Unraveling the Mystery of Sustainability in Packaging

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Agenda

- Definitions
- Questions to Ask
- Attributes to Consider
- Lifecycle Thinking
- Examples
- Summary

Book Definitions

- Sustain:
  - to keep in existence (dictionary.com)
  - to cause or allow something to continue for a period of time (Cambridge International)
- Sustainable:
  - of, relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged (Merriam-Webster)

Book Definitions

- Sustainability:
  - A concept relating to the *continuity* of various aspects of human society (Wikipedia)
  - Meeting the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland Commission, 1987)
  - For some, the equivalent of Sustainable Development

institutional & organizational:

- economical / financial - profit
- ecological / environmental - planet
- societal - people

SPC's Definition of Sustainable Packaging

- Is beneficial, safe & healthy for individuals and communities throughout its life cycle;
- Meets market criteria for performance and cost;
- Is sourced, manufactured, transported, and recycled using renewable energy;
- Maximizes the use of renewable or recycled source materials;
- Is manufactured using clean production technologies and best practices;
- Is made from materials healthy in all probable end of life scenarios;
- Is physically designed to optimize materials and energy;
- Is effectively recovered and utilized in biological and/or industrial cradle to cradle cycles.

Source: The Sustainable Packaging Coalition, www.sustainablepackaging.org

Performance

or Value

Resource Use

or Footprint

….utilizing life cycle thinking

Choosing solutions with multiple environmental, social & economic attributes

An Important Question to Ask:

What Problem Are You Wanting to Solve?

- Global Warming
- Air, Land, or Water Pollution
- Litter
- Landfill Exhaustion
- Fossil Fuel Depletion
- Energy Dependence

Attributes Creating Possible Definitions

Sustainable = Something That . . . . .

