

Recycling: An Introduction

Recycling is the remanufacturing of waste materials to make new products. It involves collecting and treating discarded materials as raw materials. Some commonly recycled materials include aluminum, glass, plastic, and paper. Recycling helps to save the earth's precious resources by treating waste as raw materials. It also helps the environment by saving energy and reducing pollution.



The Four Steps to Recycling

Recycling usually involves four steps: collection, sorting, reclaiming, reusing.

- 1. Collection:** Materials like paper, aluminum cans, glass, and plastic are collected and taken to a recycling center.
- 2. Sorting:** Materials are separated by type and grade because paper, aluminum cans, and plastic have different processing steps.
- 3. Reclaiming:** Collected materials become reusable again through processing. For example, the aluminum cans are processed into large blocks called *ingots*, which are rolled out as long aluminum sheets.
- 4. Reusing:** The reclaimed materials are used in new products. For example, the aluminum sheets create new aluminum cans.

How much is recycled in the United States every year?

- Auto batteries: 99%
- Steel cans: 62.9%
- Yard trimmings: 62%
- Paper and paperboard: 51.6%
- Aluminum beverage cans: 45.1%
- Tires: 34.9%
- Plastic beverage bottles: 30.9%
- Glass containers: 25.3%

What is waste?

Waste is anything that we discard after use. It consists of newspapers, plastic or glass bottles, food scraps, furniture, clothing, appliances, paint, and batteries. In 2006, the United States produced more than 251 million tons of waste. The following table shows the amount of waste by percentage for the year 2006.

- Paper: 33.9%
- Yard trimmings: 12.9%
- Food scraps: 12.4%
- Plastics: 11.7%
- Metals: 7.6%
- Rubber, leather, and textiles: 7.3%
- Wood: 5.5%
- Glass: 5.3%
- Other: 3.3%

Where does the waste go?

In the United States, most of the waste is disposed of in landfills while the rest is recycled, composted, or burned. In 2006, 55% of waste was dumped in landfills.

Recycled or composted waste accounted for 32.5%, or 82 million tons, while incinerated waste was 12.5% of the total.



Recycling Reduces Greenhouse Gas Emissions

Greenhouse gas emissions trap heat in the atmosphere and warm the earth's surface, which contributes to global climate change. Recycling helps to reduce greenhouse gas emissions. In 2006, the recycling of 82 million tons of paper, yard trimmings, food scraps, plastics, metals, rubber, leather, textiles, glass, and wood prevented the release of a large amount of carbon into the atmosphere. This amount is roughly equal to the amount of carbon emitted by 39 million cars, saving energy equivalent to 10 billion gallons of gasoline.

How to Manage Waste

Waste can be better managed by reducing, recycling, and reusing materials. Waste can be reduced at the source by the manufacturers or by the consumers who buy and use the products. Manufacturers can alter the design and use of products to reduce the amount and toxicity of what gets thrown away. Recycling prevents waste by using waste materials as raw materials for new products.

Recycling Helps

Recycling prevents the emission of many greenhouse gases and water pollutants, saves energy, supplies valuable raw materials to industry, creates jobs, stimulates the development of greener technologies, conserves resources for our children's future, and reduces the need for new landfills and incinerators.

The Earth's Resources

The Earth is our home planet. It is the only planet where life is known to exist. The Earth is an abundant reservoir of various natural resources. Some of these natural resources are water, soil, air, solar energy, coal, oil, and minerals. Fossil fuels are sources of energy, mineral deposits are sources of building materials, and forests are a source of fuel and other products. Natural resources may be living or non-living components that support life on Earth.

Renewable and Nonrenewable

There are two types of natural resources, *renewable* and *nonrenewable*. Renewable resources can be replaced or reproduced by natural processes. They can never be destroyed permanently. Renewable resources like solar energy, wind power, and hydroelectric power are used mainly in generating electricity. Nonrenewable resources are found in a fixed or limited amount and cannot be remade or regrown. Nonrenewable resources like coal, petroleum, and natural gas are used in generating electricity, heating homes, moving cars, and manufacturing various products.

