REVIEW OF LIFE CYCLE INVENTORY STUDY FOR COFFEE PACKAGING

I. OVERVIEW

In February 2007, The ULS Report published *A Study of Packaging Efficiency As It Relates to Waste Prevention*, an update to the original 1995 research report. Both studies led to similar conclusions, the key being that when it comes to reducing waste, the best choice is the package that delivers the most product for the least amount of material, regardless of what that material might be, and to a large extent, whether or not significant recycling of that package is occurring.

The primary recommendation of the research was that manufacturers and retailers produce, stock and promote more products in flexible, rather than rigid containers. For example, flexible pouches made of plastic and foil films, such as those used for children's beverages and coffee, and more recently for tuna, create significantly less waste than their rigid plastic, steel and glass predecessors. In general, this is true even though most flexible containers are not being recycled, while their rigid metal, glass and plastic predecessors are both more recyclable and more recycled. The reason for this counterintuitive finding is that flexible packages are so much lighter than rigid packages that recycling of the latter cannot offset the significant source reduction and waste prevention advantages of the former.

An understanding of the value of flexible packaging is particularly important today, as retailers such as Wal-Mart continue to incorporate sustainability into their operating philosophies, and expect their suppliers to do so as well. Unless a retailer's general management, buying management, merchandising management, and store management understand the benefits of source reduction, the tendency will be to continue promoting recyclability rather than the total supply chain efficiency available by light-weighting. The ultimate result will be the exact opposite of what is intended, as material consumption and greenhouse gas generation will actually increase.

Following publication of the 2007 Packaging Efficiency Study, this Editor was approached by the Plastics Division of The American Chemistry Council (ACC), which desired to take the research one step further, and use the data to help develop a life cycle inventory (LCI) which would provide additional evidence with which to confirm that light weighting should be a key strategy in the effort to produce more sustainable packaging. The ACC proposed that three prime examples sited in the ULS study, milk, tuna and coffee packaging, be further analyzed.

Given the ULS long-held belief that "light makes right" and the emerging interest in sustainable packaging by major retailers such as Wal-Mart, we agreed to provide our data, but with three conditions: 1.) The study had to be performed by a reputable firm approved by us, 2.) Results needed to be peer reviewed, and 3.) *The ULS Report* would be given first rights to review and publish the results. The ACC agreed to these terms.

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The study was performed by Franklin Associates, an independent provider of life cycle services. All data used in the study were drawn from published sources. Besides its own data, which are published in the U.S. Department of Energy's Life Cycle Database (www.nrel.gov/lci), Franklin utilized information from our 2007 Packaging Efficiency Study.

The study measured energy consumption, solid waste generation, and environmental emissions to air and water for 8 different types of coffee packaging:

- 15 oz. and 26 oz. fiberboard and steel canisters
- 11.5 oz. and 34.5 oz. steel cans
- 11.5 oz and 34.5 oz. HDPE plastic canisters
- 12 oz. PET/LDPE plastic and foil laminate bag
- 13 oz. PET/LDPE plastic and foil "brick pack"

See Table 2 for complete list of package components, including labels and seals

To create equivalency, Franklin expressed results in a functional unit that allows for comparison of different package sizes and the resulting difference in amount of product delivered. The normalized unit is 100,000 ounces of ground coffee.

To assure data quality, this study was peer reviewed by three outside experts: Dr. David Allen, University of Texas; Dr. Greg Kioleian, Center for Sustainable Systems at the University of Michigan; and Beth Quay, Private Consultant. Their comments, and Franklin Associates' responses to them, can be found in the attached report.

II. STUDY SCOPE AND BOUNDARIES

This study includes the following three steps for each packaging system:

1. Production of the packaging materials (all steps from extraction of raw materials through the steps that precede packaging manufacture).

2. Manufacture of the primary packaging systems from their component materials.

3. Postconsumer disposal and recycling of the packaging systems.

The end-of-life scenarios used in this analysis reflect the current recycling rates of the packages studied. No composting has been considered in this analysis. The steel cans used as coffee containers are commonly recycled, so their end-of-life scenario includes the widely accepted 62% steel can recycling rate. Also, HDPE canisters are generally accepted to be recycled at a rate of 15%, and this rate was also used for end-of-life scenario purposes.

Where possible, all primary packaging was considered, including label materials. Printing inks and processes are considered a negligible part of the overall findings, and are not included in the analysis.

