

Chapter Four

Recycling Processes

1. Introduction

Recycling is a dynamic process that restores the life cycle of a material. The iconic recycling symbol has 3 chasing arrows. Each arrow represents one step in the three-step process that completes the recycling loop.



The first step is **collection**. Materials are taken from the curbside or drop-off center.

The second step is **processing and marketing** of recycled materials. Materials are sorted and then sold.

The third step is **manufacturing**. The recyclables are converted into new products and take on a new life as consumer goods.

The fourth step is consumer **purchase** of products made from recycled material.

This chapter will cover step one, the collection process; step two, the processing and marketing; and step three, manufacturing. It includes what materials are recyclable and how different recyclable materials are processed into new products and, finally, the benefits of recycling.

2. The Recycling Circle

Typically, raw materials are manufactured into products for consumption. Leftovers are then thrown away. This linear process, from extraction of raw materials, to production, then consumption and disposal, has created a waste crisis. To decrease this one-way flow of resources to overburdened waste disposal facilities, materials no longer needed or wanted can be remanufactured. These different life cycles

Terms introduced in this chapter include:

- Material recovery
- Source separation
- Mixed Recycling (Commingling)
- Deposit system
- Curbside collection
- Multi-material depots
- Buy-back centers
- Cullet

are illustrated in *Figure IV-1*. The decision is the consumer's. After using an item to its fullest extent, the remains may be sent to the Coffin Butte Landfill or separated so that they may be collected, processed, and made into new products. The circle is complete when a consumer purchases items made from, or packaged in, recycled materials.

3. Collection Methods: Source Separation and Mixed Recycling

A consumer might ask questions such as "How

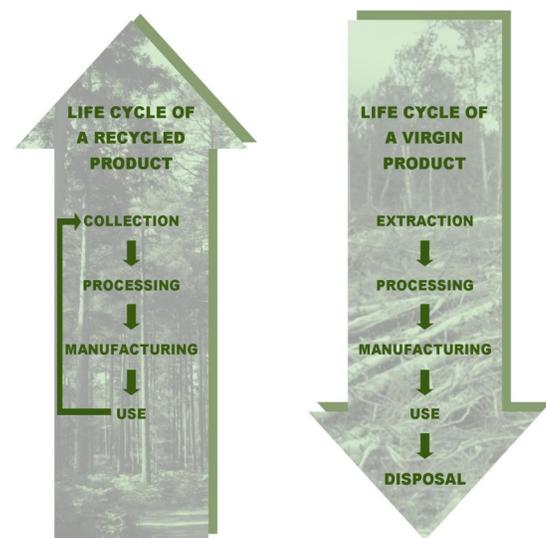


Figure IV-1. Life cycle of a recycled product versus a virgin product.

do I start recycling?” and “Am I going to recycle at a recycling center or will my cast-offs be collected curbside?”

The first step in any recycling system begins with separating recyclable materials from those that will be thrown away or reused. How one separates and prepares materials depends on the local collection system and the market specifications.

A. Recycling Services are Mandated By State Law

Communities in Oregon with over 4,000 residents are required to provide the “**Opportunity to Recycle**” to their citizens.

- < Cities with more than 4,000 but fewer than 10,000 residents must offer small scale curbside recycling programs. Cities over 10,000 must offer expanded recycling services determined by local markets and the needs of the community.
- < Communities with curbside service are expected to provide residents with recycling containers and collect their contents every week. They are also required to provide educational materials that explain the reasons to reduce, reuse, recycle, and compost. All residential, commercial, and institutional collection service customers must receive recycling notification when they start garbage service.
- < For those living in an apartment complex with five or more units, four recyclable materials should be collected, newspaper being the most common. Recycling education opportunities should be available for your neighbors. Service to apartments and businesses is not as uniform. Apartment complexes are not required to offer recycling services unless the complex is in a city that has implemented apartment recycling. However, many apartment owners have worked directly with their haulers to provide centralized recycling containers for newspaper, glass, tin, and cardboard.



Figure IV-2. Mixed recycling being collected at an apartment complex.

Recycling depots should have convenient hours and be open on weekends.

- < Businesses employing 10 or more persons and occupying 1,000 or more square feet should have recycling services.
- < Communities should have systems that include monthly curbside residential yard debris collection for composting, conveniently located yard debris depots, and programs to promote home composting of yard debris. More and more small communities are adding yard debris collection to their trash services. This gives more people the opportunity to reduce the waste volume they send to the landfill, thereby shrinking the overall volume of the waste stream.
- < Rates charged for residential trash collection should encourage waste reduction, reuse, and recycling with lower rates for smaller containers.

For specific information on recycling requirements, see HB3744 in *Chapter I*.

B. What Can Be Recycled?

Many of the materials found in a garbage can are recyclable. *Table IV-1* lists which materials are

Table IV-1.**Materials Commonly Recyclable at the Curb in Linn and Benton Counties****PAPER**

Newsprint
Office paper
Corrugated cardboard
Magazines, Junk Mail
Brown paper bags
Cereal boxes, shoe boxes, egg cartons
Phone books

GLASS (on the side)

Jars, bottles

METAL

Aluminum cans and food containers
Tin cans

PLASTICS

Plastic Bottles
Plastic Jugs
5 Tubs (New in 2020) *Specific to our area

YARD DEBRIS

Plant trimmings
Leaves
Grass clippings
Stumps (specific sites only)
Food scraps (available in some areas; check with your collector)

Special Materials Recycling

(These materials may be recyclable. Check with your hauler and also see Table IV-2 for some local options)

Scrap wood
Pallets
Cedar/ wood shakes
Concrete with/without rebar
Motor oil
Plastic bags (selected grocery stores,)
Tires (at tire company)
Auto batteries
Latex paint
Household batteries (several locations)
Large appliances
Cellular phones
Computers and related peripherals
Printer cartridges
Mercury Thermometers (HHW)

For more information on what is recyclable, where it can be recycled, or how it should be prepared, call Republic Services at 541-754-0444.