Renewable Resources

- Oxygen
- Fresh water
- Timber
- Biomass (plant materials and animal waste used as a source of fuel)
- Solar energy
- Wind power
- Hydroelectric power
- Tidal power
- Geothermal energy



Earth Is in Danger

Six billion human beings, along with millions of other species of living things, live on this planet. Human beings are primarily responsible for the exploitation of the planet's natural resources. The ever-growing population of humans requires more energy. This demand for more raw materials has led to a sharp decline in Earth's natural resources.

Earth's natural resources are used to meet our growing demand for energy and products. Humans use energy in homes, industry, the workplace, and travel. Industries use around one-third of the total energy. Residential and commercial establishments together consume about 40% of the total energy, while transportation uses about 28% of the total energy.

Nonrenewable Resources

- Gasoline
- Coal
- Oil
- Natural gas
- Diesel
- Nuclear power



Did you know?

A faucet running for 3 minutes uses more than a quart of water.

How can you help?

- Reduce, reuse, and recycle.
- Discover your carbon footprint.
- Replace an incandescent light bulb with a compact fluorescent light bulb.
- Buy organic and locally grown food.
- Plant a tree.
- Walk more and drive less.
- Do not use plastic bags at the grocery store; bring your own cloth bags.



Save Water and Energy

- Turn off the faucet while brushing your teeth.
- Fix the faucet immediately if it drips.
- Always turn off the lights when not in use.
- Use the daylight rather than artificial light.
- Wear warm clothes and turn down the thermostat.
- Do not linger over an open refrigerator door.
- Use alternative sources of energy.
- Read books instead of watching television or playing video games.
- Keep computers, televisions, and other electrical appliances turned off when not in use.

Hazardous Effects of Waste

Hazardous waste is waste that is harmful to human health or to the environment. Hazardous waste is capable of catching fire, corroding metal containers, and producing toxic gases when heated, compressed, or mixed with water. This waste, if not treated or disposed of properly, may cause illness, injury, or even death. The waste is extremely acidic and causes harm to beneficial organisms in the soil. The United States produced about 38 million tons of hazardous waste in 2005.

Identifying Hazardous Materials

Products that contain hazardous materials require labels to warn consumers about the possible threat to their health and the environment. These labels read “danger,” “warning,” “caution,” “toxic,” “corrosive,” “flammable,” or “poison.”

Hazardous Industrial Waste

Industries generate a lot of hazardous waste. These commonly include sludge, spent solvents and solvent mixtures, waste water, inorganic pigments, organic chemicals, inorganic chemicals, pesticides, explosives, and distillation tar residues. Businesses that produce hazardous waste range from small businesses like dry cleaners and automobile repair shops to large companies like oil refineries, chemical manufacturers, and electroplating companies. The computer industry also generates a lot of hazardous waste manufacturing hardware. Hardware products like computer circuit boards and processing chips generate waste containing metal salts, acids, and caustic chemicals. The process of making fiber optics, copper wire, and magnetic disks also produces hazardous waste.



Hazardous Agricultural Waste

Agricultural activities also produce hazardous waste. Materials like pesticides and herbicides used in agricultural applications produce hazardous waste. The production of phosphate fertilizer generates fluoride waste. Manure from stockyard-raised cattle and hogs contains certain soluble nitrates, which dissolve into groundwater and pollute drinking water, causing health problems.



Household Hazardous Waste

Household hazardous waste includes paints, pesticides, caustic cleaners, batteries, aerosols, ammunition, flammable solvents, mercury thermometers, and compact fluorescent light bulbs. This type of household waste must be taken to hazardous waste drop off centers and cannot be disposed of with everyday trash.