III. STUDY LIMITATIONS

1. No secondary packaging, or transportation to filling, storage, distribution, or consumer use is included, as these are outside the scope and boundaries of the analysis. If included, the differences of the studied packaging systems for these stages may affect the results of, and conclusions drawn from, the analysis.

2. The complete primary packaging of the coffee was considered, whenever possible. Printing inks and processes are considered negligible by weight and are not included in the analysis.

3. Based on the uncertainty of data used for energy, solid waste, and emissions modeling, differences between systems are not considering meaningful unless they are greater than 10% for energy and postconsumer solid waste; and 25% for industrial solid waste and emissions data.

4. The three categories studied – energy, solid waste, and emissions are independent of each other and no agreed upon weighting system has been developed that allows for their being combined to produce "an answer". Thus, no overall conclusion can be drawn between packaging alternatives unless all three measures show significant differences, and do so in the same direction.

IV. DATA

Key data are provided in two tables. Table 1 summarizes differences in total energy, solid waste, and greenhouse gas emissions for 100,000 ounces of ground coffee:

Table 1

TOTAL ENERGY, TOTAL SOLID WASTE, AND GREENHOUSE GASES FOR 100,000 OUNCES OF GROUND COFFEE

	Total Energy	Total Solid Waste		Greenhouse Gases
	(MM Btu)	(lb)	(cu ft)	(lb of CO2 equivalents)
Coffee Packaging Systems				
15-oz. Fiberboard and Steel Canister (1)	23.4	1,376	48.0	2,376
26-oz. Fiberboard and Steel Canister (1)	22.3	1,311	45.5	2,169
11.5-oz. Steel Can (2)	25.8	1,757	67.8	4,377
34.5-oz. Steel Can (2)	18.9	1,379	51.5	3,140
11.5-oz. Plastic Canister (3)	42.6	1,142	70.7	3,310
34.5-oz. Plastic Canister (3)	33.4	896	55.7	2,606
12-oz. Laminate Bag	13.0	504	14.8	1,358
13-oz. Brick Pack	10.2	384	11.1	1,051

(1) End-of-life for the fiberboard/steel canisters are modeled as 80% being landfilled and 20% combusted with energy recovery. The steel sections of the canister are collected at the waste-to-energy plants and sent to recycling.

(2) End-of-life for the steel cans are modeled as 62% being recycled and 38% going to a landfill. The plastic labels on these cans are assumed to be incinerated during the steel recycling, but the energy created during this incineration is used internally in the steel recycling.

(3) End-of-life for the HDPE canisters are modeled as 15.4% being recycled, 16.9% going to combustion with energy recovery, and 67.7% going to a landfill. The plastic labels are assumed to be recycled with the plastic canister.

Note: The end-of-life for all other packaging is modeled as 80% going to a landfill and 20% combusted with energy recovery.

Source: Franklin Associates, a Division of ERG calculations using the Franklin Associates database and the U.S. LCI Database.

Table 2 defines the weight of the alternative packages, both in terms of actual and equivalent product weights:

Table 2

WEIGHTS FOR COFFEE PACKAGING
(Basis: 100,000 OUNCES OF GROUND COFFEE)