RECYCLE RIGHT

MIXED RECYCLING GUIDE



Paper & Cardboard

- Junk mail
- Greeting cards (no foil or glitter)
- Magazines
- Newspaper
- Phone books
- Paperback books
- Paper bags
- Paperboard

Papel y Cartón

- Correo no Deseado
- Tarjetas de felicitación (sin aluminio o glitter)
- Revistas
- Periódicos
- Libros telefónicos
- Libros de tapa blanda
- Bolsas de papel
- Cartón



Plastics

- Bottles
- Jugs
- #5 Tubs

Plásticos

- Botellas
- Gallones
- #5 Bañeras



Empty. Clean. Dry.®



Metal

- Steel (tin cans)
- Aluminum cans

Metal

- Latas de acero (estaño)
- Latas de aluminio



EMPTY. CLEAN. DRY.
VACÍO. LIMPIO. SECO.



We'll handle it from here.®

Table IV-1.

Recycling Beyond the Curb: Local options

This handbook provides details on what is recyclable in curbside containers in Linn and Benton counties. Once the basics of curbside recycling are mastered, waste prevention practices can move to the next level by recycling special items that are not accepted at the curb. It's amazing how much one's contribution to the landfill can be reduced by recycling soft/film plastic, batteries, plastic foam, etc.!

Republic Services recycle Depot

Special Materials Accepted:

Batteries, electronics specific to Oregon E-Cycles Program, scrap metal, cooking & motor oil, CFL bulbs

Contact Info:

110 NE Walnut Blvd. Corvallis 97330

541-754-0444

republicservices.com/site/corvallis-or

Oregon State University- Campus Recycling

Special Materials Accepted:

Packing peanuts of all kinds are accepted from the public. For information on special materials accepted from OSU staff and students, please contact Campus Recycling.

Contact Info:

644 SW 13th St. Corvallis 97333

541-737-2856

recycle@oregonstate.edu

<http://recycle.oregonstate.edu>

Co-Op Community Recycling Center

Special Materials Accepted:

Commingled recycling, corks, ice cream and freezer containers, ink/toner cartridges, cell phones, Styrofoam (for a fee). **Acceptable items change frequently, call ahead.**

Contact Info:

1007 SE 3rd St. Corvallis 97333

541-753-3115

<https://firstalt.coop/community/recycling-center/>

Benton Habitat for Humanity ReStore

Special Materials Accepted:

Used and new building and construction materials such as windows, sinks, toilets, cabinets, doors, electrical and plumbing fixtures, paints, appliances, hardware, tile, bricks, roofing and siding, bath fixtures, furniture, heating and air conditioning, lumber, tools and equipment, in good condition.

Contact Info:

4840 SW Philomath Blvd, Corvallis

(541) 752-6637

<http://bentonhabitat.org/restore>

Local Grocery Stores

Special Materials Accepted:

Plastic grocery bags

Contact Info:

Most grocery stores accept; check with local store.

currently recyclable within Linn and Benton Counties. Materials that are not commonly recyclable, like mercury containing light bulbs, may be accepted at household hazardous waste events so check with Republic Services. This list varies depending on technology and markets. For up-to-date information or specific questions on what can be recycled, call Republic Services.

Can Plastics Be Recycled?

There has been ample debate about the recyclability of plastics. Technically, all plastic packaging is recyclable. Until recently, there were only a few manufacturing facilities on the West Coast that accepted plastics. Before 1994, plastic recycling was limited to soft drink containers and HDPE milk jugs. In 1991, Oregon passed legislation requiring that rigid plastic containers be recycled at a 25 percent rate. Because there was no place to take the materials for sorting, consolidation, and transferring, the **American Plastics Council (APC)** helped Oregon establish a **plastics recovery facility (PRF)** by providing a high technology plastic container separation system. Garten Services, Inc. in Salem was chosen due to its extensive experience in processing recyclables. The APC also offered a limited subsidy for rigid, baled plastic containers for a three-year period.

Beginning in 1994, Garten Services accepted, sorted, and shipped plastics. Because of this, rigid plastic containers continue to be collected curbside in many cities in Linn and Benton Counties. The PRF was the first system in the US to be able to sort the full range of rigid containers by color and resin. Late in 2003, depressed plastics markets and the withdrawal of the subsidy made it more costly to recycle plastics. Due to economics, Garten Services closed the PRF.

Plastics are difficult to recycle because each of the different resin types is chemically bonded in a different way. It is helpful to think of the plastics as being made with different recipes so they are not compatible. To genuinely recycle a plastic resin, it must be melted, converted to the original petrochemical gas from which it was created, and formed back into a product. The plastics recycling with which most consumers are familiar does not follow this path because it is not cost

effective.

To prevent unlike resins from contaminating one another, the Society of the Plastics Industry, Inc. (SPI) developed a resin identification coding system in 1988 to meet the needs of recyclers and to provide manufacturers with a consistent, uniform, nationally recognized system. These are the numbers 1 through 7 which are found on the bottom of containers (see *Figure IV-4*). Because municipal recycling programs typically target container packaging, the SPI coding system offers a way to identify the resin content of bottles and containers commonly found in the residential waste stream.

