

Building a SEED Park: Part III -- Recycling

In Part II of this series we explored the sources of energy and distinguished between non-renewable and renewable supplies. Biomass in the form of municipal solid waste (MSW) and the sludge produced by wastewater treatment plants was identified as a renewable energy source which is expanding even more rapidly than the population growth.

On average, each person in the US produces about 4.5 lbs of MSW/day. In Colorado, the per capita waste production was 1.7 lbs/day in 2006. If individual production of MSW remains constant as the population grows, the volume of MSW produced annually will double by 2050, if not by 2030. MSW and sludge are the only sources of biomass that expand unintentionally as the population grows.

What's in MSW? Typically, about 40 to 60% is organic and the remainder is inorganic. Organic constituents include wood, paper, food wastes, fabrics, plastics, and even the tar component of asphalt. Organics, by definition, contain the element carbon. All products made from petroleum are actually organic. Plastics made from petroleum won't necessarily decompose to produce compost, but with time and exposure to ultraviolet sunlight and heat, plastics will eventually break down to final end products of carbon dioxide and water. Similarly coal and even diamonds are organic in origin and certainly won't make good compost.

The renewable organics such as wood, paper, food waste, and agricultural residues will make compost. These organics can also be blended with sludge to produce high-grade compost. Two cities in the US, Pinetop, AZ and Sevierville, TN, now combine MSW and sludge to produce compost. Vancouver, Canada has a very large operation to produce compost from MSW and sludge. The benefits of these operations include minimizing the load of landfills, extracting value from waste, producing a product for both agricultural and horticultural use and is, in many cases, minimizing trips, and therefore transportation costs, to landfills.

In 2005, US residents, businesses and institutions produced over 245 million tons of MSW, or about 4.5 lbs of waste per person per day. By comparison, MSW per person was only 2.7 lbs per day in 1960 and the total quantity generated in the US was only just over 88 million tons. The total volume generated doubled in just about 30 years. The bulk of the waste is paper, followed by yard trimmings and plastics (Figure 1).

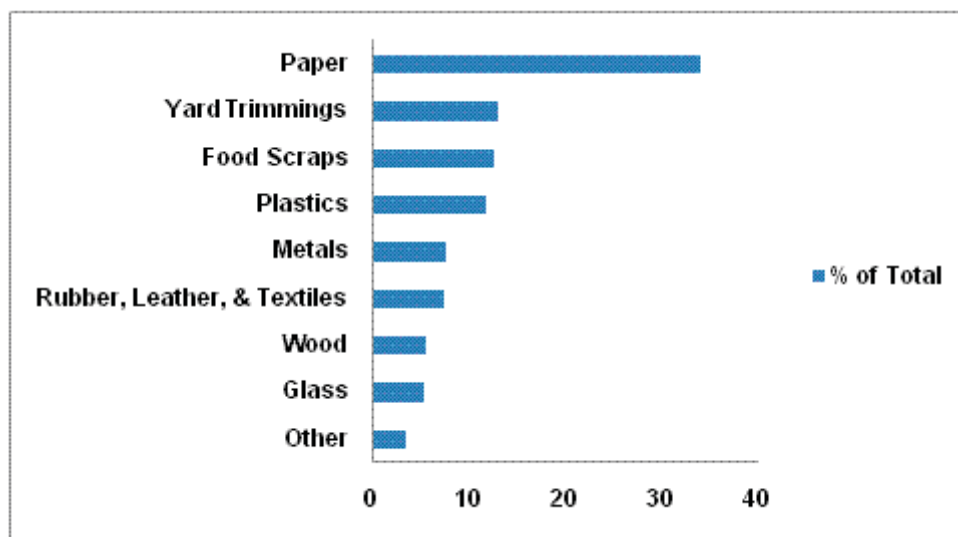


Figure 1. 2006 Total Waste Generation - 251 Million Tons (before recycling). Source: www.epa.gov/msw/facts.htm

cling has increased from about 6.4% in 1960 to 32.1% in 2005. Auto batteries have a 99% with the next highest rate of 62% for steel cans. Yard trimmings are recycled at 62%. All other components of MSW are recycled at less than 50% (Figure 2).

