CROPAK
2008

Barrier & Sealant Solutions with Metallyte™ OPP Films

Market Opportunities for Aluminum Foil Replacement in Flexible Packaging Barrier Markets

ExxonMobil Chemical

Barrier & Sealant Solutions: High Barrier Metallyte™ Films

Agenda

- A Case for Action
  - Economic
  - Performance
  - Environment
- ExxonMobil's Approach
  - Substrate Replacement
  - Structure Simplification
- Summary

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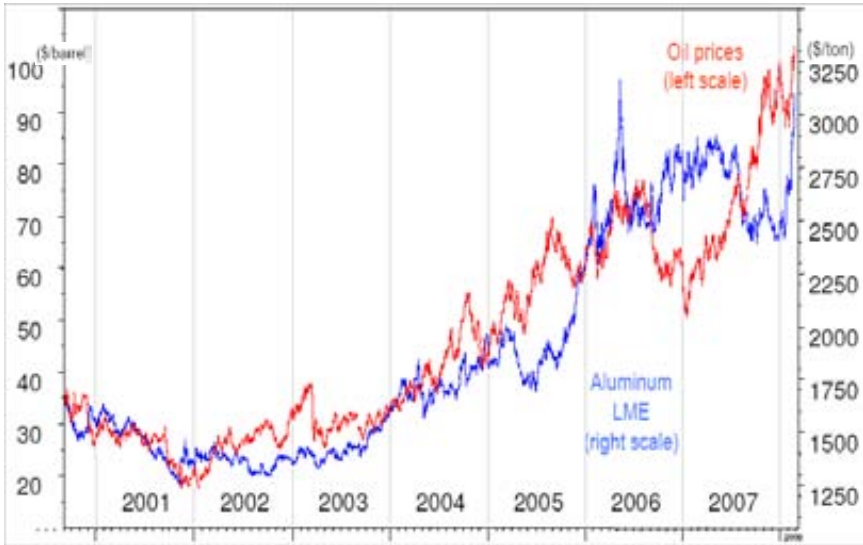
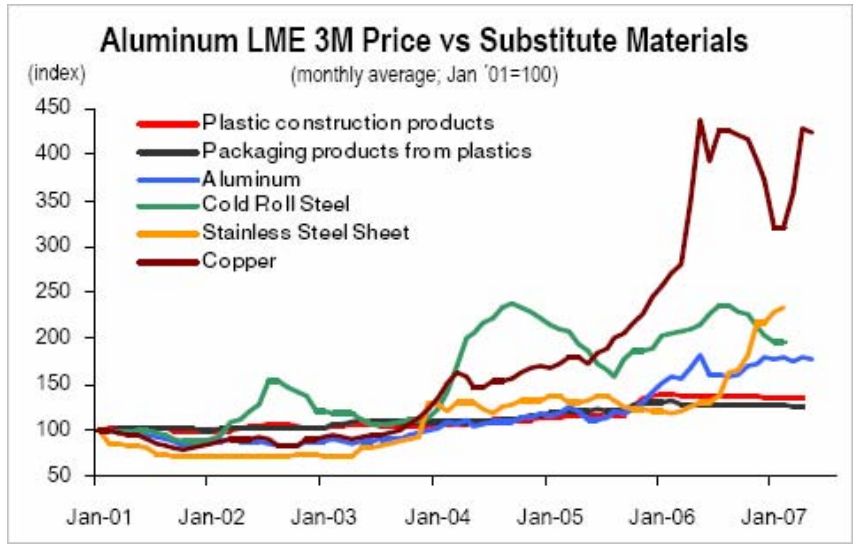
Upward Trend in Aluminum Pricing





Contributing factors

- Strong global demand: CAGR ~ 4.5% over next 10years
- High energy prices
- Record low inventory levels over last several years
- Escalating cost of raw materials
- Undervalued Aluminum versus other base metals (Zinc, Nickel, …) & Speculation
- China impact

