A New Hierarchy for Packaging: Reuse, Reduce, Recycle

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EPA Waste Reduction Hierarchy

- “Reduce, reuse, recycle”
- Focus on reducing postconsumer solid waste
- Use as little material as possible (source reduction)
- If you use it, try to reuse it
- After you finish using it, recycle it

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Solid Waste Focus

- Most focus is on recycling
- Reuse gets much less attention
- Combination of reuse and recycling can nearly eliminate solid waste

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New Hierarchy?

- Life cycle studies consider not only solid waste, but also resource and energy use, greenhouse gas, other emissions
- Recent LCI studies on reusable packaging products suggest new hierarchy for some packaging applications:

Reuse, reduce, recycle

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Transport Packaging Studies

- Steel drums
- Pallets
- Fresh produce containers
- Break-pack boxes (used for shipping mixed loads from distribution center to retail store)

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Example 1: Steel Drums

- All drums studied:
  - Steel
  - Recycled after removal from service
- Single-use drums
  - Lighter in weight than corresponding reusable drums
  - Less steel required/drum

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Example 1: Steel Drums

- Multi-trip drums
  - Heavier in weight (17-35%) than corresponding single-use
  - Reused multiple times before recycling
  - Require backhauling and reconditioning (via washing or burn out) between uses

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LCI Results for Steel Drums

Reusable steel drums resulted in the following savings compared to single-use steel drums:

- Energy: 64% for tight-head drums, 44% for open-head
- Solid waste: 80% for tight-head drums, 70% for open-head
- GHG: 65% for tight-head drums, 48% for open-head

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Example 2: Fresh Produce Containers

- Corrugated paperboard boxes
  - Lightweight
  - High recycled content
  - Not reused, but uncoated boxes recycled at high rate
  - Box coatings for wet applications can inhibit recyclability
  - Made from renewable resource

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Example 2: Fresh Produce Containers

- Reusable plastic containers (RPCs)
  - Heavier but reusable many times
  - Use energy resources as raw materials
  - Minimal recycled content
  - Fully recyclable at end of life
  - Require backhauling and cleaning for reuse

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LCI Results for Produce Containers

On average, across the 10 produce applications studied, RPCs:

- Require 39% less total energy
- Produce 95% less total solid waste
- Generate 29% less total greenhouse gas emissions

compared to corresponding display-ready corrugated paperboard containers.

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Example 3: Break-pack Boxes

- Corrugated paperboard box
  - Lightweight
  - Made from renewable resource
  - High recycled content
  - Reused a limited number of times
  - Recycled at high rate

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Example 3: Break-pack Boxes

- Corrugated plastic box
  - Heavier
  - Uses energy resources as raw materials
  - Little or no recycled content
  - Reusable many times
  - Requires periodic additions to make up for boxes diverted from reuse
  - Recyclable at end of life

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LCI Results for Break-pack Boxes

Over 5 years operation, including startup supply and makeup boxes, plastic boxes:

- Require 57% less total energy
- Produce 71% less total solid waste
- Generate 67% less total greenhouse gas emissions

compared to reusable corrugated paperboard containers.

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Reuse Not Automatically Best Option

- Must consider packaging application
- Factors that do not favor reuse:
  - High ratio of reusable package weight to packaged product weight
  - High losses from system (lowers reuse rate, requires more make-up packaging)
  - Resource-intensive reconditioning step between uses
- Soft drink container example

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Refillable Soft Drink Bottles

- Refillable container much heavier than single-use container (higher transport burdens)
- Resource-intensive cleaning process after each use
- Small financial incentive to return bottles
- Breakage, non-returns limited reuse rates

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Single-use Soft Drink Containers

- Reduced weight of packaging per product volume delivered – less material use and transport energy
- Further lightweighting via package design improvements reduces material requirements and associated environmental burdens
- Large energy/resource savings for aluminum recycling

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Key Observations on Reuse (1)

- Single-trip packaging: container must be manufactured for each shipment of product
- Even if single-trip container uses recycled material or is recycled at end of life, one trip = one fabrication step (can be energy-intensive: remelting metal, repulping paperboard)
- Reusable packaging: package production burdens incurred once for all lifetime uses of that container

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Key Observations on Reuse (2)

- Less energy and GHG to backhaul (and clean) reusable packaging than to manufacture the equivalent number of single-trip containers
- Increased transportation burdens (and cleaning burdens, where applicable) more than offset by benefits of multiple uses before end-of-life recycling (more uses per package fabrication step)

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Key Observations on Reuse (3)

- Reusable packaging system must operate as a closed-loop system with minimal losses. High replacement rates offset environmental benefits associated with container reuse.
- Benefits maximized if backhaul incorporated on return trip from delivering product

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Importance of Closed-loop System

- Losses minimized – low replacement rates
- Regular inspection/repair keeps packaging in circulation longer, maximizing reuse
- Packaging removed from service can be managed efficiently (e.g., recycled)
- Economic benefits – after initial establishment of system, reduced annual packaging purchases

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Reuse: The Ultimate Source Reduction

- Package redesign for source reduction may reduce material use by **10 percent**
- A package that is used 10 times requires 1/10 the production burdens per trip, or **90 percent** source reduction for each use!

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Conclusion - Reuse

- Case studies show that reuse can result in greater environmental benefits than container lightweighting or recycling if the reusable system operates as a closed-loop system
  - Losses minimized, reuse maximized
  - Minimize “make-up” additions to system

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Reduce versus Recycle

- Current hierarchy shows “reduce” before “recycle” i.e., it is preferable to avoid material use in the first place.
- Soft goods packaging study

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Soft Goods Packaging

- Corrugated boxes with dunnage (up to 100% postconsumer content of box and various dunnage options including shredded paper, crumpled paper, inflated plastic bags, foam “peanuts” etc.)
- Shipping bags (various combinations of paper and plastic, padded and unpadded)

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Soft Goods LCI Results

- All shipping bag options (regardless of material or recycled content) showed much lower environmental burdens than all box + dunnage options (regardless of type of dunnage or recycled content of box and dunnage)

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Conclusions – Reduce vs. Recycle

- Bags use much less material than box + dunnage (material benefit of source reduction)
- Soft goods shipment loads are volume-limited rather than weight limited, and bags take up much less space in a volume-limited load (transportation benefit of source reduction)
- Soft goods study results support preference for “reduce” over “recycle”

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