-	-
Compostable Paper	4.3%	11,814	0.0%	-	-
Non-recoverable paper	2.0%	5,397	0.0%	-	-
Plastic	**11.6%**	**31,846**	**4.9%**	**904**	
Deposit plastic bottles	0.4%	982	0.4%	81	8%
Other bottles	0.8%	2,096	2.9%	547	21%
Accepted tubs & pails	0.3%	917	0.6%	114	11%
Other rigid plastic containers	0.7%	2,053	0.0%	-	-
Bulky rigids	1.9%	5,211	0.0%	-	0%
Non-recoverable plastic	3.2%	8,722	0.0%	-	-
Recoverable film	1.6%	4,514	0.9%	162	3%
Other film	2.7%	7,351	0.0%	-	-
Glass	**4.1%**	**11,334**	**3.6%**	**672**	
Deposit glass bottles	0.4%	1,200	4.1%	768	39%
Container glass	0.9%	2,336	9.1%	1,699	42%
Non-recoverable glass	1.6%	4,309	0.0%	-	-
Metal	**4.1%**	**11,334**	**3.6%**	**672**	
Deposit aluminum cans	0.2%	433	0.1%	20	4%
Accepted aluminum cans	0.0%	-	0.0%	0	100%
Accepted other aluminum	0.2%	484	0.1%	14	3%
Deposit steel cans	0.0%	22	0.0%	0	2%
Accepted steel cans	0.9%	2,563	1.0%	186	7%
Accepted other steel	0.9%	2,407	0.7%	123	5%
Scrap metals	0.5%	1,263	1.8%	328	21%
Non-recoverable metal	1.5%	4,162	0.0%	-	-
Other	**62.9%**	**172,363**	**0.0%**	**6**	
Food	23.6%	64,724	0.0%	-	-
Yard	2.7%	7,485	0.0%	-	-
Accepted Other Compostable	0.3%	707	0.0%	-	-
Clean Wood	2.4%	6,496	0.0%	-	-
Motor oil	0.0%	7	0.0%	6	46%
Recoverable C&D	3.0%	8,285	0.0%	-	-
Other non-recoverables	30.9%	84,659	0.0%	-	-
Commingled Recycling	14.7%	40,385	84.1%	15,638	28%
Separated Recyclable	5.3%	14,532	15.9%	2,962	17%
Compostable	33.3%	91,226	0.0%	-	-
Non-recoverable	46.7%	128,047	0.0%	-	-
Total	**100.0%**	**274,190**	**100.0%**	**18,600**	**25%**