Note: LME = London Metal Exchange
Source: Harbor Intelligence

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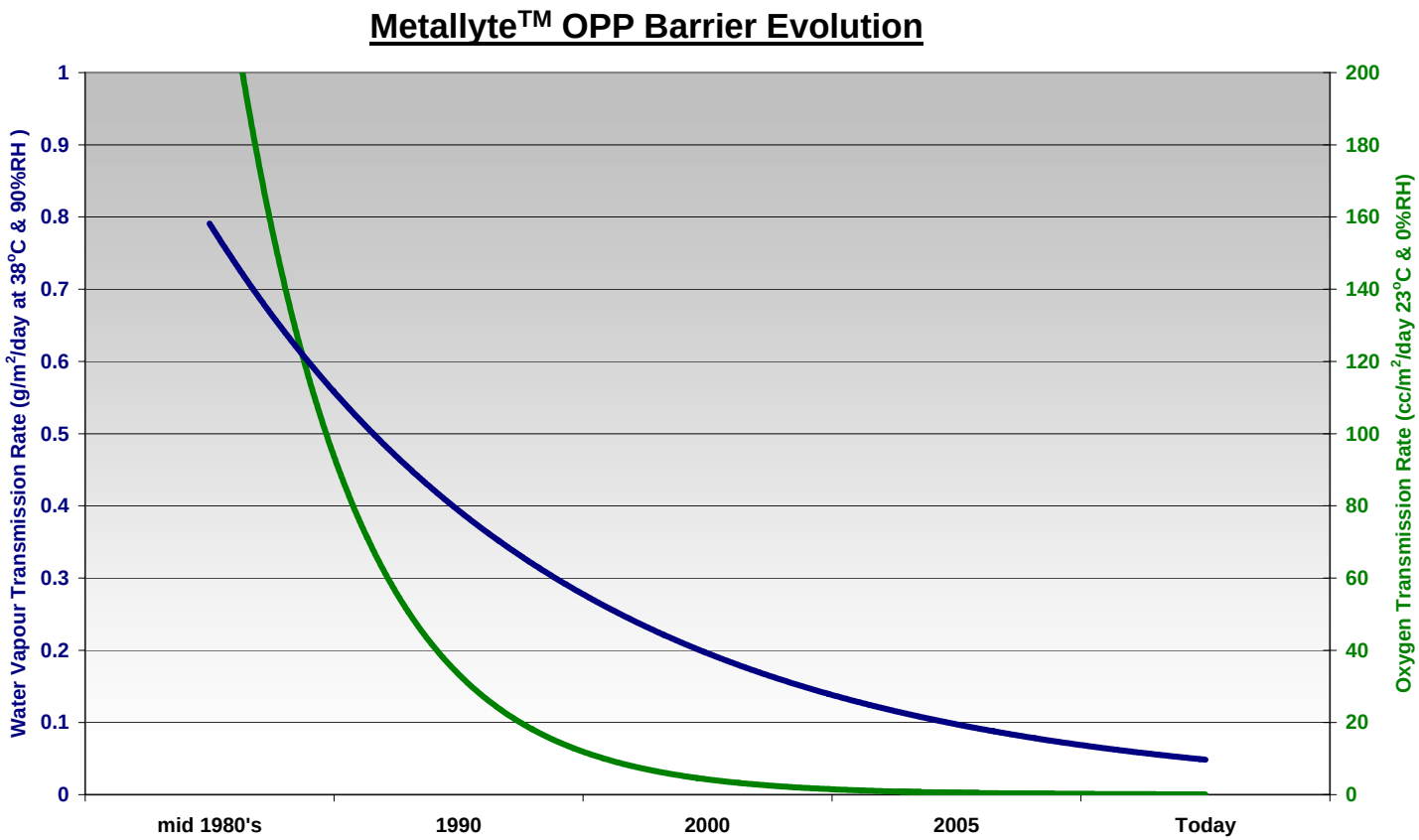
Key Enabler for Foil Replacement with Metallyte™ OPP