	Weight per unit		Weight per functional unit	
	(oz)	(g)	(lb)	(kg)
Coffee Packaging Systems				
15-oz. Fiberboard and Steel Canister (3)				
Fiberboard	1.44	40.7	599	272
Aluminum Foil	0.01	0.41	6.05	2.74
Steel Rim and Base	0.92	26.1	384	174
HDPE Lid	0.20	5.80	85.2	38.7
LDPE/Foil Seal	0.049	1.40	20.6	9.33
Bleached Paper Label	0.21	5.90	86.7	39.3
26-oz. Fiberboard and Steel Canister (3)				
Fiberboard	2.55	72.4	614	278
Aluminum Foil	0.03	0.73	6.20	2.81
Steel Rim and Base	1.42	40.4	342	155
HDPE Lid	0.33	9.35	79.3	36.0
LDPE/Foil Seal	0.076	2.15	18.2	8.27
Bleached Paper Label	0.36	10.1	85.6	38.8
11.5-oz. Steel Can (3)				
Steel Can	3.16	89.5	1,715	778
HDPE Lid	0.21	5.90	113	51.3
LDPE/Foil Seal	0.046	1.30	24.9	11.3
HDPE Label	0.053	1.50	28.8	13.0
34.5-oz. Steel Can (2)				
Steel Can	6.69	190	1,213	550
HDPE Lid	0.55	15.5	99.0	44.9
LDPE/Foil Seal	0.10	2.90	18.5	8.41
HDPE Label	0.10	2.90	18.5	8.41
12-oz. Laminate Bag (3)				
PET/LLDPE/Foil Laminate Bag	0.50	14.2	261	119
PP/steel tie	0.038	1.07	19.6	8.91
13-oz. Brick Pack (1)				
PET/LLDPE/Foil Laminate Brick	0.43	12.3	209	94.6
11.5-oz. Plastic Canister (1)				
HDPE Canister	1.71	48.6	932	423
LDPE Lid	0.35	10.0	192	87.0
PET/LDPE/Foil Seal layer	0.035	1.00	19.2	8.70
HDPE Film Label	0.039	1.10	21.1	9.57
34.5-oz. Plastic Canister (2)				
HDPE Canister	4.09	116	741	336
LDPE Lid	0.85	24.0	153	69.6
PET/LDPE/Foil Seal layer	0.095	2.70	17.3	7.83

(1) These container system weights were taken from the ULS report,
(2) These container systems were weighed by staff at Franklin Associates.
(3) The container system weights are an average of ULS report weights and weights measured by Franklin Associates staff.

Source: Franklin Associates, a Division of ERG

V. FINDINGS

A. Overall

<u>To deliver an equivalent amount of coffee, the 13 ounce brick pack consumes the least amount of energy and generates the least amounts of solid waste and greenhouse gas emissions</u>. This container does significantly better than its alternatives across all three dimensions, even though it is not recycled. For reference, comparing the brick pack to an 11.5 ounce steel can with a 62% recycling rate indicates that the brick pack consumes about 60% less energy and produces about 75% less solid waste and greenhouse gas emissions than does the can.

While it generated significantly more waste than the brick pack, the laminate bag also performed significantly better than the rigid container alternatives across all dimensions. For reference, the basic reason for the brick pack's better performance versus the bag is the fact that the former and its contents are vacuum packed, requiring less volume and therefore less packaging material.

B. By Weight

<u>In general, reduced packaging weight translates to reduced solid waste and greenhouse gas generation.</u> Again, this was true regardless of recycling rates, as the weight differences between flexible containers (brick packs and bags) and rigid cans were too great to be overcome by the inclusion of current recycling rates.

C. By Size

<u>Larger sizes are generally more environmentally efficient than their smaller counterparts</u>. The 34.5 oz. steel and plastic containers performed significantly better than their equivalent 11.5 oz. versions across all three dimensions of energy consumption, solid waste generation, and greenhouse gas emissions.

VI. CONCLUSIONS

This study, with its more rigorous lifecycle methodology, confirms the key conclusions presented in our packaging efficiency study and in our recent review of the Franklin Associates LCI of tuna packaging (*LCI Summary for 6 Tuna Packaging Systems*, August 2008 and available at http://www.use-less-stuff.com):

1. <u>Light makes right</u>. Lighter, flexible packages consume less energy and materials while generating less solid waste and greenhouse gases than their rigid counterparts. This is true even when recycling rates are significantly higher for the rigid container alternatives.

2. <u>Size matters</u>. Larger sizes are more efficient than smaller ones, since packaging volume increases faster than the material weight needed to contain that volume. (This is a simple mathematical law based on the fact that volume is a cube function (length x width x height) while surface area is a square function (length x width). This conclusion is valid as long as the increased amount of product delivered by larger packages is consumed as intended.

VII. INDICATED ACTION

Significant reductions in energy consumption, solid waste generation, and greenhouse gas emissions can be achieved by moving from rigid to flexible containers, even if the latter are not significantly recycled. Ironically, implementing this strategy would actually have a positive impact on recycling efficiency and economics, as reducing the relative amount of recyclable material available while keeping steady the amount actually being recycled will increase recycling rates and most likely the demand for recycled materials.

Robert Lilienfeld, Editor

Note:

We asked Franklin Associates to review this summary for accuracy, and they have graciously done so. Melissa Huff, Senior Chemical Engineer at Franklin, agrees that our conclusions are technically correct and consistent with their findings.