

Embodied Energy

Clarissa Morawski

We can't measure the impact of solid waste unless we study the energy we throw away.

WASTE discussions have traditionally focused on the back-end management of garbage: the significant economic and environmental implications of finding safe disposal sites, for example. But the obvious often escapes us – that garbage is made up of basic materials (metal, wood, plastic, glass, etc.) that require energy to obtain, process and manufacture.

When we throw something away, we also throw away the embodied energy used to make it. Huge amounts of energy are used to extract the primary resources required for virgin materials from which new products are made. More again goes into manufacturing. Rarely is this lost energy considered.

New products made from recycled materials require much less energy because primary resource extraction is avoided. If a new product is reused, then even more energy is saved because manufacturing is avoided. And if we avoid using something altogether, the greatest amount of energy is saved. Here are a few examples.

Using recycled aluminum cans to make new cans means avoiding limestone, salt and bauxite mining; it also eliminates the need for caustic soda, chlorine, alumina, crude oil, petroleum coke, and anode production. Using recycled cans rather than virgin aluminum as feedstock for the production of sheet metal requires 95 percent less energy.

Manufacturing corrugated packaging with old corrugate requires no round-wood harvesting, wood residual production, sodium and sulfate mining, soda ash production, or cornstarch manufacture.

Using recycled glass to make new bottles avoids limestone, glass sand, soda ash and feldspar mining.

Reusing glass bottles eliminates the need for post-consumer cullet recovery and processing, and the additional manufacturing of glass containers.

Re-refining used oil into new lubricat-

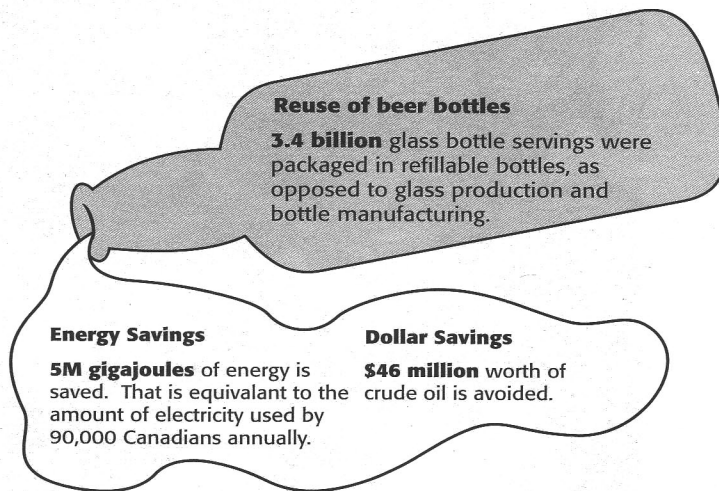
ing oil avoids crude oil exploration, drilling, water injection, heavy crude and bitumen extraction, and transportation via pipeline or shipping to the refinery.

Avoiding all these up-stream functions means significantly reducing energy use and associated greenhouse gas emissions.

Thanks to extensive lifecycle-analysis studies recently undertaken by both the US Environmental Protection Agency and Environment Canada, we can identify actual energy savings from reduction, reuse and recycling efforts. The data reveal important insights into the impact of waste diversion programs on energy conservation.

Canadians dispose of about one billion aluminum cans annually, adding about 16,000 tonnes to landfill. Were these cans recycled instead, the potential energy savings would be about one million gigajoules – enough energy to heat 10,870 homes for one year.¹ On the flip side, because Canadians do recycle about 3.5 billion cans per year, 3.3 million gigajoules of energy are saved.²

Reusing beer bottles also contributes significantly to reducing energy every year. Last year, about 3.4 billion glass bottle servings were packaged in refillable bottles with a life span of 15 uses. By avoiding glass production and bottle manufacturing, about five million gigajoules of energy are saved – equivalent



to the annual electricity requirements of almost 90,000 Canadians.³ These savings also represent over \$46-million worth of avoided crude oil costs (about 795,650 barrels).⁴

Quantifying the related embodied energy from different kinds of garbage can provide a meaningful basis for prioritizing recycling policy and programs.

But most importantly, these measurements provide cradle-to-grave energy profiles that can help product designers and manufacturers select which materials to use in the first place. ♻️

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Notes

¹ The average annual energy consumption per household in Canada is 156 GJ (gigajoules), 59 percent comprised of space heating, equivalent to 92 GJ per house: *Improving Energy Performance in Canada 2003-2004* (Ottawa: Natural Resources Canada).

² *Determination of the Impact of Waste Management Activities on Greenhouse Gas Emissions* (Ottawa: Environment Canada, March 2001).

³ Annual electricity consumption per year is 15661.13 kWh per capita, equal to 56.3 GJ <nationmaster.com/country/canada/energy> [accessed June 17, 2005].

⁴ One barrel of crude oil is equal to about 6.3 GJ of energy: US Department of Energy, *Energy Efficiency and Renewable-Industrial Technologies Program*. The value of a barrel of oil on Friday, June 17, 2005 was \$58 <www.msnbc.msn.com> [accessed June 17, 2005].

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