Continuous Barrier Improvements



Source: ExxonMobil test data

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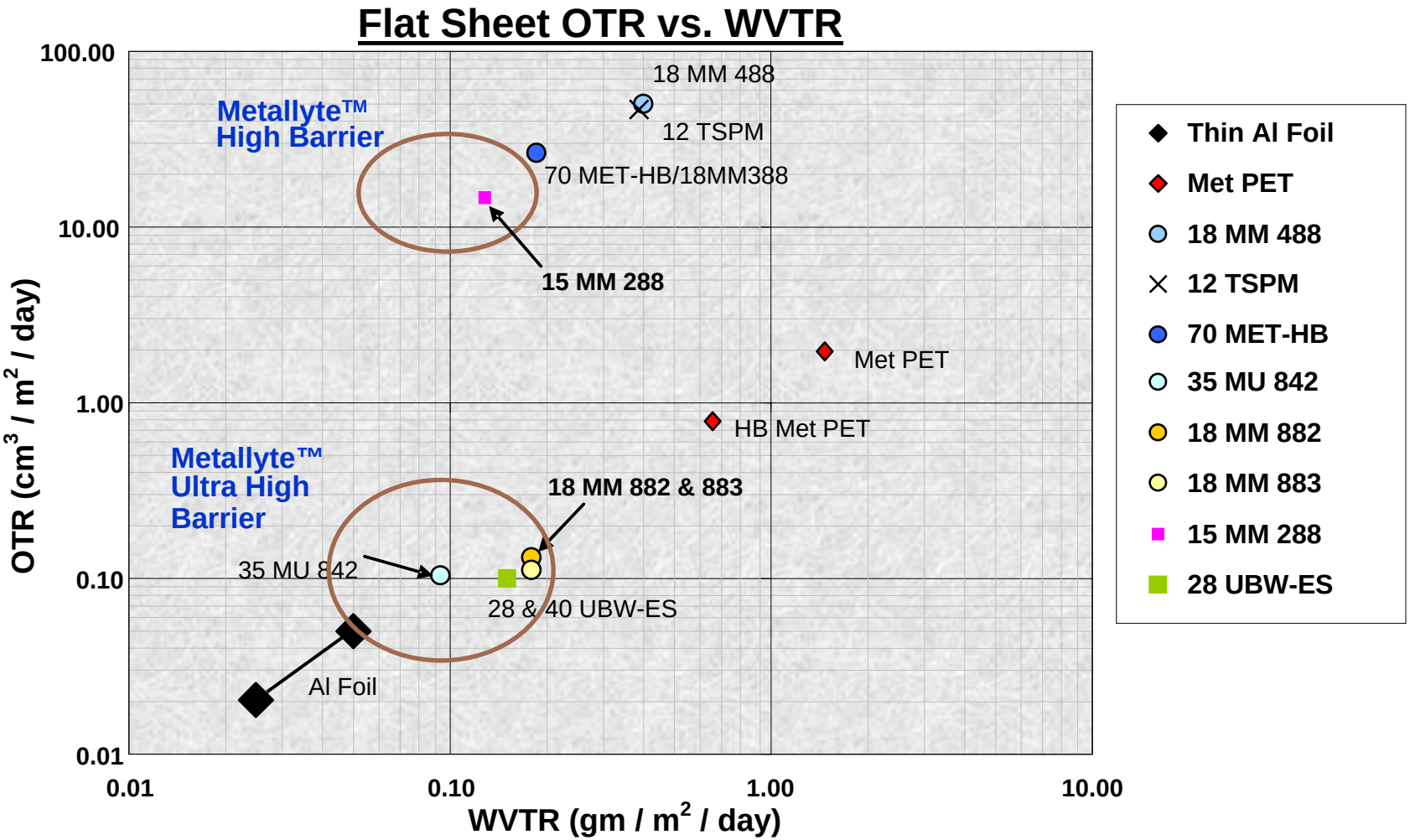
Key Enabler Barrier Metallyte™ Solutions for Foil Replacement