Hazardous Medical Waste

Hazardous medical waste is waste generated by hospitals and clinical laboratories. Medical waste is contaminated with human blood and tissue, which requires special handling in its disposal. Medical waste includes needles, syringes, scalpels, and other sharp objects. Expired or unused drugs are also considered hazardous medical waste. Some pharmacies will accept expired prescription drugs. Check with your local trash collection agency for proper disposal of drug waste. Laboratories also generate chemical waste.

Effects of Hazardous Waste

Soil Pollution

Soil pollution is a major effect of hazardous waste. The storage of waste in landfills creates soil pollution. The toxic elements in the hazardous waste contaminate the soil. Plants or crops that grow in this contaminated soil absorb the toxic elements but cannot break them down. These plants and crops can cause disease when eaten by animals and humans.

Air Pollution

Air pollution is another major effect of hazardous waste. Toxic gases released from the hazardous waste contaminate the air and create air pollution. Household paints and cleaning agents contain toxic solvents that evaporate easily and cause air pollution.

Water Pollution

Hazardous waste also creates water pollution. This waste affects the plant and animal life living in water bodies. Water contaminated with too much fluoride affects the bones and teeth. Various toxic chemicals found in insecticides and commercially produced organic chemicals like PCB, accumulate in algae, insects, and fish living in water. Humans and animals that consume the fish are exposed to these hazardous chemicals, which can cause various diseases.



Solutions

- The government can create tighter regulations concerning the disposal of hazardous waste.
- Industries can be given incentives for creating less waste.
- Industrial waste and chemical compounds can be broken down into less dangerous compounds. They can also be stored in special ways to protect the environment.
- Consumers can boycott goods whose production creates hazardous waste.
- Consumers can use low-VOC or zero-VOC (volatile organic compounds) paint and green cleaning products in their homes.
- Instead of using pesticides, consumers can use beneficial plants, insects, and compost to control common garden pests.

Did you know?

More than 80,000 chemicals are used by industries throughout the world.

Recycling and the Environment

Recycling provides us with a healthier and more pollution-free environment. It provides clean air and more forested land and reduces pollution and greenhouse gas emissions. Recycling reuses waste that would otherwise have ended up in landfills. It helps in saving natural resources and conserving energy. For example, recycling paper generates 74% less pollution and uses 50% less water than making paper from new trees. Trees help the environment by absorbing the carbon dioxide in the air.

Recycling Saves Energy

- Recycling consumes less fossil fuel such as coal, oil, and natural gas.
- Recycling of paper uses half of the total energy used in making new paper from trees.
- Recycling steel saves enough energy to light 18 million homes for a year.
- Recycling aluminum cans saves 95% of the energy used in making cans from the original source.
- Recycling one ton of glass saves the equivalent of nine gallons of fuel oil.



Recycling Reduces Greenhouse Gas Emissions

Greenhouse gases are released from the burning of fossil fuels such as coal, diesel, and gasoline. These fossil fuels are burned in the manufacture of certain products like paper, aluminum cans, and steel. Recycling reduces the burning of fossil fuels, thus reducing greenhouse gas emissions.

Recycling Saves Natural Resources

Recycling conserves natural resources and energy. The products made from recycled waste do not require the initial process of manufacturing needed when using raw materials. The used materials are reprocessed to make new products and repackaged. This reduces the consumption of natural resources.

- Recycling more than one million tons of steel saves 1.3 million tons of iron ore, 718,000 tons of coal, and 62,000 tons of limestone.
- Recycling one ton of paper saves 17 trees, 7,000 gallons of water, and 390 gallons of oil.
- Recycling one ton of plastic saves 16.3 barrels of oil.
- Recycling one ton of steel saves 1.8 barrels of oil.

What to Buy to Save the Environment

- Buy energy-saving products.
- Buy fresh food and save energy required for the storage and manufacture of processed food.
- Buy organic food, which is free from pesticides.
- Buy fuel-efficient cars.
- Buy recycled products.
- Buy rechargeable and reusable items instead of disposable items.



