

**LIFE CYCLE INVENTORY  
OF PACKAGING OPTIONS FOR SHIPMENT  
OF RETAIL MAIL-ORDER SOFT GOODS**

**FINAL PEER-REVIEWED REPORT**

*Prepared For*

**OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY (DEQ)  
And  
U.S. EPA ENVIRONMENTALLY PREFERABLE PURCHASING PROGRAM**

*By*

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## FOREWORD

This document constitutes a life cycle inventory (LCI) of packaging used to ship non-breakable items in e-commerce or catalog sales. As direct marketing and Internet sales have grown, so has the quantity of materials used to package and transport these goods. In Oregon, per-capita generation of all non-hazardous solid wastes has risen more than 20% in the last ten years. Packaging represents a significant portion of waste generation. The Oregon DEQ, Metro, and U.S. EPA have co-sponsored this study in order to evaluate the solid wastes, as well as energy, materials, and atmospheric and waterborne emissions associated with the production, use, and disposal of these packaging materials. This study demonstrates that within the realm of shipping non-breakable items in catalog or e-commerce sales, there are a wide variety of packaging choices that directly impact the quantity of solid waste generated, amounts and types of energy and raw materials used, and amounts and types of atmospheric and waterborne emissions.

Most life cycle inventories (in North America at least) are privately funded and many are never published. It is easy to misinterpret the results of an LCI, and care must be taken when reading and applying results of any LCI report. This report is no exception.

The contents of this report (and its appendices) are highly technical and should be read in that context. The findings and conclusions of this report are strictly those of Franklin Associates, which acted as an independent contractor. Neither the methodology nor the findings of the report represent official policy of the U.S. EPA, State of Oregon, or Metro. Readers should interpret the results of this study with care and with full awareness of the limitations in data, study methodology and the context in which the report was done as described in the report itself.

While life cycle assessment can be a powerful tool for improving knowledge and understanding environmental considerations, there are limits to the applications of any specific LCI. This report is a Life Cycle Inventory only; it *inventories* inputs (energy, materials) and outputs (solid waste, atmospheric and waterborne emissions) but makes no claims regarding the *impacts* of these inputs and outputs. The LCI provides no methodology for comparing the environmental impacts of the different packaging options, such as a comparison of greenhouse gases and ecotoxicity.

There are many popular questions that this report does not attempt to address. This report does not compare recycling vs. disposal. It makes no judgments or conclusions regarding individual products or manufacturers. It does not evaluate the impacts or benefits of manufacturers switching to or away from “green energy” or raw materials derived from “sustainable” or “environmentally protective” agriculture and forestry practices. It does not evaluate the sustainability of renewable versus nonrenewable material use, issues of social equity, the relative benefits of purchasing products made domestically vs. abroad or the fate of improperly discarded plastics in the marine environment.

While the study does compare some all-paper and all-plastic packaging options (and many paper/plastic blends), it does not constitute a comparison of “paper vs. plastic” that can be generalized to other packaging systems. This study does not attempt to evaluate the age-old debate of paper vs. plastic grocery retail bags. Its evaluation of corrugated boxes is limited to the

use of boxes to ship soft (non-breakable) items in e-commerce/catalog sales; the study does not discuss the many other (and larger) uses of corrugated (such as packaging of fragile/breakable items, agricultural packaging, and business-to-business packaging). While the study compares several different types of void fills, it is on a per-pound basis and then, as with boxes, in the context of e-commerce/catalog shipments of non-breakable items. The study does not evaluate these different void fills in the context of the amounts of packaging needed to protect fragile, breakable items. Readers should be aware of the limitations of the scope of this report and avoid generalizing the results to other uses of packaging.

Environmental concerns are just one of several criteria that factor into decisions about what type of packaging to use. Cost, functionality, and availability are other important criteria. The State of Oregon, Metro, and U.S. EPA do not endorse any particular brand or manufacturer of packaging; decisions as to what materials to use, how to use them, and where to buy them are the responsibility of the user.

June 9, 2004

## PREFACE

The report that follows is a Life Cycle Inventory (LCI) of two types of packaging – corrugated boxes with dunnage and shipping bags – for shipping retail mail-order soft goods. Funding for this project was provided by the Oregon Department of Environmental Quality (DEQ) and Metro, the regional government of the Portland metropolitan area. The US EPA contributed additional funding for the critical review and public appendices. The project also included development of a model that can be used to develop environmental profiles for additional packaging configurations composed of the materials analyzed in this report.

At Franklin Associates, the project was managed by Beverly J. Sauer, who served as primary life cycle analyst in developing the interactive user model, analyzing results, and responding to peer review comments. James Littlefield and Melissa Huff assisted with development of report appendices and modeling. Melissa Huff also provided quality assurance review of the report and public appendices under the peer review project. William E. Franklin provided overall project oversight as Principal in Charge.

Franklin Associates gratefully acknowledges significant contributions to this project by David Allaway of Oregon DEQ and Scott Kopacek of Pack Edge Development. Their efforts added significantly to the quality of the report. Together DEQ and Pack Edge developed the data on weights and compositions of the packaging systems. David Allaway also provided detailed writeups on data development for the report appendices, and, with assistance from Abby Boudouris of DEQ and Steve Apotheker of Metro, review of drafts of the appendices and report. Derek Smith of Norm Thompson Outfitters and Nancy Himmilfarb of Williams-Sonoma graciously contributed data to this study, as did many manufacturers of packaging materials. The project was peer reviewed by an expert panel consisting of Mary Ann Curran, U.S. EPA, National Risk Management Research Laboratory (serving as review chair), Dr. Greg Keoleian of the University of Michigan Center for Sustainable Systems, and Dr. Joyce Cooper of the University of Washington Department of Mechanical Engineering. The revisions made in response to the peer review panel's insightful comments added greatly to the quality and credibility of this final report.

This study was conducted for DEQ by Franklin Associates as an independent contractor. The findings and conclusions presented in this report are strictly those of Franklin Associates. Franklin Associates makes no statements nor supports any conclusions other than those presented in this report.

April 26, 2004

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