However, an embossed number inside chasing arrows does not mean that the package is locally recyclable. Plastics with the same number cannot necessarily be recycled together. For example, different manufacturing processes can cause #2 plastic bottles and tubs to melt at different rates. In addition, not all plastics are marked with numbers because they are being introduced by many manufacturers. To improve plastics recycling, plastic manufacturers need to use post-consumer material in their products and consumers need to buy them.

Plastics are expensive to collect and transport because they take up so much space. Collection trucks cannot hold plastic from an entire route. The truck must either drop off the plastic or be equipped with a compactor or grinder.

C. How are Recyclables Collected?

In general, there are three types of systems used to collect recyclables: material recovery, commingling, and source separation.

Material Recovery systems extract recyclables from mixed waste or high-grade loads using a variety of manual and mechanical methods. Mechanical separation takes advantage of physical properties such as size, density, magnetism, buoyancy, and color. These types of systems do not require waste generators (such as the consumer or employee) to separate or sort recyclables.

Source Separation means that recyclables are segregated from other wastes at the point of gen-

Mixed Recycling

Since the implementation of the curbside mixed recycling program in the winter and spring of 2007, the percentage of customers recycling on a regular basis has increased dramatically.



eration—at home or work—and are collected separately from garbage. Each recyclable material (plastic, glass, etc.) is placed in a separate container.

Mixed Recycling (sometimes referred to as commingling) is a collection method that is becoming increasingly common. Due to the injuries and difficulties garbage collectors have had collecting source-separated recyclables, many garbage companies have developed mixed recycling collection programs. Recyclables then go to a processing center to be separated. Customers are given a red or blue bin and a 90-gallon roll cart for recycling. Are the recyclables in good condition being processed this way? Most mixed recycling programs require isolation of materials that will contaminate others when collected together. In Linn and Benton counties, the curbside programs collect glass bottles and jars and motor oil, separately from other recyclable materials. Yard debris is also collected in a separate container. Mixed recycling has made it easier for people to recycle at the curb and has reduced confusion about what to separate. This has led to increased recycling rates. However, recyclers who prefer to source separate their own materials note that mixed recycling has a higher potential for contamination which reduces the market value of the recovered material.

Currently, source separated communities give households roll carts and the household must separate recyclable materials further from trash. These recyclable materials include clear glass, green glass, brown glass, rigid plastic containers, tin cans, aluminum, newspaper, cardboard and Kraft (brown paper) bags, and magazines. Some communities also collect food scraps and yard waste in another roll cart.

Preparing Recyclables for Collection

Recyclable materials must be prepared properly

so that they are free of contaminants and may be handled easily by a hauler.

Collection Methods

There are four common ways of collecting source-separated recyclables: deposit system, curbside collection, depots, and buy-back centers.

In 1971, Oregon passed the first bottle bill requiring refundable deposits on all beer and soft drink containers. These **deposit systems** were intended to reduce beverage container litter, conserve natural resources through recycling, and reduce the amount of solid waste going to landfills. According to the Oregon Department of Environmental Quality (DEQ), the total litter in Oregon was reduced by 47% soon after the bill was implemented. A savings of \$656,832 in trash pick-up, hauling, and land filling was reported the first year after enactment. According to DEQ, containers that carry a deposit initially enjoyed a high return rate, which assured that large amounts of glass, aluminum, and PET got recycled. Since the enactment of the Bottle Bill, the value of the deposit has been eroded by inflation, reducing the attractiveness of returning containers to recover the deposit.

It is estimated that distributors retain over ten million dollars of unclaimed deposits every year. The Association of Oregon Recyclers (AOR) worked with the State legislature to update the



Figure IV-3 examples of recycling containers

Mixed Recycling:

Mixed recycling allows users to mix together their recyclables, with a few exceptions, into a single roll cart instead of separating them into different containers

Material Preparation for Mixed Recycling

Put into recycling roll cart:

Newspaper: Anything that comes with the newspaper can be recycled with the newspaper. Include your TV Guide.

Magazines: This includes glossy bound publications with soft covers only.

Mixed Waste Paper: Mixed waste paper includes: junk mail, flyers, computer paper, carbonless forms, gift wrap (no foil or tape), paper bags, greeting cards (no foil), envelopes, tablet paper, white and colored ledger paper.

Paper board: Flatten. Greyboard includes cereal boxes (without the waxed liner), beverage boxes, gift or shoe boxes, soft cover books, construction paper, paper egg cartons, paper towel and toilet paper tubes.

No frozen food boxes, frozen juice paper cans, paper cartons, foam or wax or plastic packaging materials/liners, pet food bags, fertilizer or charcoal bags, or photographs.

Corrugated Cardboard: Flatten. You may include brown paper bags. No greasy, wax coated, or food contaminated cardboard.

Aluminum & Tin Cans: Remove all non-metal parts, rinse. No need to flatten or to remove bottom. If label is removed, the paper can be recycled. Both can and loose label go into the roll cart.

Plastic Bottles: Rinse. No caps, spray pumps, or Styrofoam cups, packing peanuts, and trays. Do not include bottles that contained petroleum based products (i.e., motor oil or pesticides).

Plastic Jugs: Rinse. Remove and discard caps. Labels are okay. No caps or cap rings.

#5 Tubs: Rinse. No lids. Labels are okay. No bigger than 1 gallon.

Special Separated Recycling (Do not put into the mixed recycling roll cart) Put into small recycling bin on the side only:

Glass Jars and Bottles: Rinse. Labels are okay to leave on. If lids are steel, put into roll cart. Do not include light bulbs, flower vases, Pyrex, cookware, ceramics, drinking glasses, window glass, or any broken glass.