Good Habits

- Tell others about the environmental changes caused by waste.
- Recycle more and buy less.
- Avoid wasting food.
- Walk more or ride your bicycle and drive less.
- Repair and reuse old items instead of buying new ones.
- Turn the thermostat down by one degree. It reduces carbon emissions and fuel bills by 10%.
- Use low-energy compact fluorescent bulbs to save electricity.



Did you know?

British households generate 28 million tons of waste every year. That is equivalent to the weight of 3½ million double-decker buses.

Recycling Aluminum Cans

Aluminum cans are containers used to package beverages and food. Aluminum is soft, lightweight, and easy to work into new shapes, which makes it an ideal material for cans. Every year, 1.55 million tons of aluminum cans is generated as waste, which accounts for less than 1% of all solid waste in the United States. At present about 45% of all used aluminum cans are recycled. Every second 1,500 aluminum cans are recycled.

Why is it important to recycle aluminum cans?

Aluminum is a sustainable metal that never wears out and can be recycled over and over again. It is the most recycled and most recyclable beverage container in the world. Recycling aluminum cans helps to save a lot of time, energy, natural resources, and money. Recycling aluminum cans uses 95% less energy than producing new cans from ore. It also creates 97% less water pollution. The money earned from recycling cans helps people and their communities.

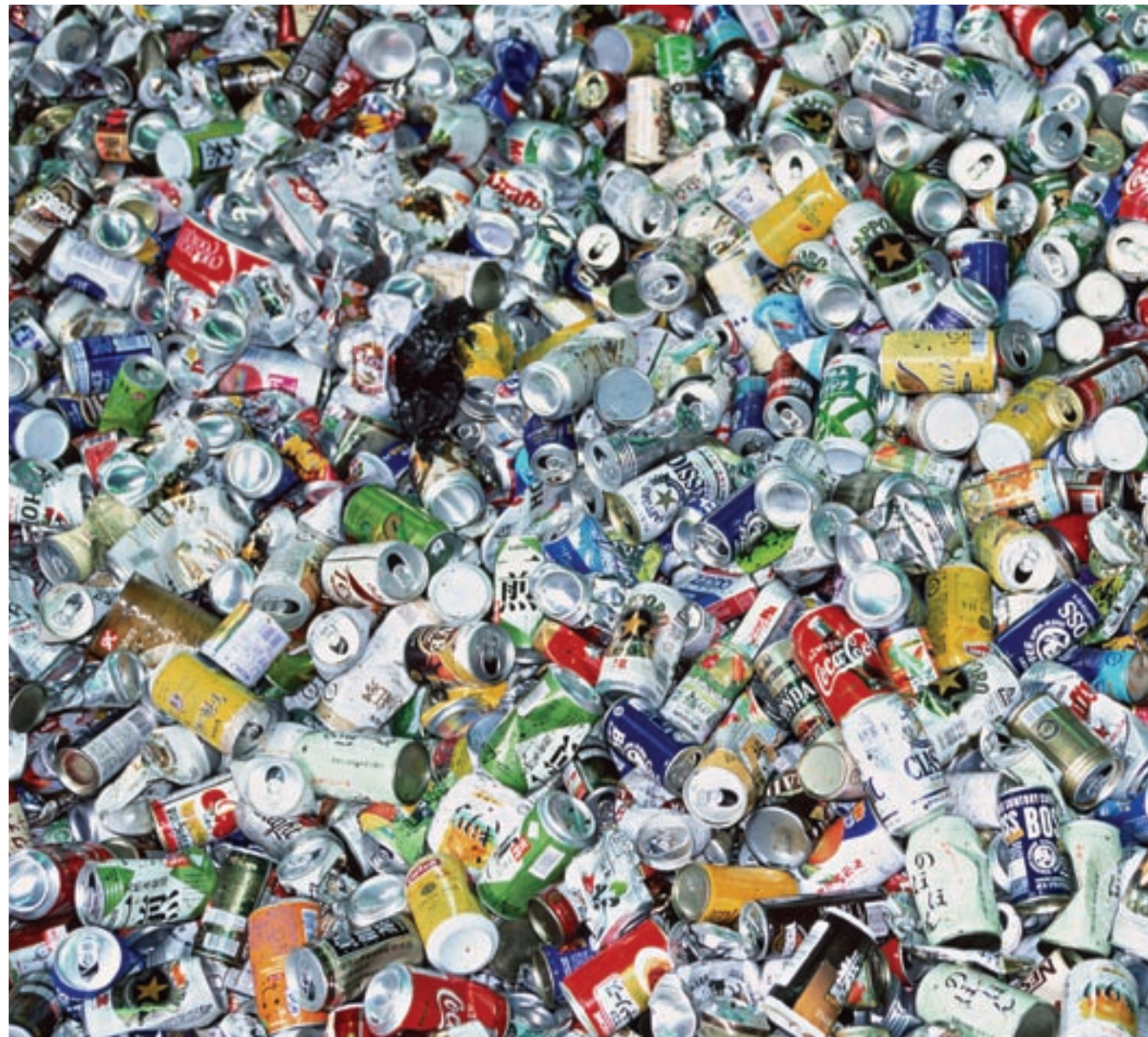
Recycling 1 ton of aluminum saves 14,000 kilowatt-hours of energy, 40 barrels of oil, and 10 cubic yards of landfill space.