Note: Typical measured values indicated
Source: EMCC

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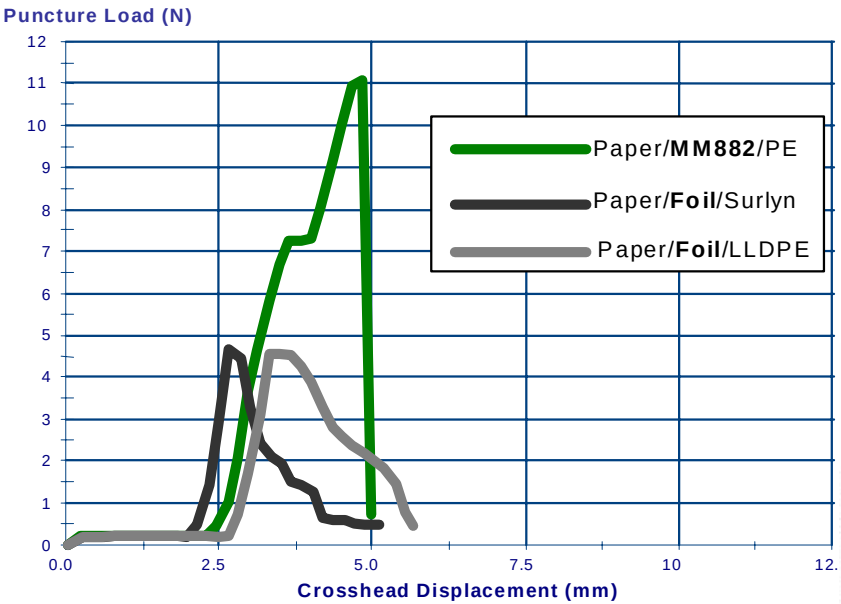
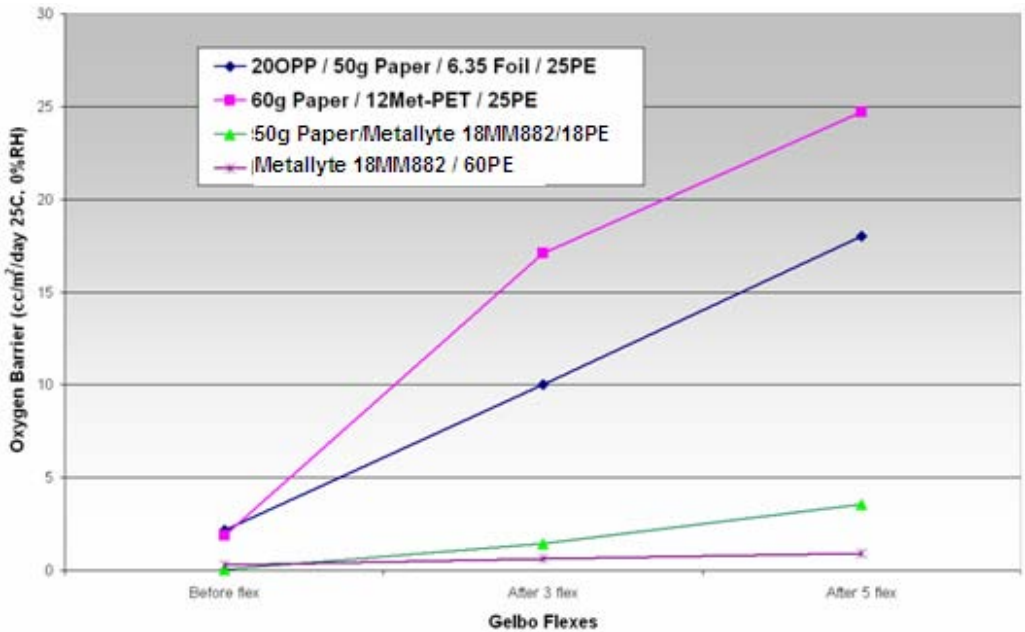
Key Enabler for Foil Replacement with Metallyte™ OPP

Improved Puncture & Flexcrack Resistance



Enhanced puncture resistance with Oriented PP Films



Source: ExxonMobil test data

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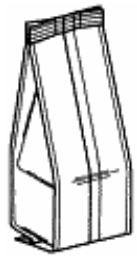
Source Reduction – Material Unit Weight Comparison

Barrier Substrate	Unit weight index
12Met-OPP	47%
15Met-OPP	56%
18Met-OPP	67%
6.35 Foil	70%
20Met-OPP	75%
7 Foil	78%
8 Foil	89%
25Met-OPP	94%
9 Foil	100%

(%) 50 60 70 80 90 100

Substrate Replacement

Replace to enhance



12PET / 9µm Foil / 80PE

Replace Foil with 18MM883

- **33% weight reduction**
- **7% overall weight reduction**

Barrier Substrate	Unit Weight
9µm Foil	24.4 g/m^2
18MM883	16.4 g/m^2

Structure Simplification

Reduce to improve

57g Paper// 7µm Foil / 23g PE

Replace Foil & sealant with 28UBW-ES

- **50% weight reduction**
- **17% overall weight reduction**

Barrier & Sealant	Unit Weight
7µm Foil/ 23g/m^2 PE	41.9 g/m^2
28 UBW-ES	20.7 g/m^2

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Sustainability: Life Cycle Inventory – "Cradle to Substrate"