CASCADIA CONSULTING GROUP

2017 Baseline Composition Table

OREGON

Material	Commercial				
	Disposal		Recycling		Recycling Capture Rate
	Est %	Est Tons	Est %	Est Tons	
Paper	**14.0%**	**148,148**	**84.7%**	**153,399**	
Corrugated cardboard	3.5%	37,079	54.2%	98,137	73%
Newspaper	0.5%	5,660	9.6%	17,479	76%
Paper recyclable with newspaper	2.6%	27,296	16.0%	29,032	52%
Paper not recyclable with newspaper	1.1%	11,404	4.8%	8,675	43%
Gable tops & Aseptics	0.1%	972	0.0%	77	7%
Polycoated containers & cups	0.9%	9,853	0.0%	-	-
Compostable Paper	3.6%	38,062	0.0%	-	-
Non-recoverable paper	1.7%	17,822	0.0%	-	-
Plastic	**11.7%**	**124,154**	**3.4%**	**6,171**	
Deposit plastic bottles	0.2%	2,199	0.2%	429	16%
Other bottles	0.5%	5,059	2.3%	4,091	45%
Accepted tubs & pails	0.4%	4,255	0.4%	672	14%
Other rigid plastic containers	0.7%	6,880	0.0%	-	-
Bulky rigids	1.8%	19,019	0.0%	-	0%
Non-recoverable plastic	3.5%	37,334	0.0%	-	-
Recoverable film	2.4%	25,056	0.5%	979	4%
Other film	2.3%	24,351	0.0%	-	-
Glass	**4.4%**	**46,547**	**5.0%**	**8,975**	
Deposit glass bottles	0.4%	4,444	2.3%	4,115	48%
Container glass	0.5%	5,059	4.7%	8,506	63%
Non-recoverable glass	2.3%	24,624	0.0%	-	-
Metal	**4.4%**	**46,547**	**5.0%**	**8,975**	
Deposit aluminum cans	0.1%	1,384	0.3%	591	30%
Accepted aluminum cans	0.0%	25	0.0%	6	20%
Accepted other aluminum	0.1%	1,049	0.1%	258	20%
Deposit steel cans	0.0%	22	0.0%	-	0%
Accepted steel cans	0.4%	4,368	1.0%	1,845	30%
Accepted other steel	0.8%	8,751	0.2%	446	5%
Scrap metals	1.2%	12,739	3.2%	5,829	31%
Non-recoverable metal	1.7%	18,208	0.0%	-	-
Other	**66.6%**	**703,865**	**0.0%**	**23**	
Food	20.2%	213,801	0.0%	-	-
Yard	2.2%	22,933	0.0%	-	-
Accepted Other Compostable	2.6%	27,527	0.0%	-	-
Clean Wood	7.3%	77,215	0.0%	-	-
Motor oil	0.0%	275	0.0%	23	8%
Recoverable C&D	7.3%	76,846	0.0%	-	-
Other non-recoverables	27.0%	285,268	0.0%	-	-
Commingled Recycling	10.4%	109,524	89.3%	161,739	60%
Separated Recyclable	6.3%	66,591	10.7%	19,451	23%
Compostable	35.9%	379,538	0.0%	-	-
Non-recoverable	47.4%	501,187	0.0%	-	-
Total	**100.0%**	**1,056,840**	**100.0%**	**181,190**	**51%**

2017 Baseline Composition Table

OREGON

Material	Self-haul				
	Disposal		Recycling		Recycling Capture Rate
	Est %	Est Tons	Est %	Est Tons	
Paper	**5.9%**	**32,830**	**42.8%**	**42,337**	
Corrugated cardboard	2.3%	12,911	33.5%	33,117	72%
Newspaper	0.1%	689	2.2%	2,179	76%
Paper recyclable with newspaper	1.3%	7,277	5.6%	5,542	43%
Paper not recyclable with newspaper	0.6%	3,098	1.5%	1,445	32%
Gable tops & Aseptics	0.0%	79	0.1%	53	40%
Polycoated containers & cups	0.2%	953	0.0%	-	-
Compostable Paper	0.5%	2,544	0.0%	-	-
Non-recoverable paper	1.0%	5,278	0.0%	-	-
Plastic	**6.9%**	**38,130**	**2.5%**	**2,460**	
Deposit plastic bottles	0.1%	464	0.2%	158	25%
Other bottles	0.2%	955	1.4%	1,341	58%
Accepted tubs & pails	0.2%	1,290	0.2%	221	15%
Other rigid plastic containers	0.1%	667	0.0%	-	-
Bulky rigids	2.0%	11,158	0.0%	-	0%
Non-recoverable plastic	2.7%	15,155	0.0%	-	-
Recoverable film	1.0%	5,552	0.7%	740	12%
Other film	0.5%	2,888	0.0%	-	-
Glass	**5.0%**	**27,625**	**45.5%**	**44,981**	
Deposit glass bottles	0.2%	1,241	2.8%	2,788	69%
Container glass	0.2%	1,378	5.2%	5,160	79%
Non-recoverable glass	1.0%	5,419	0.0%	-	-
Metal	**5.0%**	**27,625**	**45.5%**	**44,981**	
Deposit aluminum cans	0.0%	270	0.2%	165	38%
Accepted aluminum cans	0.0%	2	0.0%	1	34%
Accepted other aluminum	0.1%	558	0.1%	58	9%
Deposit steel cans	0.0%	1	0.0%	1	53%
Accepted steel cans	0.2%	1,254	0.9%	862	41%
Accepted other steel	1.2%	6,889	0.1%	144	2%
Scrap metals	1.3%	7,293	44.2%	43,750	86%
Non-recoverable metal	2.0%	11,358	0.0%	-	-
Other	**80.8%**	**448,947**	**1.2%**	**1,155**	
Food	4.0%	22,032	0.0%	-	-
Yard	1.8%	9,746	0.0%	-	-
Accepted Other Compostable	0.7%	3,635	0.0%	-	-
Clean Wood	13.3%	74,088	0.0%	-	-
Motor oil	0.0%	2	1.2%	1,155	100%
Recoverable C&D	33.9%	188,458	0.0%	-	-
Other non-recoverables	27.2%	150,987	0.0%	-	-
Commingled Recycling	6.4%	35,739	45.8%	45,287	56%
Separated Recyclable	4.8%	26,623	54.2%	53,593	67%
Compostable	20.2%	112,045	0.0%	-	-
Non-recoverable	68.6%	381,163	0.0%	-	-
Total	**100.0%**	**555,570**	**100.0%**	**98,880**	**61%**