Protects human health

Is made from a material that is grown

Is recyclable

Creates no greenhouse gases

Is degradable

Has the potential to be reused

Has been recycled

Is made using renewable energy

Generates zero landfill waste

Minimizes water usage

Lasts a long, long time

Results in no air pollution

Attributes Creating Possible Definitions

Sustainable = Something That

No solution meets every single possible criteria for sustainability

Sustainability is a journey, not a destination

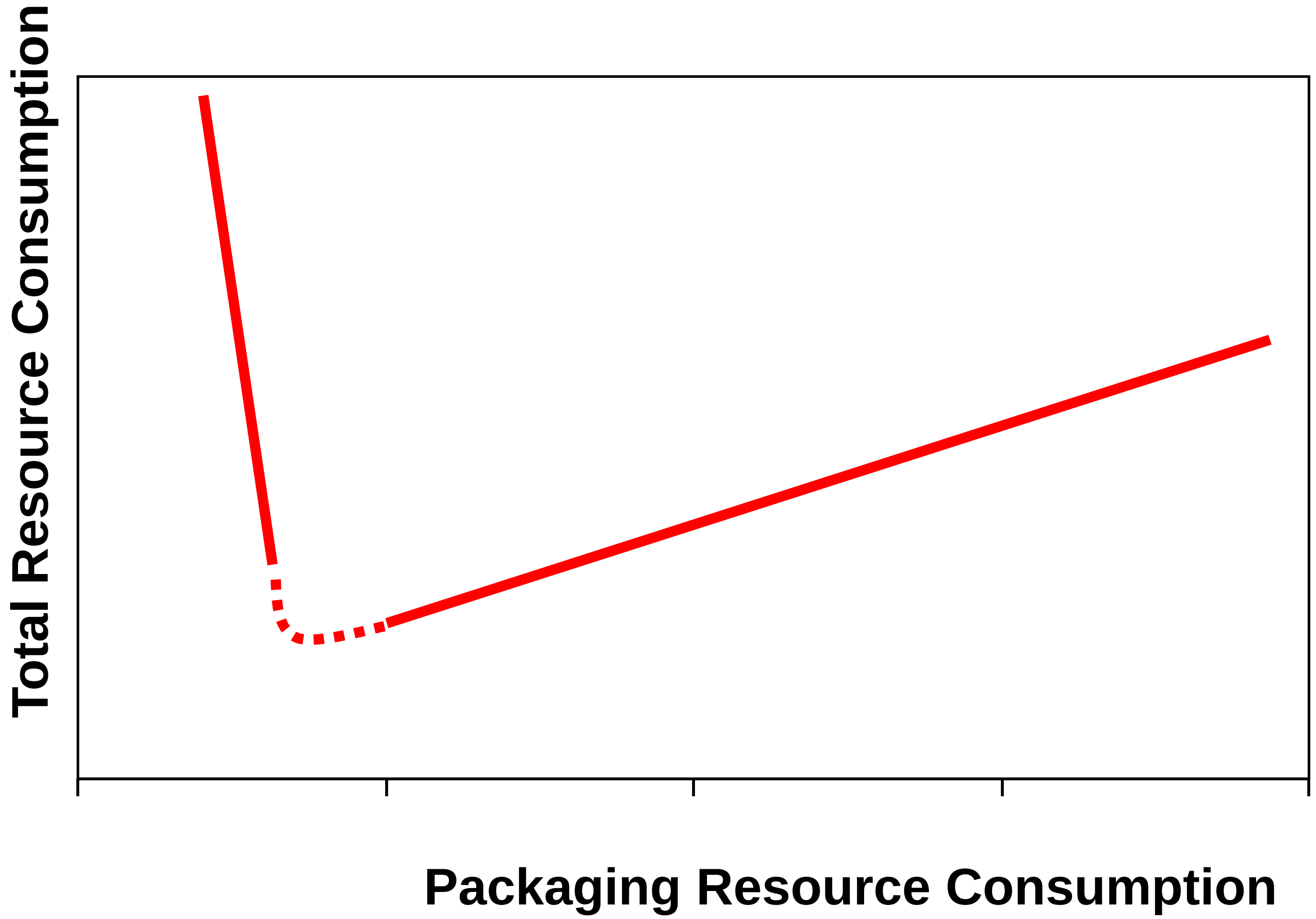
Lasts a long, long time

Results in no air pollution

Some Additional Factors to Consider

- Scarce Resources
    - Water
    - Energy
    - Labor
    - Raw materials
    - Land
- Origin of Raw Materials
- Health & Safety Profiles
- Consumer Behavior
- Secondary Effects (e.g. the effect of package weight on transportation costs)

Optimizing Packaging Sustainability



Watch Out for Narrow Definitions

- Some define sustainable packaging narrowly:
  - The use of bio-based or renewable raw materials
  - Packaging that is compostable/biodegradable
  - Products that contain a high level of recycled content or are recycled at high levels
- The problem with these definitions:
  - While such materials may have some sustainable attributes, this does not make them sustainable per se.
  - Traditional packaging solutions offer different sustainable attributes.
  - Full life cycle thinking is a vital tool in understanding what solutions are more sustainable.

Bio-Based vs. Bio-Degradable

- Bio-Based means that the product has been made from a biological (living) source, such as soybeans.
- Bio-Degradable means that the product can be broken down by other living organisms, such as bacteria, that exist in nature. If a material will not break down in a reasonable period of time, it is described as non-biodegradable. (The rate of degradation is dependent upon the conditions in which it exists as well as its actual composition.)
- Some products are both bio-based and bio-degradable, some products are one but not the other, and some products are neither biodegradable or bio-based.

Zero Waste: Just One Attribute

- Creating "zero waste" is a common sustainability goal
- Some define "zero waste" as sending nothing to the landfill
- While minimizing waste is desirable, landfill waste is only one kind of waste and requiring zero landfill waste does not allow a complete lifecycle view to be taken. As a stand-alone constraint, eliminating all landfill waste could result in:
  - Increased water pollution
  - Increased rate of depletion of fossil fuels
  - Increased green house gas emissions
  - Overall system inefficiency