- Scope & boundaries:
  - Raw materials extraction
  - Substrate processing & fabrication steps
- Life cycle inventories of <u>resources</u> (raw materials & energy) and environmental <u>emissions</u> (gas, liquid, solid)

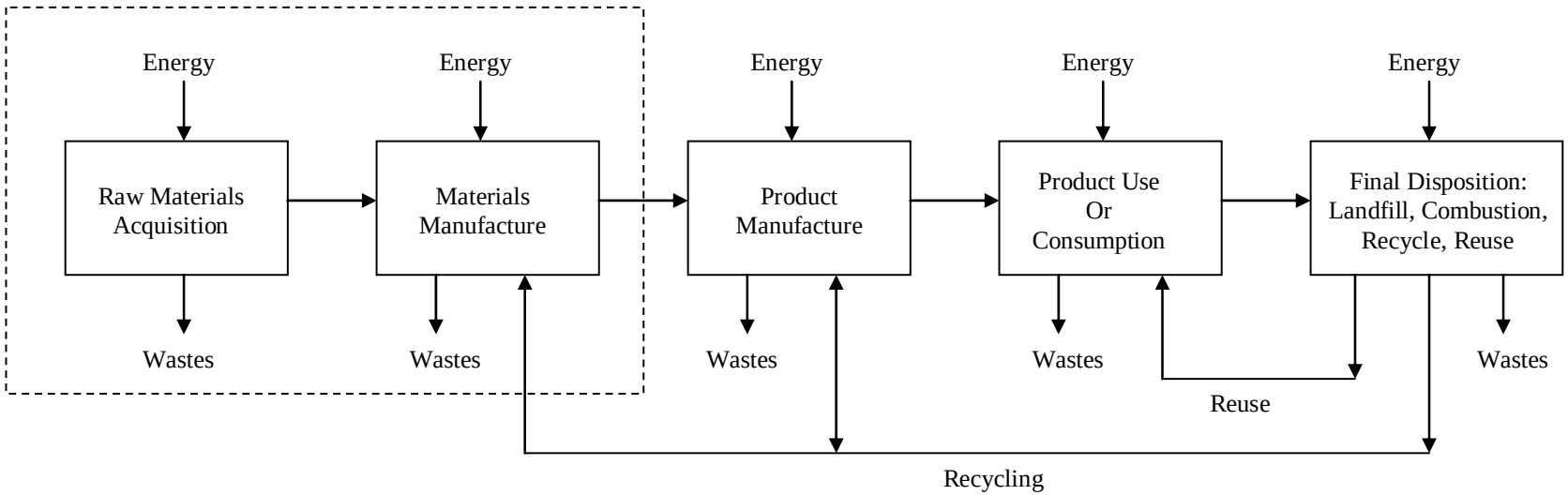

Figure 1-1. General material flow diagram for complete "cradle-to-grave" life cycle inventory. Dashed lines indicate the boundaries of this LCI analysis.

Note: Franklin Associates' LCI methodology is consistent with ISO 14040 & 14044

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Sustainability: Life Cycle Inventory – “Cradle to Substrate”

- **Energy Requirements:**
  - Pre-combustion energy
    - Extraction, transportation & processing of fuels up to point of use
  - Process energy
    - Combustion of process fuels
    - Electricity use
  - Energy of material resource (Inherent energy)
    - Fossil based materials (petroleum-derived)
  - Transportation energy
    - Process-to-process raw material transits
    - Truck, rail, boat, …

- **Environmental Emissions:**
  - Atmospheric Emissions (GHG)
    - Process-related
    - Fuel-related
  - Waterborne Emissions (effluents)
    - Process-related
    - Fuel-related
  - Solid Wastes (landfill or incineration)
    - Process-related
    - Fuel-related