What is aluminum?

Aluminum is a silver-white metal. It is the most abundant element on the earth's crust, after oxygen and silicon. Aluminum is mined from bauxite, a reddish clay-like ore that is rich in aluminum compounds.

The Benefits of Aluminum Recycling

- Recycling aluminum saves precious natural resources.
- Aluminum cans can be recycled and back on store shelves in 60 days.
- Recycling aluminum provides an economic incentive. The aluminum industry pays over \$800 million for empty cans.
- Recycling aluminum cans enables charitable organizations to raise funds.



Old Cans to New Cans

The old aluminum cans are taken to an aluminum reclamation plant. The cans are shredded into potato chip-sized pieces and fed into a melting furnace. The molten aluminum is gradually hardened into rectangular slabs, called *ingots*, and then formed into thin sheets of aluminum.

The metal from recycled aluminum cans is usually made into new aluminum cans. This is called closed-loop recycling because the old cans are turned into the same thing again. Aluminum beverage containers can be recycled into new cans and put back onto store shelves within 60 days!



Aluminum Recycling Process

Aluminum cans are shredded, cleaned, melted, and mixed with a pure aluminum base, then recast into new aluminum products. This basic melt-and-recast process eliminates the mining, shipping, and refining processes necessary to create new aluminum from bauxite ore. Aluminum cans account for all of the beverage can market, but only a small percentage of the food can market.

The recycling of aluminum cans is a four-stage process:

1. Shredding the aluminum cans
2. De-coating the lacquer on the cans
3. Melting the aluminum
4. Casting the ingots



Did you know?

Aluminum cans are the most recycled consumer products in the United States.

Recycling Paper

Almost one-third of all solid waste is made up of paper and paperboard products. Paperboard includes newspapers, food packaging, tissues, cardboard boxes, office paper, and paper plates. An impressive 53.4% of the paper consumed in the United States was recovered for recycling in 2006. In fact, if measured by weight, more paper is recovered for recycling than all glass, plastic, and aluminum combined.

Why is it important to recycle paper?

Recycling paper helps to save a lot of resources. It also helps to save a lot of energy. Making new paper from old paper uses 60% to 70% less energy than making paper from trees and uses 55% less water. It also helps our environment by reducing air pollution by 74%.

