Waste Management and Energy Savings: Benefits by the Numbers

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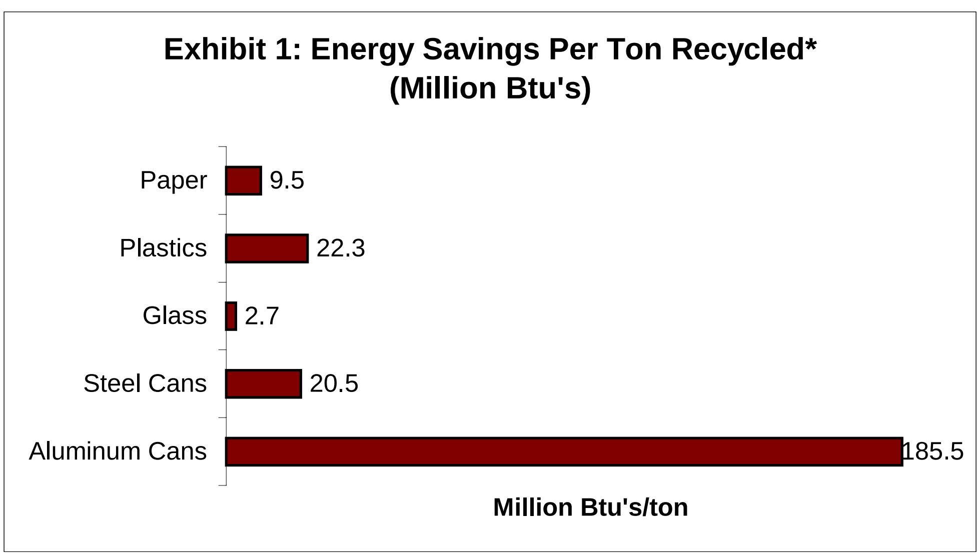
The environmental impacts of waste management are more far-reaching than you may think. In addition to affecting soil, water, and air quality, waste management practices have impacts on energy consumption. In 1999, the United States generated nearly 230 million tons of municipal solid waste. Managing this waste with the energy consequences in mind could lead to significant energy savings across the country.

Products that ultimately end up in the waste stream have energy impacts at each stage of their “life cycle”: the acquisition of raw materials, their manufacture into products, their use by consumers, and their disposal. Waste reduction practices, such as recycling and reuse, reduce the demand for raw material and energy inputs to the manufacturing stage of the life cycle, thereby conserving energy. Energy savings can also come from waste combustors and landfill gas collection systems.

In 1998, the U.S. Environmental Protection Agency (EPA) published a report titled “Greenhouse Gas Emissions from Management of Selected Materials in Municipal Solid Waste” (EPA530-R-98-013). In this report, EPA developed greenhouse gas emission factors for five waste management practices—source reduction, recycling, composting, combustion, and landfilling—to aid waste planners in assessing the benefits of waste reduction activities (e.g., recycling, source reduction) as compared to traditional waste disposal practices (e.g., combustion, landfilling).

Recently, using public data from the greenhouse gas research effort, EPA developed energy factors that capture the energy impacts of waste management measures. Exhibit 1 presents energy savings associated with recycling in units of million British thermal units (Btu) per ton of material. As the exhibit indicates, the energy impacts vary by material type, but in each case, recycling of these common



*Assumes recycled materials would otherwise have been disposed in a landfill.

materials results in energy savings.

The energy savings associated with recycling various materials are driven by the difference between manufacturing the material using virgin imports and manufacturing the material using recycled inputs. As you can see, recycled aluminum cans result in the most significant energy savings per ton. This reflects the energy intensive processes involved in manufacturing aluminum cans from virgin inputs and the relatively insignificant energy requirements associated with manufacturing aluminum cans using recycled aluminum.

Exhibit 2 presents the energy impacts associated with four waste management options: source reduction, recycling, combustion, and landfilling. Energy impacts are shown in million Btu's per ton of material. Negative values indicate net energy savings.