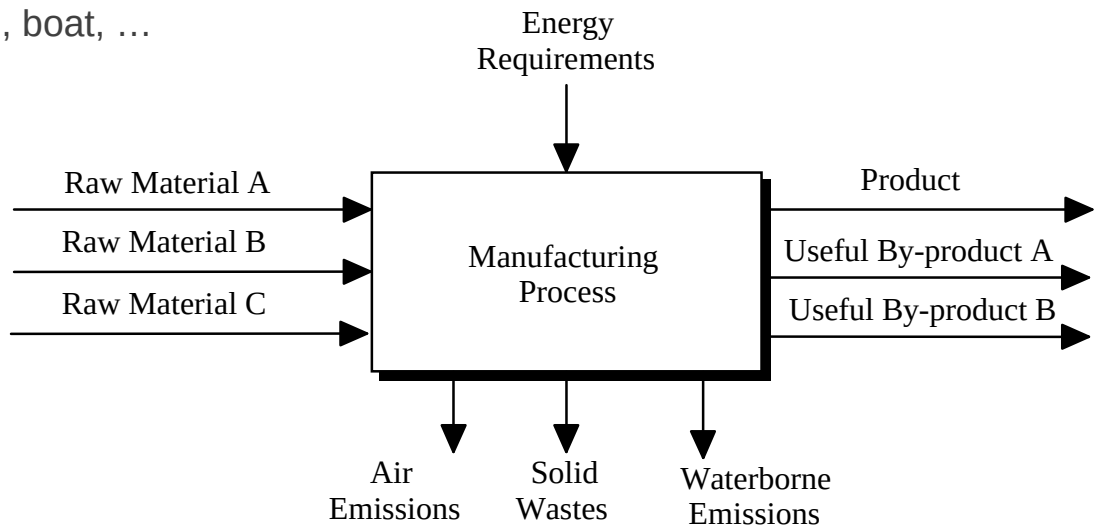

Figure 1-2. "Black box" concept for developing LCI data.

Data Sources: US LCI Database, Franklin Database, Plastics Europe Eco-Profiles plastic film conversion

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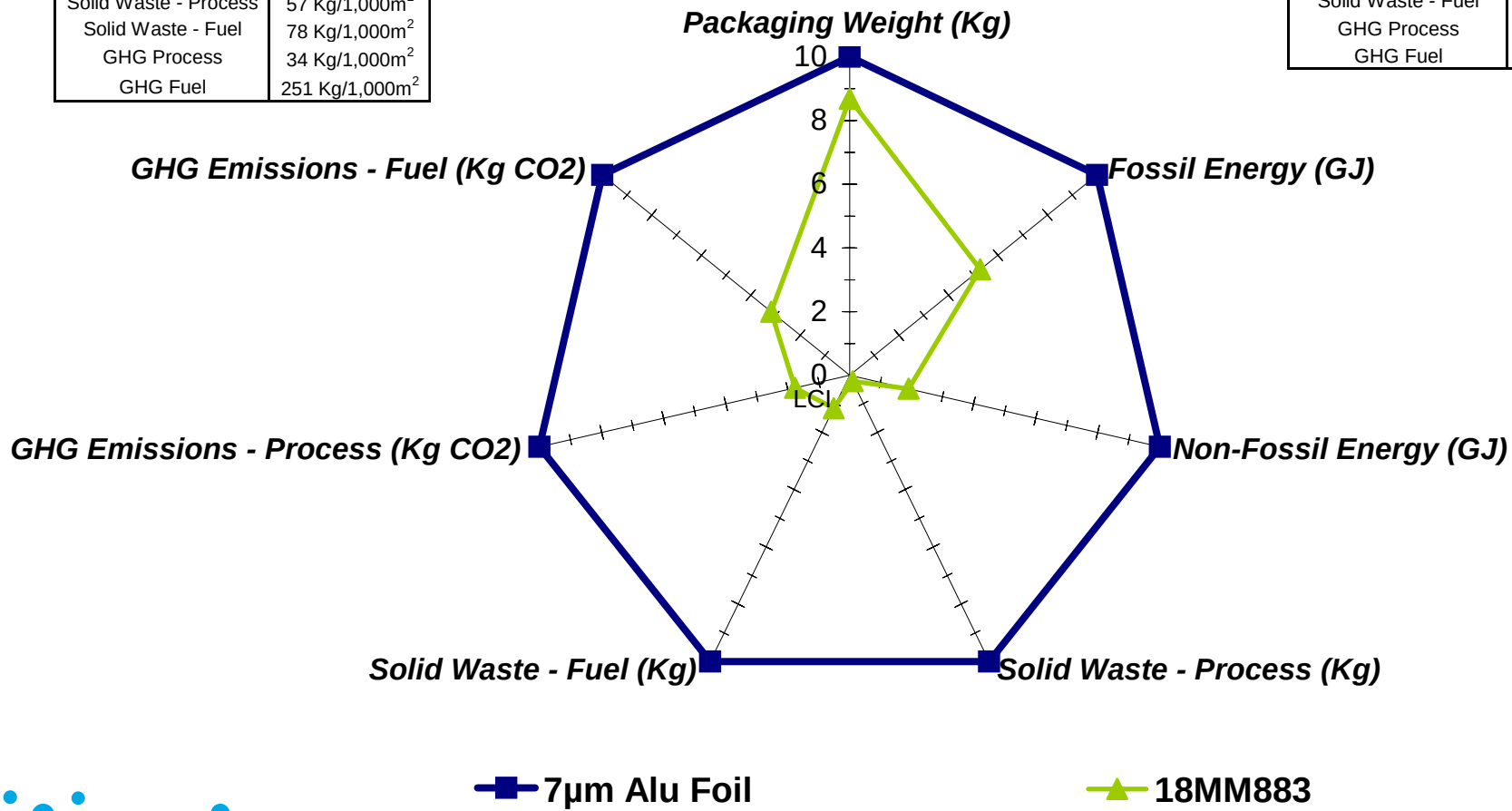
Barrier Substrate LCI Data: Weight, Emissions & Energy