2017 Baseline Composition Table

OREGON

Material	Bottle Bill Recycling Est %	Bottle Bill Recycling Est Tons	Other Recycling Collectors Recycling Est %	Other Recycling Collectors Recycling Est Tons
Paper	**0.0%**	**-**	**38.5%**	**302,053**
Corrugated cardboard	0.0%	-	29.2%	228,679
Newspaper	0.0%	-	2.2%	17,344
Paper recyclable with newspaper	0.0%	-	5.6%	44,108
Paper not recyclable with newspaper	0.0%	-	1.5%	11,500
Gable tops & Aseptics	0.0%	-	0.1%	422
Polycoated containers & cups	0.0%	-	0.0%	-
Compostable Paper	0.0%	-	0.0%	-
Non-recoverable paper	0.0%	-	0.0%	-
Plastic	**12.5%**	**9,122**	**3.1%**	**24,652**
Deposit plastic bottles	12.5%	9,122	0.2%	1,185
Other bottles	0.0%	-	1.3%	10,081
Accepted tubs & pails	0.0%	-	0.2%	1,661
Other rigid plastic containers	0.0%	-	0.0%	-
Bulky rigids	0.0%	-	0.0%	-
Non-recoverable plastic	0.0%	-	0.0%	-
Recoverable film	0.0%	-	1.5%	11,725
Other film	0.0%	-	0.0%	-
Glass	**16.5%**	**12,082**	**51.5%**	**403,409**
Deposit glass bottles	71.1%	52,046	0.4%	3,515
Container glass	0.0%	-	0.8%	6,506
Non-recoverable glass	0.0%	-	0.0%	-
Metal	**16.5%**	**12,082**	**51.5%**	**403,409**
Deposit aluminum cans	16.5%	12,082	1.1%	8,611
Accepted aluminum cans	0.0%	-	0.0%	42
Accepted other aluminum	0.0%	-	0.4%	3,000
Deposit steel cans	0.0%	-	0.0%	2
Accepted steel cans	0.0%	-	0.2%	1,544
Accepted other steel	0.0%	-	0.0%	259
Scrap metals	0.0%	-	49.7%	389,951
Non-recoverable metal	0.0%	-	0.0%	-
Other	**0.0%**	**-**	**5.6%**	**43,864**
Food	0.0%	-	0.0%	-
Yard	0.0%	-	0.0%	-
Accepted Other Compostable	0.0%	-	0.0%	-
Clean Wood	0.0%	-	0.0%	-
Motor oil	0.0%	-	5.6%	43,864
Recoverable C&D	0.0%	-	0.0%	-
Other non-recoverables	0.0%	-	0.0%	-
Commingled Recycling	28.9%	21,204	41.9%	328,439
Separated Recyclable	71.1%	52,046	58.1%	455,561
Compostable	0.0%	-	0.0%	-
Non-recoverable	0.0%	-	0.0%	-
Total	**100.0%**	**73,250**	**100.0%**	**784,000**

Notes: All information presented represents estimates and approximations developed using available information within the available research budget. Information represents high-level estimates, and there is a high degree of uncertainty in all materials -- especially in plastics. Due to an extreme amount of uncertainty and lack of composition studies examining this material detail, we are not able to present estimates for polystyrene. Information is suitable for this project but should not be used for investment decisions. Tonnage estimates have been rounded to two significant digits (if less than 100,000 tons) or three significant digits (if 100,000 tons or more). Percentage increases and avoided GHG emissions were calculated BEFORE rounding. Data were gathered in spring 2019.