Motor Oil: Pour used motor oil and automotive lubricants into an unbreakable container with a tight fitting lid (original container, rinsed plastic bleach bottle, or rinsed milk bottle) and seal tightly.

Place into gray yard debris roll cart:

Yard Debris- Place grass, leaves, and other “green” waste into the yard debris container. No non-vegetative material such as plastic, metal, concrete, rock, or garbage. Food scraps are accepted in some communities; call Republic Services to check: 541-754-0444

Figure IV-4. How to Prepare recycling materials

Bottle Bill to make it meaningful in current markets and to restore its value as a steady supply of clean, sorted recyclables that feed recycling markets. A deposit was added to water bottles and juice containers. And in 2017 the deposit amount was increased to 10 cents per container, and in 2018 the state expanded the list to include more beverage types. For more information on the bottle bill visit https://www.oregon.gov/OLCC/pages/bottle_bill.aspx

The second collection method is **Curbside Collection**. Because curbside collection is required in all Oregon communities with a population of over 4,000, containers are generally provided to each household. (*Figure IV-3*)

Commercial and municipal haulers, may collect recyclables that are of value from businesses such as office paper, cardboard, and glass. Some collection companies pay businesses for these recyclables.

In another collection method, **Multi-Material Depots** serve as repositories for rural residents, apartment dwellers and urban residents who choose to recycle material not accepted by curbside programs. Sometimes drop boxes are placed in parking lots for single items such as newspapers.

Buy-Back Centers pay commercial or residential generators for delivering high-value recyclables to them. Materials include car batteries, appliances and other metals. Check your local phone directory under recycling services for specific information.

4. Processing

Regardless of the method, once collected, many recyclables need sorting and processing to prepare them for resale. For example, office paper is sorted to remove neon colors, newsprint, plastics, and other contaminants.

Once sorted or graded, materials are often compacted, baled, or condensed in other ways for cost effective transport to remanufacturers. Glass is usually crushed into **cullet**, and metals, paper, and plastics are baled. Processing eliminates contaminants which can lower the quality of recycled products or damage manufacturing

equipment. Once materials are processed, they are sold to manufacturers who can use them to make new products.

5. Manufacturing with Recycled Resources

The next step in recycling is the actual manufacturing of a new product and its purchase by individuals, businesses, and governments. The following are brief descriptions of basic manufacturing processes for the most commonly recycled materials.

Office Paper

The U.S. paper industry has made dramatic progress with respect to recycling since the early 1990s. According to the American Forest and Paper Association, in 2012, 65.1 percent of all paper consumed in the U.S. was recovered for recycling, nearly doubling our rate of paper recovery since 1990. Every bit of paper used for recycling helps to improve the environment and produce new paper products used by consumers every day.

Some of the office paper collected in Oregon goes to a mill in Longview, WA. Most of the paper goes to the James River pulp plant in Halsey. There the paper is made into 100% recycled “market pulp” which is shipped to paper mills to make high quality writing, printing and computer paper. It is also manufactured into paper towels and toilet tissue. Often office paper is shipped to out of region paper mills or exported.

Paper fibers can only be recycled about five times because the fibers get shorter with each reuse. At a mill, the paper is mixed with water and heated in vats to form pulp. The pulp is screened to remove contaminants such as paper clips, staples, and plastic. It is then processed by centrifugal cleaners and water washes. This washing, along with bleaching and de-inking, is necessary to produce white paper. The watery pulp is spread over rotating screens, pressed, and dried to form paper.

Newspaper

The EPA reports that about 73 percent of newspaper/mechanical papers were recovered in 2011. In fact, more newsprint is recycled in the United

	<p>Polyethylene Terephthalate (PET, PETE). PET is clear, tough, and has good gas and moisture barrier properties. Commonly used in soft drink bottles and many injection molded consumer product containers. Other applications include strapping and both food and non-food containers. Cleaned, recycled PET flakes and pellets are in great demand for spinning fiber for carpet yarns, producing fiberfill and geo-textiles. Nickname: Polyester (ex: plastic soft drink, water, sports drink, beer, mouthwash, catsup and salad dressing bottles. Peanut butter, pickle, jelly and jam jars. Ovenable film and ovenable prepared food trays)</p>
	<p>High Density Polyethylene (HDPE). HDPE is used to make bottles for milk, juice, water and laundry products. Unpigmented bottles are translucent, have good barrier properties and stiffness, and are well suited to packaging products with a short shelf life such as milk. Because HDPE has good chemical resistance, it is used for packaging many household and industrial chemicals such as detergents and bleach. Pigmented HDPE bottles have better stress crack resistance than unpigmented HDPE bottles. (ex: milk, water, juice, cosmetic, shampoo, dish and laundry detergent bottles; yogurt and margarine tubs; cereal box liners; grocery, trash and retail bags)</p>
	<p>Polyvinyl Chloride (PVC/Vinyl). In addition to its stable physical properties, PVC has good chemical resistance, weatherability, flow characteristics and stable electrical properties. The diverse slate of vinyl products can be broadly divided into rigid and flexible materials. Bottles and packaging sheet are major rigid markets, but it is also widely used in the construction market for pipes and fittings, siding, carpet backing and window frames. Flexible vinyl is used in wire and cable insulation, film and sheet, floor coverings, synthetic leather products, blood bags, medical tubing and other applications. (ex: clear food and non-food packaging, medical tubing, wire and cable insulation, film and sheet, construction products such as pipes, fittings, siding, floor tiles, carpet backing and window frames)</p>
	<p>Low Density Polyethylene (LDPE). Used predominately in film applications due to its toughness, flexibility and relative transparency, making it popular for use in applications where heat sealing is necessary. LDPE is also used to manufacture some flexible lids and bottles and it is used in wire and cable applications. (ex: dry cleaning, bread and frozen food bags, squeezable bottles, e.g. honey, mustard)</p>
	<p>Polypropylene (PP). Polypropylene has good chemical resistance, is strong, and has a high melting point making it good for hot-fill liquids. PP is found in flexible and rigid packaging to fibers and large molded parts for automotive and consumer products. (ex: catsup bottles, yogurt containers and margarine tubs, medicine bottles)</p>
	<p>Polystyrene (PS). Polystyrene is a versatile plastic that can be rigid or foamed. General purpose polystyrene is clear, hard and brittle. It has a relatively low melting point. Typical applications include protective packaging, containers, lids, cups, bottles and trays. (ex: compact disc jackets, food service applications, grocery store meat trays, egg cartons, aspirin bottles, cups, plates, cutlery)</p>
	<p>Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination. (ex: three and five gallon reusable water bottles, some citrus juice and catsup bottles)</p>