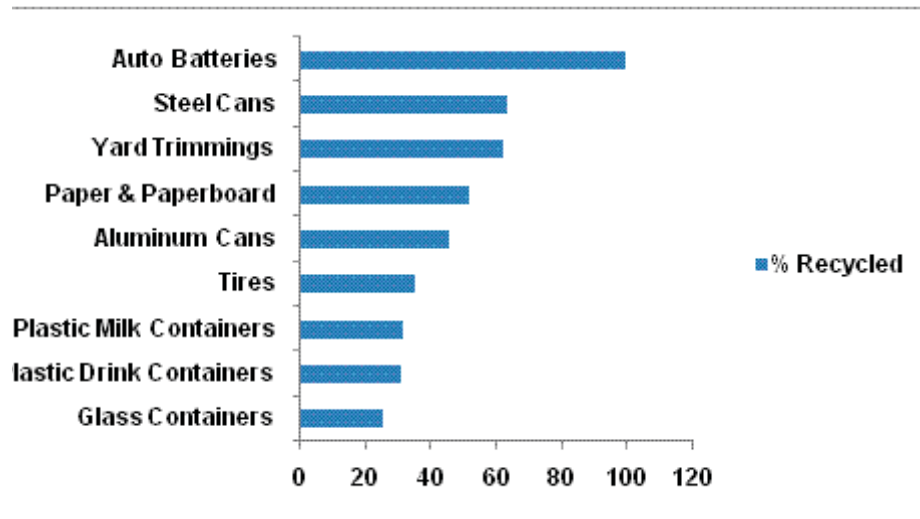


Figure 2. Recycling Rates of Selected Materials. Source: www.epa.gov/msw/facts.htm

and data obtained from EPA reflect only MSW and do not include construction and demolition wastes, agricultural residues, forestry residues, petroleum contaminated soil, coal combustion residuals, and other similar large volume wastes.

In the US, Colorado produced over 8.2 million tons of wastes in 2006 – up from 4.7 million tons in 2005. The solid waste user fee has remained about constant over this period, being \$3.2 million in 2005 and rising to only \$3.7 million in 2006. An additional cost not reflected in these figures has been the increasing reliance on foreign oil used to fuel trucks transporting solids to the landfills.

Materials such as metals, stone and concrete can be reclaimed and recycled. Today the aluminum can is recycled about seven times per year. In some areas, used tires are recycled into rubber mats and thousands of tons of road surface materials. Stone, concrete, asphalt, bricks and other inorganics are being recycled as building materials. Glass is recycled to make more glass and is also crushed to produce a bedding material for landscaping. Ferrous materials, such as tin cans, steel and iron are easily reclaimed and recycled. Electronic components contain a variety of high-value metals and components such as aluminum, nickel, cobalt, lithium, silver, gold, platinum, palladium, iridium, rhodium, ruthenium, selenium, tellurium, vanadium, niobium, tantalum, zirconium, titanium, cerium, lanthanum, yttrium, barium, strontium, calcium, magnesium, sodium, potassium, phosphorus, sulfur, silicon, boron, and arsenic. Many of these elements are hazardous and have a very high value, both monetarily and environmentally. For example, the metal tantalum, columbite-tantalite ore, is mined in Africa...destroying the habitat of the mountain gorilla. Tantalum capacitors, of which there are 500 million in the US, with 100 million new ones added each year, are made from columbite-tantalite ore and helps preserve gorilla habitat. Tantalum is used in mobile phones, video game consoles, and game consoles.

Dr. Robert Whitman, a microbiologist at Columbia University, has proposed recycling on a grand scale. He has proposed vertical urban farms to be located in skyscrapers. These urban farms could supply the food for 100 people consuming 2,000 calories/day. He proposed to use sewage water and a series of filters to extract nutrients, producing clean water, fruits and vegetables. Additional high-purity water should be captured by condensing water vapor placed in the atmosphere by the transpiration of plants. This volume of water collected from each urban farm would supply the needs of 100 people.