Life Cycle Thinking

- Life cycle thinking is an objective, scientific approach and provides a comprehensive view of a product from cradle to grave.
- It is critical to look at a packaging application and its function.
  - Not appropriate to compare a pound of one material vs. a pound of another
  - It is important to look at how much of a given material is needed to provide the functionality required in that packaging application.
- A balanced look at end-of-life options is also necessary.
  - For example, recycling is great to a certain extent; however, studies have shown that trying to capture to very high a percentage of any material leads to wasted resources… mostly in the form of energy.
  - Composting is desirable if composting facilities are readily available to the consuming public. If compostable materials end up in landfills, they are actually worse for the environment, since they may evolve into green house gases

Sources: Athena Institute; American Center for Lifecycle Analysis

Thoughts on Life Cycle Thinking

- Recent Athena/Franklin life cycle study of PLA vs. traditional polymers revealed the following for 16 oz drink cups (basis – 10,000 cups):

	Total Energy (GJ)	Post consumer Solid Waste (kg)	Greenhouse Gases (kg of CO_2 eq)
PLA	14.5	118	510
HIPS	13.3	98.4	576
PP	9.82	84.0	345
PET	16.1	126	719

- The PP cup uses 32% less total energy, creates 29% less waste, and creates 32% less greenhouse gas emissions.

What solution would you consider to be the sustainable choice?

Life Cycle Thinking

Helps avoid mistakes due to “counter-intuitive” outcomes

- Q: When does adding more packaging improve sustainability?
- A: When it protects more resources than it consumes

- Q: When does getting more exercise not improve health?
- A: When you’re injured due to over-training

- Q: What uses more resources than throwing away a package?
- A: Throwing away all the food that was protected by that package

Paper or Plastic

- According to a recent report by Robert Lilienfeld of ULS:
  - Paper's biodegradability advantage is rarely realized
  - Plastic bags produce 60% less green house gas emissions
  - Plastic bags use less than 4% as much water to produce
  - Plastic bags consume 40% less energy during production
  - Plastic bags generate 80% less solid waste

- Many consumers don't know the facts, but they assume that paper is a "natural" choice for improved sustainability

Source: Robert Lilienfeld, The ULS Report, June 2007

www.use-less-stuff.com

Examples of
More Sustainable Packaging Solutions



Industrial Stretch Film

- Made predominantly from LLDPE
- Improvements in resin design and polymer processing have allowed downgauging of industrial stretch film
  - Critical property requirements
    - Extensibility
    - Puncture resistance

Year	Standard Stretch Film*	High Performance Stretch Film*
1998	80	60
2001	70	51
2004	65	51
2007	57	45
Reduction	29%	25%

* Units are gauge. 80 gauge = 20 micron

Industrial Stretch Film

- With global stretch film usage of nearly 3 billion pounds, this downgauging saves over 1 billion pounds per year of PE from being used to make stretch film.
- 1 billion pounds = 36.6 trillion BTUs
- Equivalent to 293 million gallons of gasoline
- Enough to heat and cool 643,000 homes for a year

While this reduction and savings have taken place, recycling has grown

* US EPA publication: Waste Management & Energy Savings: Benefits by the Numbers; 9/05

Heavy-Duty Shipping Sacks

- By using higher-performance resins, Dow has been able downgauge heavy-duty shipping sacks used to package and transport our own resins by 40 percent.
- As a result, approximately 5 MM pounds LESS polymer is used for packing Dow plastic resins each year.

Year	Thickness
1993	7.8 mil
1994	7.0 mil
1995	6.3 mil
1998	5.5 mil
2001	4.7 mil

* Units are gauge. 80 gauge = 20 micron

Aluminum Can 6 Packs: Paperboard vs Loop Carrier

Package Type	Contents	Impact per 100 oz Beverage		
		Landfill Discards* (g)	Process GHG** (kg CO^2 Eq)	Total Energy** (MJ)
Paperboard	6x 12oz	43.3	0.088	0.839
Loop Carrier	6x 15oz	4.30	0.009	0.338

Reduction vs Paperboard	
Landfill Discards	90%
GHG	89%
Energy	60%

Dow internal calculations based on:

- System boundary: Raw Material Cradle-to-Gate, plus recycle
- *Discards = package mass – recycle stream
- Paperboard assumptions
  - No recycled content
  - 30% recovered to recycle stream †
- **Lifecycle inventory data sources:
  - Paper: Environmental Defense- www.papercalculator.org
  - Plastics: Boustead Model V5
- †From The ULS Report, February 2007

Granola: Cereal Box vs Stand-Up Pouch

Package Type	Contents	Impact per 100 oz Cereal		
		Landfill Discards* (g)	Process GHG** (kg CO^2 Eq)	Total Energy** (MJ)
Paperboard and HDPE Liner	11 oz	380.0	.861	12.1
Stand-Up Pouch	12 oz	117.5	.265	9.25

Reduction vs Box	
Landfill Discards	68%
GHG	69%
Energy	23%

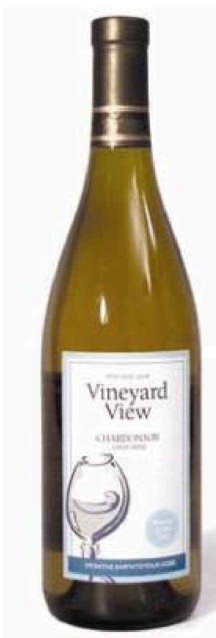
Dow internal calculations based on:

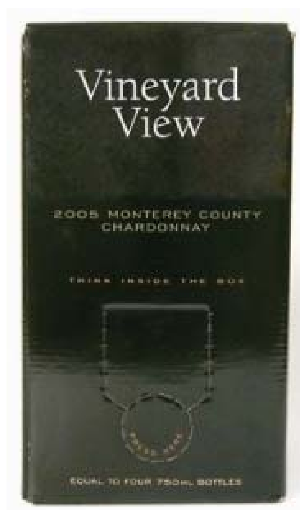
- System boundary: Raw Material Cradle-to-Gate, plus recycle
- *Discards = package mass – recycle stream
- Cereal box assumptions
  - 100% recycled content
  - 30% recovered to recycle stream †
- **Lifecycle inventory data sources:
  - Paper: Environmental Defense- www.papercalculator.org
  - EVA: The Dow Chemical Company
  - Other Plastics: Boustead Model V5
- †From The ULS Report, February 2007

Wine: Traditional Bottle vs Bag-in-Box

Package Type	Contents	Impact per 100 oz Wine		
		Landfill Discards* (g)	Process GHG** (kg CO^2 Eq)	Total Energy** (MJ)
Glass Bottle	.75 L	607.9	0.586	8.82
Bag-in-Box	3.0 L	52.5	0.118	2.08

Reduction vs Glass	
Landfill Discards	91%
GHG	80%
Energy	76%





Dow internal calculations based on:

- System boundary: Raw Material Cradle-to-Gate, plus recycle
- *Discards = package mass – recycle stream
- Glass assumptions
  - No recycled content
  - 20% recovered to recycle stream
- Paper assumptions
  - No recycled content
  - 30% recovered to recycle stream †
- **Lifecycle inventory data sources:
  - Paper: Environmental Defense- www.papercalculator.org
  - Glass and Plastics: Boustead Model V5
- †From The ULS Report, February 2007

Salsa: Glass Bottle vs Squeeze Bottle vs Pouch

Package Type	Contents	Impact per 100 oz Salsa		
		Landfill Discards* (g)	Process GHG** (kg CO^2 Eq)	Total Energy** (MJ)
Glass Bottle	16 oz	1489.5	1.95	30.9
Squeeze Bottle	20 oz	248.0	0.521	18.5
Pouch	16 oz	62.5	0.257	6.02

Reduction vs Glass		
	Squeeze Bottle	Pouch
Landfill Discards	83%	96%
GHG	73%	87%
Energy	40%	81%

Dow internal calculations based on:

- System boundary: Raw Material Cradle-to-Gate, plus recycle
- *Discards = package mass – recycle stream
- Glass assumption
  - 20% recovered to recycle stream †
- Metal assumptions
  - 50% recycled content
  - 50% recovered to recycle stream †
- **Lifecycle inventory sources
  - Plastics and Glass: Boustead Model V5
  - Metal: BUWAL 1998, Life Cycle Inventories of Packaging, Volume 1
- †From The ULS Report, February 2007

Key Concepts

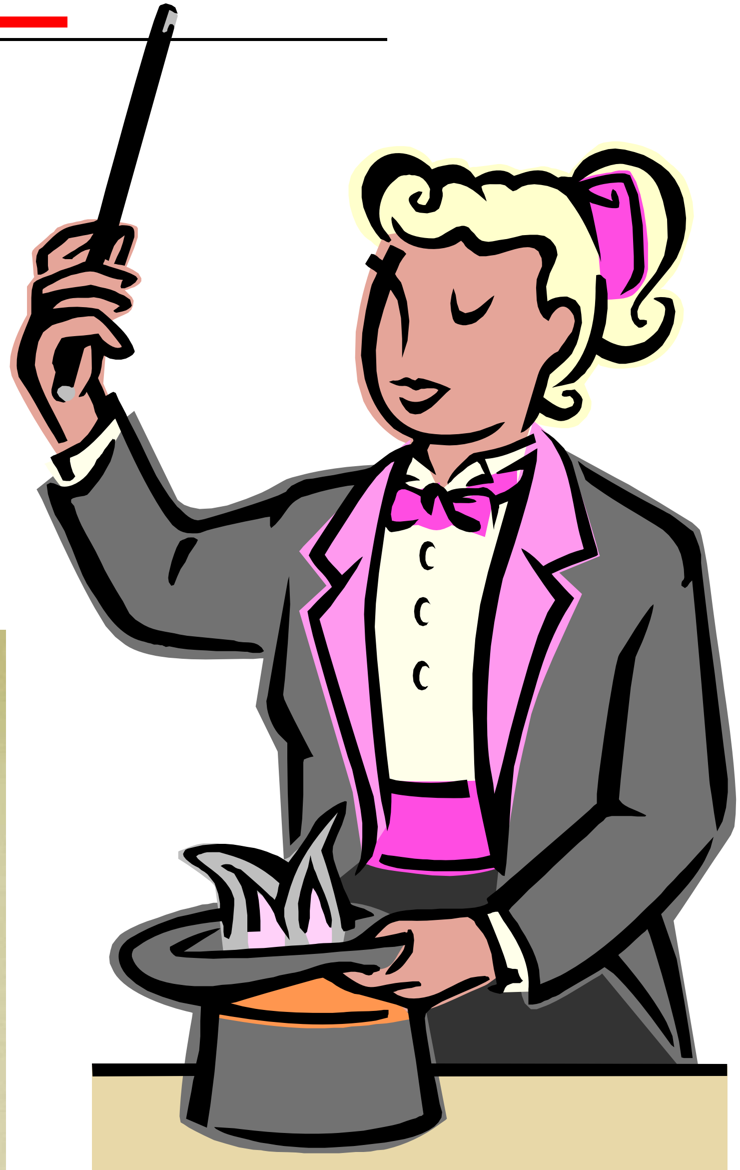
- Sustainability includes multiple aspects of performance, and must include the entire life of a product, not just a single element
- Different packaging materials can provide different sustainable attributes under different conditions

  (assuming everything else stays the same)
- Life cycle analysis can be used to quantify the effects of various choices, including the selection of packaging
- Initial material selection is an important consideration when designing for sustainability
- Downgauging, package redesign, and material substitution all offer alternatives for improving sustainability performance

Sustainable Solutions

- Meet all performance criteria
- Consider all life cycle impacts (to avoid sub-optimization)
- Consume the minimum possible amount of raw materials
- Are efficient in their use of fossil fuels
- Offer safety and ease of use
- Result in a minimum total amount of waste
- And exhibit other positive attributes

Magic Bullet ?



Sustainability = Long Term Viability

Profitability
Environmental Responsibility
Social Accountability

Sustainability is Here to Stay