Source: American Plastics Council (APC)

Figure IV-4. Plastic Resin Identification Codes.

States each year than is actually made here. (That's because some U.S. newsprint for newspapers comes from Canada.) Old newspapers are an important "raw material" and manufacturers want all they can get to make new newsprint and other paper products.

Most Northwest newspapers are recycled into

new newsprint or sold to a broker for export to Asia. There it may be made into new newsprint or paperboard for such things as cereal or cracker boxes or boxboard. At a paper mill, recycled newspapers are de-inked, washed in a chemical compound, mixed with wood-chip pulp and possibly some recycled magazine pulp, then rolled out into new newsprint.

Many states have laws governing recycled fiber content for newsprint. Annually each newspaper in Oregon must report to the DEQ the amount of recycled fiber content in its newsprint. The newspapers serving Albany, Lebanon and Corvallis use newsprint with 18-25% recycled fiber content. The amount of recycled newsprint available in the area cannot always meet demand.

Corrugated Cardboard

Corrugated containers are made from a renewable resource. Along with Kraft paper, corrugated containers consistently rank high when it comes to recovery: Approximately 91% of corrugated cardboard was recovered in 2011, up from 75% in 2002.

Corrugated cardboard and Kraft bags are baled together before being shipped to a mills. It is mixed with wood-chip fiber and made primarily into the middle layer of new cardboard. Some may be used in outside layers of cardboard or for Kraft paper.

The use of corrugated paperboard can date back

to the mid 1800s in the clothing fashion industry. In 1856, two Englishmen, Healey and Allen, received a patent for the first known use of corrugated paper. Using a hand-cranked adaptation of a collar press (originally intended for pressing pleats and ruffles on clothing), they started producing "pleated" paper to line tall, stiff men's hats that were so popular in Victorian England. Corrugated paper was stronger than the cylinder of plain paper previously used to line hats and its flutes provided cushioning in the sweatband. The first use of corrugated paper for packaging came in 1871, when an American, Albert Jones, introduced an idea of wrapping bottles and glass chimneys in it. It was the addition of a liner to one and then to the other side of corrugated paper that signaled the birth of corrugated boxes—commonly known today as cardboard.

Walls of cardboard boxes consist of two main parts: linerboard (or facing) and corrugating medium (fluted paper). The flutes in the corrugating medium form a series of connecting arches. An arch with a certain curve can support many times its own weight, especially when the ends of the arch are anchored. In corrugated containers, they