	Should the material be targeted in Phase 2?			Estimated/ Modeled Tons Generated in 2017	Estimated/ Modeled/ Projected Tons Generated in 2025	Estimated Percentage Change in Tons Generated 2017-2025	Notes on Estimated or Anticipated Markets
Material	**Recommendation**	**Pros**	**Cons**	**TOTAL**	**TOTAL**	**TOTAL**	Notes on Anticipated Market Demand
Traditional Paper							
Corrugated Boxes	Yes	Total GHG impact, total tons, market demand		**497,000**	**542,000**	**5% to 10%**	Some/good demand, so there would be markets if Oregon focused on increasing collection for these grades.
Newsprint	Yes	Total GHG impact, total tons		**94,000**	**102,000**	**5% to 10%**	If clean: some/good demand, so there would be markets if Oregon focused on increasing collection for these grades. Curbside ONP has weak demand, so there would not be good markets if Oregon focused on increasing collection quantities for them.
Paperboard	Yes	Total GHG impact, total tons	Market demand	**58,000**	**68,000**	**15% to 20%**	Weak demand, so there would not be good markets if Oregon focused on increasing collection quantities for them.
Printing-Writing Paper	Yes	Total GHG impact, total tons	Market demand	**202,000**	**221,000**	**5% to 10%**	Weak demand, so there would not be good markets if Oregon focused on increasing collection quantities for them. For high-quality paper, it will be a few years until demand increases.
Gable-Top Cartons & Aseptic Packaging	Maybe, only if targeting Gable-tops		Total GHG impact, total tons	**3,700**	**4,000**	**5% to 10%**	Aseptic and Gable-Top are combined in the same grade. Moderately growing market demand although no current West Coast markets. Strong stable export demand from Korea and and Mexico (tissue), growing demand for building materials in the Western USA, or tissue markets in the Eastern USA.
Plastics							Overall demand for recycled plastic is low due to low virgin pricing, and dependence on price makes the future very uncertain. High-quality, appropriately segregated material will be easier to move than mixed materials.
PET Bottles (BB)	Yes	Total tons, market demand		**17,000**	**20,000**	**10% to 15%**	Likely continued demand for PET Bottle commodity.
Other PET Bottles & Jars	Yes	Market demand	Total GHG impact, total tons	**19,000**	**21,000**	**10% to 15%**	Likely continued demand for PET Bottle commodity.
PET Tubs	Maybe, if targeting all plastics		Total GHG impact, total tons	**2,800**	**3,000**	**5% to 10%**	Uncertain, depends on virgin pricing, markets may or may not emerge.

Notes: All information presented represents estimates and approximations developed using available information within the available research budget. Information represents high-level estimates, and there is a high degree of uncertainty in all materials -- especially in plastics. Due to an extreme amount of uncertainty and lack of composition studies examining this material detail, we are not able to present estimates for polystyrene. Information is suitable for this project but should not be used for investment decisions. Tonnage estimates have been rounded to two significant digits. Percentage increases and avoided GHG emissions were calculated BEFORE rounding.

	Waste Hierarchy	Estimated Avoided GHGs (recycling to landfilling) per EPA's WARM Tool			Contamination
Material	Waste Hierarchy	Est. Avoided Emissions per Ton of Material Recycled (MTCO2E)	Est. Cumulative MTCO2E at 100% capture rate	Material proxy used in WARM	Does the material typically cause a problem or require non-standard or advanced equipment or sorting methods to handle in a MRF?
Traditional Paper					
Corrugated Boxes	Recycled	2.88	1,560,000	Corrugated Containers	No
Newsprint	Recycled	3.52	360,000	Newspaper	No
Paperboard	Recycled	3.40	233,000	Mixed Paper (general)	No
Printing-Writing Paper	Recycled	3.40	0	Mixed Paper (general)	No
Gable-Top Cartons & Aseptic Packaging	Recycled	3.40	0	Mixed Paper (general)	Depends on equipment and configuration.
Plastics					
PET Bottles (BB)		1.13	22,000	PET	No
Other PET Bottles & Jars		1.13	24,000	PET	No
PET Tubs		1.13	3,400	PET	No

