REVIEW OF LIFE CYCLE DATA RELATING TO DISPOSABLE, COMPOSTABLE, BIODEGRADABLE, AND REUSABLE GROCERY BAGS

I. BACKGROUND

In March 2007, the Board of Supervisors of the City of San Francisco passed an ordinance effectively banning the use of plastic grocery bags at supermarkets and large pharmacies. The Board's objective was to stop environmental degradation and reduce litter, and its solution was to legislate the replacement of traditional plastic bags with reusable bags or bags made from paper or compostable plastic.

In an effort to gauge the impact of the Board's decision, both in terms of environmental impact and litter reduction, the Editors of *The ULS Report* have examined a number of credible third-party research reports, and used the findings to develop their own conclusions and recommendations.

Please note that this review was originally published in June, 2007 and has been revised as follows:

1. This review includes research performed by Boustead Consulting & Associates that was released after the previous version was published in June 2007.

2. Information from the EPA's web sites cited in the previous summary has been removed from this version, as it is no longer publicly available.

3. All results mentioned below have been made equivalent to reflect the different carrying capacity of paper vs. plastic bags. For reference, it is generally accepted that 1.5 plastic bags equal the capacity of 1 paper bag.

II. METHODOLOGY

An examination was made of four studies that compared the environmental impacts of various grocery bags, or provided data widely used to do so:

1. Carrefour Group, an international retail chain that was founded in France and is second only to Wal-Mart in terms of global retail revenues, commissioned a Life Cycle Assessment (LCA) Study by Price-Waterhouse-Coopers/EcoBalance *(Évaluation des impacts environnementaux des sacs de caisse, February 2004, #300940BE8)* that compared the environmental impact of four types of bags: plastic made from high density polyethylene (HDPE), paper, biodegradable plastic (50% corn starch and 50% polycaprolactone compostable plastic), and reusable plastic (flexible PE). The study evaluated environmental impacts from material production, through bag manufacturing and transport, to end of life management.

   The study was completed according to ISO standards 14040-14043, and peer reviewed by the French environmental institute, ADEME, the Agency for

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Environment and Energy Management. The first review was by Henri Lecouls, an independent lifecycle analysis expert assisted by Laura Degallaix, representative of the Federal Consumers' Union, Que Choisir, and Dominique Royet, World Wildlife Federation (WWF) representative. A second review was made by related parties: APME (European Plastics Manufacturers Association; CEPI (Confederation of European Paper Industries); and Novamont, manufacturer of the biodegradable plastic assessed in the study.

2. *Life Cycle Inventories for Packagings*, Environmental Series No. 250/1, Swiss Agency for the Environment, Forests and Landscape (SAEFL), 1998. The study was critically reviewed by corporate and association members representing the paper, plastics, glass, aluminum and steel packaging industries.

3. *Eco-Profiles of the European Plastics Industry*, performed by I. Boustead for PlasticsEurope, 2005. This series was developed by LCA pioneer Boustead Consulting and conforms wherever possible to ISO standards 14040-14043. The data on polyethylene film are also referenced in the SAEFL study listed above.

4. *Life Cycle Assessment for Three Types of Grocery Bags – Recyclable Plastic; Compostable, Biodegradable Plastic; and Recycled, Recyclable Paper,* performed by Boustead Consulting & Associates Ltd. for the Progressive Bag Alliance, 2007. The study compared traditional grocery bags made from polyethylene, bags made from compostable plastics, and paper bags made using at least 30% recycled fibers. The life cycle assessment factored in every step of the manufacturing, distribution, and disposal stages of these bags.

   The study was peer reviewed by Dr. Michael Overcash, Professor of Chemical Engineering, as well as a Professor of Biological and Agricultural Engineering, at North Carolina State University.

III. STUDY LIMITATIONS

1. Findings, conclusions, and recommendations are based on data that have been obtained through publicly available channels or through the broad group of contacts that *The ULS Report* has developed. There may be other data available that refute, confirm, or extend the findings herein developed.

2. Results are based upon an analysis of quantitative data, especially in relation to materials consumption, energy and water usage, pollution, and greenhouse gas (GHG) production. Because of their qualitative and personal nature, issues that transcend a scientific approach, such as the social value of renewable vs. non-renewable resources and composting vs. landfilling, are best considered independently by the reader.

