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Reusable vs. Disposable Cups

University of Victoria 1994

This classic life-cycle energy analysis was performed by University of Victoria professor of chemistry Martin B. Hocking. Hocking compared three types of reusable drinking cups (ceramic, glass and reusable plastic) to two types of disposable cups (paper and polystyrene foam).

The energy of manufacture of reusable cups is vastly larger than the energy of manufacture of disposable cups (Table 1). In order for a reusable cup to be an improvement over a disposable one on an energy basis, you have to use it multiple times, in order to “cash in” on the energy investment you made in the cup. If a cup lasts only ten uses, then each use gets “charged” for one-tenth of the manufacturing energy. If it lasts for a hundred uses, then each use gets charged for only one-hundredth of the manufacturing energy.

But in order to reuse a cup, it has to be washed. The efficiency of the dishwasher, and the efficiency of the energy system that powers it, determine how much energy is required for each wash.¹ Hocking assumed a new, commercial dishwasher running on Canadian electricity, requiring about 0.18 MJ/cup-wash.² The total amount of energy per use is this wash energy plus the appropriate fraction of manufacturing energy, depending on the cup’s lifetime. Figure 1 shows how the energies per use of the three reusable cups decline, the more you use them.

Cup type	Cup Mass	Material Specific Energy	Embodied Energy
	g/cup	MJ/kg	MJ/cup
Ceramic	292	48	14
Plastic	59	107	6.3
Glass	199	28	5.5
Paper	8.3	66	0.55
Foam	1.9	104	0.20

Table 1 - The embodied energy in each of the five cups (last column) is the cup mass (first column) multiplied by the material specific energy (second column).

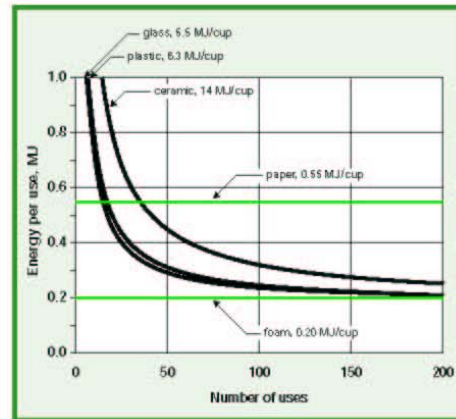


Figure 1 - The energy per use of each reusable cup (black lines) declines as it is used more times. The energy per use of each disposable cup (green lines) is a constant equal to the manufacturing energy, since it is used only once and is never washed. The numbers in the labels are the manufacturing energies for the different cups.

The lifetime needed for the energy per use of a reusable cup to become less than for a disposable cup, is called the "break-even point." In Table 2, the break-even matrix shows how many uses are required for each reusable cup to do better than either disposable cup.

Reusable Cup	Disposable Cup	
	Paper	Foam
Ceramic	39	1006
Plastic	17	450
Glass	15	393

Table 2 - Break-even matrix. Each number shows the uses necessary before the reusable cup listed on the left, becomes equally energy efficient to the disposable cup listed on the top.

The results are extremely sensitive to the amount of energy the dishwasher requires for cleaning each cup. Hocking's choice for the dishwasher, requiring 0.18 MJ/cup-wash, is barely less than the manufacturing energy of the foam cup, 0.19 MJ/cup. If Hocking had chosen even a slightly less energy-efficient dishwasher as his standard, then the reusable cups would never have broken even with the foam cup.

The lesson of this life-cycle energy analysis is that the choice between reusable and disposable cups doesn't matter much in its overall environmental impact. One should use one's best judgement.

Indeed, in situations where cups are likely to be lost or broken and thus have a short average lifetime, disposable cups are the preferred option.

Source: Hocking, Martin B. "Reusable and Disposable Cups: An Energy-Based Evaluation." Environmental Management 18(6), 1994, pp. 889-899.

1 Dishwashers generally require less energy than hand washing, because they make particularly efficient use of the hot water, which is the most energy-intensive part of washing dishes. U.S. Department of Energy, Energy-Efficient Water Heating, www.eren.doe.gov/erec/factsheets/eewtrhtr.html.

2 ILEA reports most energy values in megajoules (MJ). A megajoule is enough energy to bring about 3 quarts of room-temperature water to boiling.

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