Notes: All information presented represents estimates and approximations developed using available information within the available research budget. Information represents high-level estimates, and there is a high degree of uncertainty in all materials -- especially in plastics. Due to an extreme amount of uncertainty and lack of composition studies examining this material detail, we are not able to present estimates for polystyrene. Information is suitable for this project but should not be used for investment decisions. Tonnage estimates have been rounded to two significant digits (if less than 100,000 tons) or three significant digits (if 100,000 tons or more). Percentage increases and avoided GHG emissions were calculated BEFORE rounding. Data were gathered in spring 2019.

	Should the material be targeted in Phase 2?			Estimated/ Modeled Tons Generated in 2017	Estimated/ Modeled/ Projected Tons Generated in 2025	Estimated Percentage Change in Tons Generated 2017-2025	Notes on Estimated or Anticipated Markets
Material	**Recommendation**	**Pros**	**Cons**	**TOTAL**	**TOTAL**	**TOTAL**	Notes on Anticipated Market Demand
PET Thermoforms	Maybe, if targeting all plastics		Total GHG impact, total tons	**5,700**	**6,800**	**15% to 20%**	Uncertain, depends on virgin pricing, markets may or may not emerge.
HDPE Bottles (BB)	Yes	Market demand	Total GHG impact, total tons	**180**	**200**	**10% to 15%**	Likely continued demand for HDPE bottle commodities.
HDPE Bottles & Jars	Yes	Market demand	Total GHG impact	**16,000**	**18,000**	**10% to 15%**	Likely continued demand for HDPE bottle commodities.
HDPE Tubs	Maybe, if targeting all plastics		Total GHG impact, total tons	**1,800**	**2,300**	**25% to 30%**	Uncertain.
PP Bottles (BB)	Maybe, but requires additional sorting	Market demand	Total GHG impact, total tons	**180**	**200**	**10% to 15%**	Likely continued demand for a combined PP small rigid commodity.
PP Bottles & Jars	Maybe, but requires additional sorting	Market demand	Total GHG impact, total tons	**700**	**770**	**10% to 15%**	Likely continued demand for a combined PP small rigid commodity.
PP Tubs	Maybe, but requires additional sorting	Market demand	Total GHG impact, total tons	**7,700**	**8,400**	**5% to 10%**	Likely continued demand for a combined PP small rigid commodity.
PP Rigid Packaging & Products	Maybe, but requires additional sorting and market considerations		Total GHG impact, total tons	**3,500**	**4,500**	**25% to 30%**	Smaller rigid can go with PP small rigid PP. Bulky PP would go to a mixed bulky rigid, which is dependent on virgin pricing.
All Polystyrene	No			**14,000**	**15,000**	**5% to 10%**	Uncertain, depends on virgin pricing, markets may or may not emerge for PS curbside stream, stable for commercial collected material.
PE Film	Maybe, primarily source-separated or as contaminant concern	Total tons		**60,000**	**85,000**	**40% to 45%**	Uncertain due to virgin pricing, even for clean commercial film, but particularly for retail collected film and curbside MRF film.
Plastic Pouches	No, except as contaminant -- but quantities are small		Total GHG impact, total tons, market demand	**2,000**	**2,200**	**5% to 10%**	Very uncertain.
Glass							
Deposit glass bottles	Yes, assuming bottle bill continues	Total tons, market demand		**87,000**	**95,000**	**10% to 15%**	Stable when collected through bottle bill or on the side; market challenges if collected commingled.
Container glass	Maybe, but curbside collection poses either labor/cost or sortation challenges	Total tons	Total GHG impact	**68,000**	**74,000**	**5% to 10%**	Stable when collected through bottle bill or on the side; market challenges if collected commingled.