Using one ton of recycled paper can save 17 trees, 7,000 gallons of water, 225 kilowatt-hours of energy, and 3.3 cubic yards of landfill space.

Paper That Can Be Recycled

- Magazines
- Newspapers
- Office paper
- Cardboard
- Phone books and yellow pages
- White/colored paper
- White/colored envelopes with windows
- Soft-covered books with white pages
- Fax/telex copy paper
- Greeting cards
- Adding machine tape
- NCR/carbonless forms
- Booklets/manuals
- Post-it notes
- Tab/time cards
- Manila folders
- Cereal boxes (lining removed)
- Tissue boxes
- Cardboard egg cartons

Paper That Cannot Be Recycled

- Paper with food waste or grease on it
- Pizza boxes
- Juice boxes
- Milk cartons
- Coffee cups
- Cellophane (candy wrappers)
- Dirty or wet paper towels
- Blueprints/carbon paper
- Metallic or plastic coated paper
- Tissue/toilet paper
- Dirty paper plates
- Dirty napkins
- Plastic laminated paper
- Pet food bags
- Waxed paper
- Thermal fax paper
- Disposable diapers

Good Recycling Habits

- Collect more recyclable material in recycling bins.
- Build more recycling plants.
- Educate people about recycling.
- Make sure there are enough trash collection trucks to collect the recyclables.
- Find new ways of reusing the material by making it into a useful item.

Dos and Don'ts

- Deposit used paper at your local recycling facility.
- Most home recycling bins, provided by your local government, usually accept paper products.
- Only recycle gummed paper if specified, such as envelopes and stickers.
- Reduce paper waste by canceling unwanted deliveries, or read news online as opposed to buying newspapers.
- Contact the Direct Marketing Association's (DMA) Mail Preference Service (MPS) to reduce unwanted junk mail deliveries.
- Reuse paper around the home as scrap paper or packing material. Envelopes can also be reused.
- Set your printer to print on both sides of the paper.
- Buy recycled paper whenever possible.

Did you know?

If all newspapers in the U.S. were printed on recycled paper, 41,000 trees would be saved every day.



Recycling Batteries

A battery is a device that converts chemical energy into electrical energy and stores it. It is made of heavy metals like nickel cadmium, alkaline, mercury, lead acid, and other elements. Batteries provide an instant power supply for cars, mobile phones, cameras, laptops, MP3 players, and PDAs. In the United States, more than 350 million rechargeable batteries are used in a year. Every year Americans trash almost 180,000 tons of batteries, 14,000 tons of which are rechargeable batteries.

Why is it important to recycle batteries?

Recycling batteries is good for the environment. It helps in conservation of land and reduces the mining of minerals. Recycling batteries also creates less air and water pollution. A recycled lead battery consumes four times less energy to make a new lead battery. It is important to recycle spent batteries to prevent the toxic components from leaking into the ground in landfills and a risk to the environment and human health.

Working of a Battery Recycling Plant

- Spent or used batteries are collected from various sources.
- Used batteries are taken to recycling facilities where they are broken down and separated into components to begin the recycling process.
- Lead, plastic, and acid are separately sent for further recycling. Plastic recycled from old batteries is used to manufacture battery covers and cases.
- Lead ingots are recycled from battery grids. Lead oxides are used to manufacture new battery grids and components.
- Sodium sulfate crystals separated from old battery acid are recycled and used for various purposes.



How Batteries Are Used

- Alkaline batteries are used in scanners, television remote controls, some digital cameras, and portable CD players.
- Lithium-manganese batteries are used in watches, pacemakers, flashlights, and video games.
- Zinc chloride batteries are used in motor-driven toys and calculators.
- Silver oxide batteries are used in digital watches, hearing aids, calculators, and pagers.
- Mercuric oxide batteries are used in electronic cameras and photographic equipment.
- Nickel-cadmium batteries are used in commercial and military applications, scanners, and portable radios.
- Nickel-metal hydride batteries are used in high-discharge devices like portable power tools, digital cameras, and laptops.
- Lithium-ion batteries are used in cell phones and mobile computing devices.

