



REVIEW OF LIFE CYCLE INVENTORY STUDY FOR TUNA 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 cited 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.

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 6 different types of tuna packaging:

- 12-ounce steel can with paper label
- 12-ounce pouch of PET/Foil/Nylon/Polypropylene (PP)
- 6-ounce steel can with paper label
- 3-ounce pouch of PET/Foil/Nylon/PP
- 3, 3-ounce steel cans with paper labels, in a paperboard sleeve
- 2, 2.8 -ounce plastic cups (PP with PET/foil lids) in coated paperboard sleeve

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 tuna consumed.

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 tuna containers are commonly recycled, so their end-of-life scenario includes the widely accepted 62% steel can recycling rate.

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.

II. STUDY LIMITATIONS

1. No secondary packaging, transportation to filling, distribution, retail storage, or consumer use is included, as these are outside the scope and boundaries of the analysis. The transport of materials to the filler and of filled tuna containers from the filling step may affect the results of this report.
2. This analysis is representative of U.S. production. All three major tuna producers have filling plants outside of the contiguous U.S. It is unknown whether all of the plants utilize each packaging type considered within this analysis.
3. The omission of data from some life cycle stages may affect the conclusions of the analysis. For example, the tuna in the 12 ounce containers may not be completely consumed in one sitting. This would probably require refrigeration of remaining product, adding unrecognized energy and emissions.
4. 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.
5. 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.

III. 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 tuna consumed:

Table 1

TOTAL ENERGY, TOTAL SOLID WASTE, AND GREENHOUSE GASES FOR 100,000 OUNCES OF TUNA CONSUMED

Tuna Packaging Systems	Total Energy	Total Solid Waste		Greenhouse Gases
	(MM Btu)	(lb)	(cu ft)	(lb of CO2 equivalents)
12-oz. Steel Can (1)	22.7	1,333	44.0	4,292
12-oz. Pouch	9.30	346	10.5	977
6-oz. Steel Can (1)	24.1	1,413	46.6	4,551
3-oz. Pouch	25.2	936	28.4	2,647
3-3-oz. Steel Cans in Paperboard Sleeve (1)	43.2	2,562	83.6	7,518
2-2.8-oz. Plastic Cups in Paperboard Sleeve	28.2	1,106	37.8	1,702

(1) End-of-life for the steel cans are modeled as 62% being recycled and 38% going to a landfill. The paper labels are assumed to be incinerated during steel recycling. Ash from the incineration of the labels is included in solid waste.

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

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

Table 2
WEIGHTS FOR TUNA PACKAGING
(Basis: 100,000 OUNCES OF TUNA CONSUMED)

Tuna Packaging Systems	Weight per unit		Weight per functional unit	
	(oz)	(g)	(lb)	(kg)
12oz. Can				
Steel Can	2.09	59.2	1,088	493
Paper Label	0.07	1.9	34.9	15.8
12oz. Pouch (1)				
PET/Foil/Nylon/PP Pouch	0.40	11.2	206	93.3
6oz. Can				
Steel Can	1.11	31.4	1,154	523
Paper Label	0.04	1.0	36.7	16.7
3oz. Pouch (1)				
PET/Foil/Nylon/PP Pouch	0.27	7.6	558	253
3 -3oz. Cans in Paperboard Sleeve				
Steel Cans	0.89	25.2	1,854	841
Paper Label	0.02	0.6	44.1	20.0
Coated paperboard Sleeve	0.40	11.4	279	127
2-2.8 oz. Plastic Cups in Paperboard Sleeve				
PP Cups	0.28	7.8	614	279
PET/Foil Lid (2)	0.03	0.9	70.9	32.1
Coated paperboard Sleeve	0.38	10.7	421	191

(1) The weight percentages of these layers have been estimated as 40% PET, 15% aluminum foil, 5% nylon, and 40% PP. The nylon layer has been included as PET.

(2) The weight percentages of these layers have been estimated as 90% PET and 10% aluminum foil.

IV. FINDINGS

A. Overall

To deliver an equivalent amount of tuna, the 12-ounce pouch consumes the least amount of energy and generates the least amounts of solid waste and greenhouse gas emissions. This container does significantly better than its alternatives across all three categories, even though it is not recycled. For reference, comparing the pouch to a 12-ounce steel can with a 62% recycling rate indicates that the pouch consumes about 60% less energy and produces 75% less solid waste and greenhouse gas emissions than does the can.

B. By Weight

In general, reduced packaging weight translates to reduced solid waste and greenhouse gas generation. Again, this was true regardless of recycling rates, as the weight differences between flexible containers (pouches) and rigid cans were too great to be overcome by differences in recycling rates.

C. By Size

Larger sizes are generally more environmentally efficient than their smaller counterparts. The 12-ounce pouch produced significantly less waste and consumed significantly less energy than did the 3-ounce pouch. While the 12-ounce and 6-ounce can results were statistically similar, both were significantly better than results for the 3-ounce cans. (Note: This last finding was due in part to the use of a paperboard sleeve which enclosed the three, 3-ounce cans.)

V. 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 coffee packaging (*LCI Summary for 8 Coffee Packaging Systems*, September 2008 and available at <http://www.use-less-stuff.com>):

1. Light makes right. 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. Size matters. 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.

VI. 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.