Notes: All information presented represents estimates and approximations developed using available information within the available research budget. Information represents high-level estimates, and there is a high degree of uncertainty in all materials -- especially in plastics. Due to an extreme amount of uncertainty and lack of composition studies examining this material detail, we are not able to present estimates for polystyrene. Information is suitable for this project but should not be used for investment decisions. Tonnage estimates have been rounded to two significant digits. Percentage increases and avoided GHG emissions were calculated BEFORE rounding.

	Waste Hierarchy	Estimated Avoided GHGs (recycling to landfilling) per EPA's WARM Tool			Contamination
Material	Waste Hierarchy	Est. Avoided Emissions per Ton of Material Recycled (MTCO2E)	Est. Cumulative MTCO2E at 100% capture rate	Material proxy used in WARM	Does the material typically cause a problem or require non-standard or advanced equipment or sorting methods to handle in a MRF?
PET Thermoforms	Most of these plastics can be mechanically recycled into a variety of products, but the potential over the next 5 years is dependent on the demand and the quality, which depends on the infrastructure to handle the material. MRF curbside film, pouches, and curbside polystyrene may require conversion to fuel or chemical recycling.	1.13	7,600	PET	Yes, for a segregated commodity.
HDPE Bottles (BB)		0.83	170	HDPE	No
HDPE Bottles & Jars		0.83	15,000	HDPE	No
HDPE Tubs		0.83	1,900	HDPE	No
PP Bottles (BB)		1.01	170	Mixed Plastics	Depends, requires additional sorting that is emerging in MRFs due to value of material if segregated.
PP Bottles & Jars		1.01	640	Mixed Plastics	Depends, requires additional sorting that is emerging in MRFs due to value of material if segregated.
PP Tubs		1.01	7,000	Mixed Plastics	Depends, requires additional sorting that is emerging in MRFs due to value of material if segregated.
PP Rigid Packaging & Products		1.01	3,700	Mixed Plastics	See PP tubs for PP small Rigid, other is bulky PP that would be pulled off the front end and added to a mixed bulky rigid commodity.
All Polystyrene		1.01	15,000	Mixed Plastics	Yes
PE Film		1.01	71,000	Mixed Plastics	Yes
Plastic Pouches		1.01	2,200	Mixed Plastics	Yes
Glass					
Deposit glass bottles	Recycled	0.26	24,000	Glass	NA
Container glass	Recycled	0.26	19,000	Glass	Depends on equipment and configuration.

Notes: All information presented represents estimates and approximations developed using available information within the available research budget. Information represents high-level estimates, and there is a high degree of uncertainty in all materials -- especially in plastics. Due to an extreme amount of uncertainty and lack of composition studies examining this material detail, we are not able to present estimates for polystyrene. Information is suitable for this project but should not be used for investment decisions. Tonnage estimates have been rounded to two significant digits (if less than 100,000 tons) or three significant digits (if 100,000 tons or more). Percentage increases and avoided GHG emissions were calculated BEFORE rounding. Data were gathered in spring 2019.

	Should the material be targeted in Phase 2?			Estimated/ Modeled Tons Generated in 2017	Estimated/ Modeled/ Projected Tons Generated in 2025	Estimated Percentage Change in Tons Generated 2017-2025	Notes on Estimated or Anticipated Markets
Material	**Recommendation**	**Pros**	**Cons**	**TOTAL**	**TOTAL**	**TOTAL**	Notes on Anticipated Market Demand
Metal							
Deposit aluminum cans	Yes	Total GHG impact, total tons, market demand		**25,000**	**28,000**	**5% to 10%**	Increasing demand due to high quality. One can-to-can market in Colorado, all other markets are in the Eastern USA.
Other accepted aluminum	Yes	Total GHG impact	Total tons, market demand	**7,800**	**8,500**	**5% to 10%**	Weak demand for food cans and foil products at much lower prices than beverage cans.
Deposit steel cans	Yes, assuming bottle bill or targeting other steel cans		Total GHG impact, total tons	**70**	**80**	**10% to 15%**	Demand and pricing fluctuates based on the strength of the economy as recycled steel goes into discretionary purchases including construction and automotive.