3. While the 2007 Boustead Consulting study was performed in the United States, the other studies originated in Europe. Because production processes are relatively similar globally, the data provide accurate assessments that can be used to draw valid conclusions in the United States. The similarity in results between the American and European studies further bears this out.

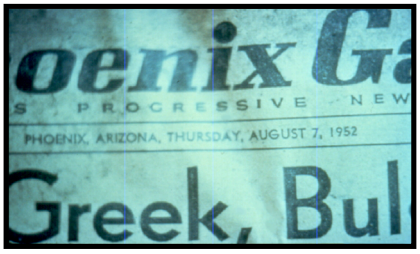
IV. FINDINGS

A. Biodgredation/Compostability

<u>While paper and certain plastics may be biodegradable or compostable in specially designed industrial facilities, evidence indicates that this feature may be of little value in the effort to reduce waste</u>:

1. Current research shows that in modern landfills, paper does not degrade or break down at a substantially faster rate than plastic does. Due to the lack of water, light, oxygen, and other important elements necessary for the degradation process to occur, nothing completely degrades in modern landfills.

   As evidence of this, here is a photo of a newspaper buried in an Arizona landfill and dug up after more than three decades. As can be clearly seen, paper does not degrade rapidly in landfills. *(Photo credit: Dr. William Rathje, Founder of The Garbage Project at The University of Arizona.)*

   Compostable plastics, which are produced from plant-based feedstocks, do not degrade in landfills, either. According to Natureworks®, a producer of a corn-based plastic known as PLA, containers made from its material will last as long in landfills as containers made from traditional plastics.[1]

2. In order to breakdown as intended, compostable plastics must be sent to an industrial or food composting facility, rather than to backyard piles or municipal composting centers. Since there are apparently fewer than 100 of these facilities functioning in the entire United States, the economic and environmental costs of wide-scale plastics composting are prohibitive, significantly reducing the value of such an alternative.[2]

3. By definition, composting and biodegradation release carbon dioxide (CO_2), a greenhouse gas, into the atmosphere, increasing the potential for climate change. For example, composted paper produces approximately twice the CO_2 emissions produced by non-composted paper. (See Paragraph B.1. just below for specific details.)

B. Waste, Energy Consumption, Greenhouse Gas Emissions

<u>The evidence does not support conventional wisdom that paper bags are a more environmentally sustainable alternative than plastic bags</u>. While this is certainly counterintuitive for many people, relevant facts include the following:

1. Plastic bags generate 39% less greenhouse gas emissions than uncomposted paper bags, and 68% less greenhouse gas emissions than composted paper bags. The plastic bags generate 4,645 tons of CO_2 equivalents per 150 million bags; while uncomposted paper bags generate 7,621 tons, and composted paper bags generate 14,558 tons, per 100 million bags produced.[3]

2. Plastic bags consume less than 6% of the water needed to make paper bags. It takes 1004 gallons of water to produce 1000 paper bags and 58 gallons of water to produce 1500 plastic bags.[4]

3. Plastic grocery bags consume 71% less energy during production than paper bags.[5] Significantly, even though traditional disposable plastic bags are produced from fossil fuels, the total non-renewable energy consumed during their lifecycle is up to 36% less than the non-renewable energy consumed during the lifecycle of paper bags and up to 64% less than that consumed by biodegradable plastic bags.[6]

4. Using paper sacks generates almost five times more solid waste than using plastic bags.[7]

5. After three uses, reusable plastic bags are superior to all types of disposable bags --paper, polyethylene and compostable plastic -- across all significant environmental indicators.[8]

C. Litter

While the data appear to indicate that paper and compostable plastic bags may account for less litter, data also indicates that this finding is offset by the increased environmental impacts these bags produce versus traditional plastic bags:

1. The manufacture of paper bags consumes twice as much water and emits about 60% more greenhouse gases than the production of plastic bags.[9]

2. Compared to disposable plastic bags, biodegradable plastic bags generate higher levels of greenhouse gas emissions, atmospheric acidification and eutrophification (a process whereby bodies of water receive excess nutrients that stimulate excessive plant growth, such as algae blooms).[10]

V. CONCLUSIONS/INDICATED ACTIONS

The conclusion to be drawn about how to reduce the environmental impacts and litter associated with grocery bags is very much in line with both longstanding EPA guidelines and the *ULS Report* philosophy: the issue is not paper or plastic, but rather finding ways to reduce, reuse, and recycle both of them – *in that order*. By putting more items in fewer bags, avoiding double bagging, switching to durable tote bags, and reusing and recycling disposable bags, significant reductions in material and non-renewable energy consumption, pollution, solid waste, greenhouse gas emissions, and litter, will occur.