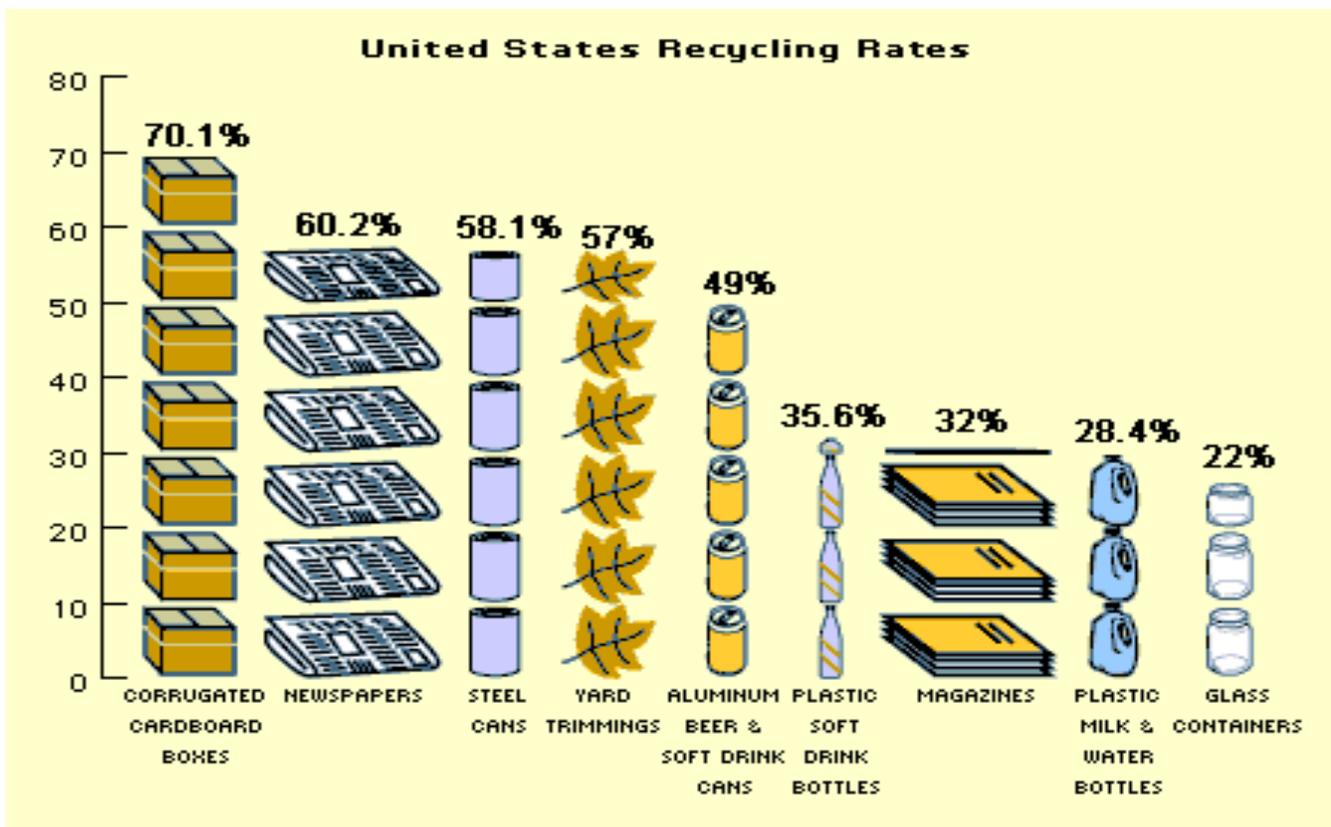


Figure IV-5. Recycling rates for selected material.

are anchored to a facing. A vertical sheet of linerboard, used as the skin or facing, can support a weight greater than itself if it is held in place. Most linerboard is produced using softwoods. They have the longest fibers, and produce the strongest paperboard. The fluted corrugating material helps it stay in place, while the facing, in turn, protects the flutes from damage. Containers made from these materials protect products both from external forces and sudden temperature changes. Arches of the flute act like springs when affected by pressure, and the air trapped between the flutes acts as a cushion. This trapped air also serves as a thermal insulator.

Mixed Paper

Mixed paper is the paper left over after the higher grades have been separated out. It includes junk mail, paper with unbleachable dyes or tape, and paperboard boxes. A small percentage of the stock for Kraft paper comes from mixed paper. Other mixed waste paper is used in boxboard or other molded pulp products such as egg cartons. Some is also shipped overseas.

Glass

It takes one million years for a glass bottle to break down in a landfill. About 28 percent of glass was recovered for recycling in 2011.

Other types of glass such as vases, bake ware, drinking glasses, eye glasses, window glass, mirrors, dishes, light bulbs, ceramics, broken glass, etc. cannot be recycled. Glass bottles and jars are different from other types of glass. They have different ingredients and melt temperatures. Mixing other types of glass with jars and bottles during manufacturing can weaken the structure of a bottle or jar, which can cause it to crack or explode when being filled or opened.

Tin Cans

These cans are made of steel which is electroplated with tin to protect foods from rust. (If a can is not shiny, it may have a resin coating instead of a tin coating.) In 2011, the United States generated about 2.2 million tons of steel as containers and packaging in the MSW stream. Even though only 0.25% of the can is tin, it is worth removing because recycled tin cans are the only source of tin in the U.S. The cans are first

soaked in an acid bath which dissolves the tin, removing it from the steel cans. The tin is melted off of the electroplates and poured into ingots, or bar-shaped molds. It may be used for new cans, as an ion exchange in metal extraction processes, or in fluoride toothpaste. The steel is shipped to a steel mill such as Cascade Steel Rolling Mills (Schnitzer Steel) in McMinnville.

Aluminum

Aluminum is one of the most frequently recycled materials in the world, due in part to the fact that it takes twenty times as much energy to extract aluminum from bauxite ore as it does to recycle it. In 2011, 55 percent of aluminum beer and soft drink containers generated were recycled (about 0.7 million tons). Baled aluminum cans, pie plates, and patio furniture are delivered to a smelter such as Alcoa Aluminum in Wenatchee, Washington. There they are reprocessed into similar items. Foil is less valuable than other items because it is thin and often contaminated.

Other Metals

Iron and steel have been recycled since the beginning of their use. Steel mills have different capabilities in using scrap metal. Older mills can use 28-50% scrap with the rest being virgin material. Most new steel mills, including those in Oregon and Washington, are using electric furnaces which can make steel out of 100 percent scrap. These furnaces also use 75% less energy than their predecessors.

Copper and brass are the most valuable of the metals typically recycled.

Motor Oil

Used motor oil is accumulated in drums and delivered to an oil processor where it is cleaned to meet EPA requirements. Most of it is used as fuel to heat ship boilers or as tar for asphaltting roads. A small portion is reused as lubricant for machinery or chain saws.

Plastics

In 2011, only 8% of the total plastic waste generated was recovered for recycling. Because plas-

tic is inexpensive, has a low density, and varies a great deal in chemical composition, plastics recycling is in its infancy. Also, because plastic is porous and retains contaminants, it often cannot be reused for the same purpose. For example, plastic from milk jugs will not be reused to make milk jugs. Milk jugs can be shredded, processed into pellets, mixed with other plastic, and used to make other products such as flower pots, plastic strapping for shipping, and new detergent bottles. Soda bottles are used primarily for polyester fiber, fiberfill, carpets, or remade into plastic bottles.