Notes: All information presented represents estimates and approximations developed using available information within the available research budget. Information represents high-level estimates, and there is a high degree of uncertainty in all materials -- especially in plastics. Due to an extreme amount of uncertainty and lack of composition studies examining this material detail, we are not able to present estimates for polystyrene. Information is suitable for this project but should not be used for investment decisions. Tonnage estimates have been rounded to two significant digits. Percentage increases and avoided GHG emissions were calculated BEFORE rounding.

	Waste Hierarchy	Estimated Avoided GHGs (recycling to landfilling) per EPA's WARM Tool			Contamination
Material	Waste Hierarchy	Est. Avoided Emissions per Ton of Material Recycled (MTCO2E)	Est. Cumulative MTCO2E at 100% capture rate	Material proxy used in WARM	Does the material typically cause a problem or require non-standard or advanced equipment or sorting methods to handle in a MRF?
Metal					
Deposit aluminum cans	Recycled	9.11	252,000	Aluminum Cans	NA
Other accepted aluminum	Recycled	7.18	0	Aluminum Ingot	Depends on specific material, equipment, and configuration.
Deposit steel cans	Recycled	1.81	140	Steel Cans	NA

Notes: All information presented represents estimates and approximations developed using available information within the available research budget. Information represents high-level estimates, and there is a high degree of uncertainty in all materials -- especially in plastics. Due to an extreme amount of uncertainty and lack of composition studies examining this material detail, we are not able to present estimates for polystyrene. Information is suitable for this project but should not be used for investment decisions. Tonnage estimates have been rounded to two significant digits (if less than 100,000 tons) or three significant digits (if 100,000 tons or more). Percentage increases and avoided GHG emissions were calculated BEFORE rounding. Data were gathered in spring 2019.

	Should the material be targeted in Phase 2?			Estimated/ Modeled Tons Generated in 2017	Estimated/ Modeled/ Projected Tons Generated in 2025	Estimated Percentage Change in Tons Generated 2017-2025	Notes on Estimated or Anticipated Markets
Material	**Recommendation**	**Pros**	**Cons**	**TOTAL**	**TOTAL**	**TOTAL**	Notes on Anticipated Market Demand
Accepted steel cans	Yes	Total tons		**24,000**	**26,000**	**5% to 10%**	Demand and pricing fluctuates based on the strength of the economy as recycled steel goes into discretionary purchases including construction and automotive.
Accepted other steel	Yes	Total tons		**25,000**	**27,000**	**5% to 10%**	Demand and pricing fluctuates based on the strength of the economy as recycled steel goes into discretionary purchases including construction and automotive.
Scrap metals	Maybe, but most tons collected outside residential/ commercial system	Total GHG impact, total tons		**467,000**	**510,000**	**5% to 10%**	Demand and pricing fluctuates based on the strength of the economy as recycled steel goes into discretionary purchases including construction and automotive.

Notes: All information presented represents estimates and approximations developed using available information within the available research budget. Information represents high-level estimates, and there is a high degree of uncertainty in all materials -- especially in plastics. Due to an extreme amount of uncertainty and lack of composition studies examining this material detail, we are not able to present estimates for polystyrene. Information is suitable for this project but should not be used for investment decisions. Tonnage estimates have been rounded to two significant digits. Percentage increases and avoided GHG emissions were calculated BEFORE rounding.

	Waste Hierarchy	Estimated Avoided GHGs (recycling to landfilling) per EPA's WARM Tool			Contamination
Material	Waste Hierarchy	Est. Avoided Emissions per Ton of Material Recycled (MTCO2E)	Est. Cumulative MTCO2E at 100% capture rate	Material proxy used in WARM	Does the material typically cause a problem or require non-standard or advanced equipment or sorting methods to handle in a MRF?
Accepted steel cans	Recycled	1.81	48,000	Steel Cans	No
Accepted other steel	Recycled	1.81	49,000	Steel Cans	Depends on specific material, equipment, and configuration.
Scrap metals	Recycled	4.37	2,230,000	Mixed Metals	Depends on equipment and configuration.