And, while recycling can help save resources, its real value lies in the reduction of greenhouse gas emissions, and the minimization of waste going to landfills. Also, recycling helps reduce litter, as bags are contained and stored. Containment reduces the potential for them to be left in open spaces, where they become eyesores.

VI. SUMMARY

Legislation designed to reduce environmental impacts and litter by outlawing grocery bags based on the material from which they are produced will not deliver the intended results. While some litter reduction might take place, it would be outweighed by the disadvantages that would subsequently occur (increased solid waste and greenhouse gas emissions). Ironically, reducing the use of traditional plastic bags would not even reduce the reliance on fossil fuels, as paper and biodegradable plastic bags consume at least as much non-renewable energy during their full lifecycle.

Further, an Internet scan of available government and non-profit information for the United States, United Kingdom, Canada and Australia indicates that chewing gum and cigarette butts account for up to 95% of the litter generated in the English-speaking world.[11] Thus, there would appear to be far better and potentially more effective legislative opportunities available if the objective is to significantly reduce litter.

Again, when it comes to reducing the environmental and litter impacts of grocery and merchandise bags, the solution lies in a.) Minimizing the materials used to produce all types of bags, regardless of their composition, and b.) Building public awareness and motivation to reduce, reuse and recycle these bags – in that order.

Robert Lilienfeld, Editor

Footnotes

[1] *Corn Plastic to the Rescue*, by Elizabeth Royte, *Smithsonian*, August 2006 (www.smithsonianmag.com/issues/2006/august/pla.php?page=1).

[2] These figures were provided by a number of experts, but due to the fluctuating dynamics of the composting industry, no firm citation can be given. One article that mentioned the relative unavailability of industrial and food composting was *Composting that Plastic* by Eliza Barclay*, Metropolis Magazine,* March 1, 2004 (www. metropolismag.com/cda/story.php?artid=153). See also the *BioCycle* site www.findacomposter.com.

[3] *Life Cycle Inventories for Packagings*, Volume 1, SAEFL, 1998, Environmental Series 250/I and *Eco-Profiles of the European Plastics Industry*, developed by I. Boustead for PlasticsEurope, March 2005 (www.plasticseurope.org/content/Default.asp?PageID=404&IsNewWindow=True).

[4] Ibid and *Life Cycle Assessment for Three Types of Grocery Bags - Recyclable Plastic; Compostable, Biodegradable Plastic; and Recycled, Recyclable Paper,* performed by Boustead Consulting & Associates Ltd. for the Progressive Bag Alliance, 2007.

[5] *Life Cycle Assessment for Three Types of Grocery Bags - Recyclable Plastic; Compostable, Biodegradable Plastic; and Recycled, Recyclable Paper. Op cit.*

[6] Ibid and *Évaluation des impacts environnementaux des sacs de caisse Carrefour* (Evaluation of the Environmental Impact of Carrefour Merchandise Bags), prepared by Price- Waterhouse-Coopers/Ecobilan (EcoBalance), February 2004, #300940BE8. (www.ademe.fr/htdocs/actualite/rapport_carrefour_post_revue_critique_v4.pdf).

[7] *Life Cycle Assessment for Three Types of Grocery Bags - Recyclable Plastic; Compostable, Biodegradable Plastic; and Recycled, Recyclable Paper. . Op cit.*

[8] *Évaluation des impacts environnementaux des sacs de caisse Carrefour. Op cit.*

[9] Ibid.

[10] Ibid.

[11] See *Litter Composition Survey of England,* October 2004, produced by ENCAMS for INCPEN (www.incpen.org/pages/userdata/incp/LitterCompSurvey24Jan2005.pdf). Also see *Facts About Litter* from an Australian governmental site (www.environment.nsw.gov.au/litter/factsaboutlitter.htm), and equivalent government and non-profit sites in Canada and the United States, such as Keep America Beautiful.