Agri-Plas Inc., a company located in Brooks, used to collect and reprocesses agricultural plastics when markets for it existed. They converted soft plastic soakers and bags into pellets and shipped them to Nevada to make into Trex lumber. They also baled plastic baling twine and send it to remanufacturers.

The sizeable nursery industry in Oregon uses its plastic pots only once before they go to Agri-Plas to be cleaned and shredded for new uses. Food and beverage barrels and buckets are handled there as well. In 2009 they shipped their first tanker of crude oil recovered from plastic through their own patented process.

Scrap Tires

Markets now exist for about 80 percent of scrap tires — up from 17 percent in 1990. In 2003, RB Rubber in McMinnville, Oregon recycled approximately 3 million tires which they ground up and made into rubber mats, pavers, and other surface products. The best destination for old tires is a retreading facility, but only about 10 percent of Oregon discards are retreaded.

Some used tires are shredded and used as fuel in pulp and paper mills and cement kilns. A few are used whole to make dock floats and buoys or processed to make flooring, sound insulation, and railroad crossings. Rubber modified asphalt concrete, incorporating ground tires, is being tested as pavement for highways. In the Southwest, tires are being used in the construction of passive solar homes known as “Earthships.” Tires are stacked, stuffed with earth, plastered inside, and covered with stucco on the outside. These homes rarely require any heating or cooling systems. Despite varied uses for discarded tires, most are still being

shredded and land filled.

Yard Debris

The amount of yard debris that is being recycled is increasing, primarily due to curbside collection. Yard waste collected in Linn and Benton Counties is taken to Republic Services’ Pacific Region Compost. There, the material is run through a hammer mill and placed in aeration and maturation piles where it decomposes for about three months. Finally the compost is screened and sold as a soil amendment, top dressing, or potting soil.

6. Recycling Begins and Ends at Home and Work

The last step in the recycling cycle is the consumer. Chapter 5 will explore this step. The circle is not completed until goods made with recycled materials are purchased.

Some common uses of recycled resources are outlined in *Table IV-4*.

7. Recycling in Oregon

In 2016, over 42 percent of the waste generated in Oregon was recovered. *Table IV-5* shows the amount of material generated, disposed of, and recovered from the different waste-sheds in Oregon in 2016. It also shows where wastesheds were in meeting the State goals outlined in HB3744.

8. Why Recycle? Energy Use, Environment and the Economy

Relieving our solid waste disposal problems is a good reason to recycle and reduce waste. However, it is not the only reason, or even the most important reason. In addition, recycling:

- conserves natural resources
- saves energy
- reduces environmental pollution
- creates jobs in local industries

Table IV-3 summarizes the benefits of using recycled materials.

Saving resources and reducing pollution through use of recycled materials benefits families and the U.S. economy.

Some examples:

- ◆ **Oil imports.** Oil imports are the single largest item in the U.S. trade deficit. Recycling a single aluminum beverage container saves the equivalent of one-half of a can of gasoline or enough energy to run a television for three hours.
- ◆ **Economic Development.** The Institute for Local Self Reliance estimates that for every 100,000 tons of solid waste produced, only 1 job is created if it is landfilled, but 6 jobs are created if it is recycled.
- ◆ **Energy.** The energy saved by recycling one glass bottle lights a 100-watt light bulb for four hours. Every ton of paper recycled saves 4,100-kilowatt hours of energy.
- ◆ **Land.** Recycling reduces the amount of land depleted by mining and needed for landfills.
- ◆ **Forests.** Recycling reduces the number of acres of forests that are cut down. Recycling a ton of paper saves about 17 trees.
- ◆ **Water.** Recycling saves water and reduces water pollution. Every ton of paper that is recycled saves 7,000 gallons of water and reduces water pollutants by as much as 35%.
- ◆ **Environmental pollution.** Metal and paper manufacturing are major contributors to water and air pollution, including acid rain. Energy used for manufacturing materials contributes to global warming.
- ◆ **Stewardship.** Recycling is evidence of stewardship of natural resources. Recycling can preserve landscapes for wildlife and for human enjoyment.
- ◆ **Other resources.** Recycling reduces the depletion of scarce resources such as bauxite ore used for creating aluminum products. Bauxite may be imported from Guinea, Brazil, or Australia.

Transforming a waste disposal system into a resource recycling system requires cooperation among government, private industry and the public. First, humans need to unlearn wasteful habits. Next, government, in cooperation with private industry, needs to develop programs and services that make participating in waste reduction and recycling convenient. The system that is currently collecting, processing, and recycling needs to be expanded in order to comply with the current legislative requirements and have no annual increase in total municipal solid waste generation.

The Environmental Defense Fund says:

*“If you’re not recycling,
you’re throwing away a lot
more than your trash.”*

Table IV-3. Benefits of Using Recycled Materials Instead of Virgin Resources

BENEFIT	ALUMINUM	STEEL	PAPER	GLASS
Reduction of:				
* Energy use	90-97%	47-74%	23-74%	4-32%
* Air pollution	95%	85%	74%	20%
* Water Pollution	97%	76%	35%	—
* Mining wastes	—	97%	—	80%
* Water use	—	40%	58%	50%

(Source: Robert C.Letcher and Mary T. Sheil, “Source Separation and Citizen Recycling” in the Solid Waste Handbook, William Robison, ed.)