Recycling Different Types of Batteries

- Lithium-manganese batteries are recycled by recovering the lithium and selling it back to battery manufacturers.
- The zinc in zinc chloride batteries is reprocessed.
- Silver oxide batteries should not be sent to landfills as they contain mercury. These batteries are first shredded, and then the electrolytes are neutralized and the heavy metals are recovered.
- Nickel-cadmium batteries contain toxic heavy-metal cadmium, which should be disposed of carefully. The process involves recovering of cadmium and iron-nickel for steel production.
- Nickel-metal hydride batteries have elements that should be recycled. The individual materials of these batteries are mechanically separated, and high nickel content is produced and used in the manufacture of stainless steel.
- Lithium-ion batteries should not be damaged as they explode when damaged. The terminals of the batteries should be taped before recycling them.



Hazards

Improperly disposed batteries may produce the following potential problems or hazards:

- Pollute lakes and streams as the metals vaporize into the air when burned.
- Contribute to heavy metals that potentially may leach into the surrounding soil of solid-waste landfills.
- Expose the environment and water to lead and acid.
- Contain strong corrosive acids.
- Cause burns or danger to eyes and skin.

Dos and Don'ts

- Always turn off any battery-operated appliances when not in use.
- Always remove batteries from appliances if they are not going to be used for a long time.
- To prevent a potential safety hazard, do not mix old batteries with new ones. When old and new batteries are mixed, leaking or rupturing could occur, possibly resulting in injury or property damage.
- Do not recharge a battery unless it is specifically marked rechargeable. Attempting to recharge a non-rechargeable battery can cause it to leak or rupture.
- Do not burn used batteries.
- Do not open battery casings.
- Do not insert batteries backward into any device.
- Rechargeable batteries containing cadmium or lead should be recycled.
- Read labels and buy batteries that have less mercury and heavy metals.
- Consider rechargeable batteries for some needs, but remember that they also contain heavy metals such as nickel-cadmium.

Recycling Building Materials

Building materials are heavy and bulky materials used during the construction, renovation, or demolition of buildings, roads, and bridges. Building materials include concrete, asphalt, bricks, wood, and iron. Concrete and asphalt are the most recycled materials in North America, with more than 155 million tons being recycled every year. Concrete accounts for 130 million to 140 million tons, while asphalt accounts for 15 million to 25 million tons. However, if highway millings are included, the figure for asphalt could be around 90 million tons.

Why is it important to recycle building materials?

Recycling building materials reduces the demand for new raw materials and their production. It helps in conservation of landfill space and creates new jobs for people. Building projects generally require various purchases and disposal expenses. Recycling cuts these expenses and saves money.

Building Materials That Can Be Recycled or Reused

- Concrete
- Wood (from buildings)
- Asphalt (from roads and roofing shingles)
- Gypsum (the main component of drywall)
- Metals
- Bricks
- Glass
- Plastics
- Salvaged building components (doors, windows, and plumbing fixtures)
- Trees, stumps, earth, and rock from clearing sites



Percentage of Building Material Waste

Concrete and mixed rubble	40–50%
Wood	20–30%
Drywall	5–15%
Asphalt roofing	1–10%
Metals	1–5%
Bricks	1–5%
Plastics	1–5%

Concrete Recycling

Concrete is one of the basic building materials used in most types of construction. In the past, concrete debris from demolitions was dumped in landfills. Nowadays, with more awareness about our environment, recycling of concrete is increasingly becoming popular. There are many benefits of recycling concrete. Using recycled concrete keeps construction costs down. Recycled concrete also weighs 10% to 15% less than virgin concrete. It also provides superior compaction and constructability. It can also be used as gravel, reducing the need for gravel mining.