Exhibit 2: Energy Consumed/Avoided from MSW Management Options (Million Btu's/Ton)

Material	Source Reduction for Current Mix of Inputs*	Recycling	Combustion	Landfilling
Aluminum Cans	-103.25	-184.99	0.12	0.53
Steel Cans	-26.45	-19.97	-17.04	0.53
Glass	-6.49	-2.13	0.08	0.53
HDPE	-24.07	-18.99	-6.66	0.53
LDPE	-35.26	-24.10	-6.66	0.53
PET	-26.86	-22.20	-3.46	0.53
Corrugated Cardboard	-18.26	-13.00	-2.51	0.51
Magazines/third class mail	-32.83	-0.69	-1.87	0.52
Newspaper	-31.41	-16.49	-2.83	0.52
Office Paper	-31.90	-10.08	-2.42	0.49
Phonebooks	-37.83	-11.93	-2.83	0.52
Textbooks	-34.89	-1.03	-2.42	0.49
Dimensional Lumber	-3.41	0.59	-2.96	0.52
Medium Density Fiberboard	-11.19	0.86	-2.96	0.52
Food Scraps	NA	NA	-0.85	0.52
Yard Trimmings	NA	NA	-1.00	0.52
Mixed Paper	0.00	0.00	0.00	0.00
Broad Definition	NA	-6.65	-2.52	0.51
Residential Definition	NA	-6.65	-2.10	0.51
Office Paper Definition	NA	-13.95	-1.98	0.51
Mixed Plastics	NA	-20.53	-4.92	0.53
Mixed Recyclables	NA	-16.78	-2.65	0.51
Mixed Organics	NA	NA	-0.93	0.52
Mixed MSW	NA	NA	-1.78	0.52

* "Current mix" refers to the current mix of virgin and recycled inputs. Most new materials are produced using some percentage of recycled inputs. These calculations account for this percentage, rather than assuming new products are produced from 100 percent virgin inputs.

As the exhibit indicates, waste reduction efforts such as recycling and source reduction can result in significant energy savings. Source reduction techniques, such as double-sided copying and using materials more than once, are even more effective at reducing energy use than recycling. This is because source reduction completely eliminates energy consumption associated with extracting raw materials and manufacturing them into products.

Energy impacts of waste management practices are calculated by subtracting energy consumed in a baseline scenario from energy consumed in an alternate scenario. For example, as shown in Exhibit 3, someone interested in understanding the energy benefits of recycling aluminum cans could subtract the energy impact of landfilling 1 ton of aluminum cans from the energy impact of recycling 1 ton of aluminum cans.

Exhibit 3: Estimating the Energy Impacts of Waste Reduction Example Calculation:

Baseline: landfill 1 ton of aluminum cans
1 ton * 0.53 million Btu/ton = 0.53 million Btu

Alternate: recycle 1 ton of aluminum cans
1 ton * -184.99 million Btu/ton = -184.99 million Btu

Energy Savings:
-184.99 million Btu - 0.53 million Btu =
-185.46 million Btu

The energy factors presented above also can be used to quantify national energy savings associated with recycling. In 1997, U.S. communities recycled an estimated 28 percent—50.6 million tons—of total municipal solid waste. EPA estimates that those recycling activities account for roughly 633 trillion Btu in energy savings—an amount equivalent to the consumption of 5 billion gallons of gasoline or 109 million barrels of oil (see Exhibit 4 for common energy conversion factors).

If the U.S. recycling rate were to increase to 35 percent, energy savings would increase to an estimated 907 trillion Btu—an amount equivalent to the consumption of 7 billion gallons of gasoline or 156 million barrels of oil. Compared to the 28 percent recovery scenario, the increased energy savings would have the same effect as removing nearly four million passenger cars from the roadway each year.

Exhibit 4: Common Energy Conversion Factors:

Fuel:

Million Btu per Barrel of Oil:	5.8
Gallons oil per Barrel of Oil:	42
Million Btu per gallon of gas:	0.125

Cars: ("average" passenger car over one year)

Fuel Consumption:	556 gallons of gas
CO2 emissions (tons/year):	5

Communities nationwide are doing their part to conserve energy. The energy factors presented above demonstrate that conscientious waste management can lead to substantial energy savings.

For more information on the climate change impacts of waste management, visit <www.epa.gov/mswclimate>.