Table IV-4. Uses for Recycled Materials

<u>MATERIALS</u>	<u>RECYCLED USES</u>
Newsprint	Newsprint, insulation, roofing, phone directories, molded pulp, box board, Homasote underlayment, roof decking, floor decking, wall board, and office divider panels
Cardboard and paper bags	Cardboard, paper bags, pencils
High grade office paper	Office paper, printing & writing paper, tissue, note pads
Magazines	Newsprint, phone directories
Mixed waste paper	Roofing felt, cardboard, cereal or shoe boxes, egg cartons, molded pulp
Glass bottles and jars	New glass containers
Aluminum cans	New aluminum cans and other aluminum products
Tin cans	Steel for new cans, cars, rebar and structures Tin for new cans, an agent in copper recovery, pharmaceuticals
Plastics	
PET bottles	Fiberfill, carpet, carpet backs, fabric
HDPE milk jugs	Flower pots, strapping, insulation, tape, detergent bottles, binders, new bottles
Motor oil	Lubricating oil
Tires	Tire recaps, road surfacing, mats, soundproofing, pavers
Wood Waste	Fiberboard, hardboard, siding, roofing, Durisol Blocks

Table IV-5: Wasteshed Recovery Rates, 2016

2016 Material Recovery and Waste Generation Rates Report



Table 1: Wasteshed Recovery Rates, 2016

Wasteshed	Tons Disposed	Tons Recovered	Tons Generated	Calculated Recovery Rate ¹	SB 263 Goal ² 2025
Baker	12,432.0	3,111.1	15,543.1	20.0%	25%
Benton	61,999.2	34,315.5	96,314.7	35.6%	44%
Clatsop	34,075.9	20,675.4	54,751.3	37.8%	53%
Columbia	28,656.7	13,817.5	42,474.1	32.5%	45%
Coos	45,444.8	13,219.8	58,664.6	22.5%	30%
Crook	20,339.8	5,302.2	25,641.9	20.7%	20%
Curry	19,222.1	7,001.0	26,223.0	26.7%	30%
Deschutes	161,087.5	79,756.9	240,844.3	33.1%	45%
Douglas	75,053.9	27,838.1	102,892.0	27.1%	34%
Gilliam	2,247.4	349.0	2,596.4	13.4%	25%
Grant	3,867.8	1,456.7	5,324.4	27.4%	25%
Harney	4,035.6	1,156.0	5,191.6	22.3%	25%
Hood River	20,187.3	7,471.7	27,659.0	27.0%	35%
Jackson	175,856.0	110,488.0	286,344.0	38.6%	25%
Jefferson	13,348.2	6,165.8	19,514.0	31.6%	32%
Josephine	70,075.9	38,486.3	108,562.2	35.5%	20%
Klamath	58,111.8	20,064.7	78,176.5	25.7%	20%
Lake	6,496.3	897.4	7,393.7	12.1%	15%
Lane	258,040.7	258,369.6	516,410.3	50.0%	63%
Lincoln	47,700.4	17,013.1	64,713.5	26.3%	37%
Linn	97,379.1	60,103.2	157,482.3	38.2%	45%
Malheur	22,204.6	7,976.8	30,181.4	26.4%	25%
Marion ²	243,107.4	237,151.7	480,259.2	49.4%	64%
Metro	1,259,663.4	1,153,153.3	2,412,816.8	47.8%	64%
Milton-Freewater	4,670.2	1,809.2	6,479.4	27.9%	25%
Morrow	17,477.5	5,455.1	22,932.6	23.8%	20%
Polk	46,532.8	39,520.3	86,053.1	45.9%	48%
Sherman	1,219.2	158.4	1,377.5	11.5%	20%
Tillamook	26,403.4	9,331.5	35,734.9	26.1%	37%
Umatilla	72,808.0	26,966.3	99,774.3	27.0%	20%
Union	20,625.1	6,915.5	27,540.6	25.1%	25%
Wallowa	4,091.3	1,513.4	5,604.7	27.0%	25%
Wasco	19,418.5	6,900.0	26,318.5	26.2%	35%
Wheeler	371.4	57.4	428.8	13.4%	20%
Yamhill	96,181.1	42,588.4	138,769.6	30.7%	45%
OR Totals	3,050,432	2,266,556	5,316,989	42.6%	

¹ The recovery rate is calculated using the following formula:

1) Tons Disposed + Tons Recovered = Total Tons Generated

2) Tons Recovered / Total Generated = Calculated Recovery Rate

² The Marion County disposal and recovery rates reflect 12,481.54 tons of recyclable materials burned for energy in 2016 (per ORS 459A.010(3)(f)(B)).

Chapter IV Recycling Processes

Recycling Timeline

PREFLECTION – Recall early experiences with recycling.

What is the first thing you remember recycling?
Was it called recycling then?
Who encouraged you to recycle?
Who benefited from the recycling?

ACTION – Create a personal recycling timeline. Invite others in your household to do the same. (See below for suggestion with young children.)

Dig 5 legal sized envelopes out of your recycle bin.
Lay the envelopes address side down and end to end on the kitchen or dining room table.
Mark the top of each one with the years representing one-fifth of your life.
On each envelope, down the left hand side, list items that were recycled in your household during that time frame.
Next to each item on the list identify where the item was recycled, what you think it was then used for, and who most likely benefited from the recycling.

REFLECTION – Ask yourself these questions:

How has my recycling experience changed over time?
What influenced my experiences with recycling at a particular age?
If someone else in my household created a timeline, what were common elements? What differed?
What influences caused these differences?
In what ways does the recycling experience of my young children/teens differ from my experience at the same age?

RE-ACTION – Plan for your recycling future.

Add a sixth envelope labeled *future* to your timeline.
Identify at least one new item you would like to recycle.
Do a web search for places this item might be recycled and what products it might become.

INVOLVE YOUNG CHILDREN

If there are children in your household who do not yet write easily, engage them in conversation about what they recycle, where they think the items go and what they might be used for.