Scale 10 = Values for 7µm Alu Foil	
LCI Component	**7µm Alu Foil**
Unit Weight	18.9 Kg/1,000m^2
Fossil Energy	3.6 GJ/1,000m^2
Non-Fossil Energy	1 GJ/1,000m^2
Solid Waste - Process	57 Kg/1,000m^2
Solid Waste - Fuel	78 Kg/1,000m^2
GHG Process	34 Kg/1,000m^2
GHG Fuel	251 Kg/1,000m^2

Life Cycle Inventory Data*

(Weight, Energy or Emission units per 1,000m^2 area)

LCI Component	18 Met-OPP
Unit Weight	16.4 Kg/1,000m^2
Fossil Energy	1.9 GJ/1,000m^2
Non-Fossil Energy	0.2 GJ/1,000m^2
Solid Waste - Process	1.2 Kg/1,000m^2
Solid Waste - Fuel	9 Kg/1,000m^2
GHG Process	6 Kg/1,000m^2
GHG Fuel	80 Kg/1,000m^2



*Source: Franklin Associates Ltd. "LCI of Film Packaging structures" April 2008

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Barrier Metallyte™ Films Solutions for Foil Replacement

- Replaced 7µm aluminum foil
- Excellent oxygen and moisture protection
- Benefits to brand:
  - Improved puncture resistance
  - Cost-effective
  - Improved packaging quality
  - Easier converting process

Film Type: METALLYTE 18MM883
Key Attribute: Barrier & Puncture Resistance
*Structure: 50g/m^2 Paper / **18MM883** / 30 PE*
Format: Four side sealed flat pouches

Market Segment: Dehydrated Foods

Sensitive Dehydrated Soup

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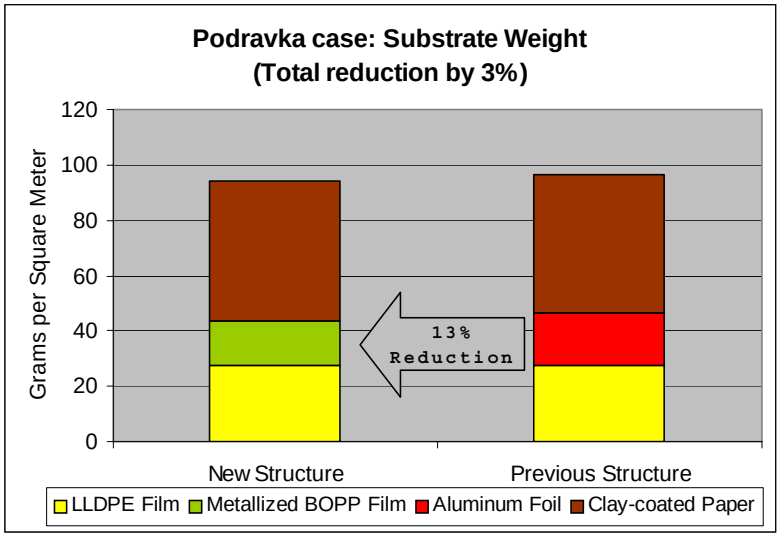
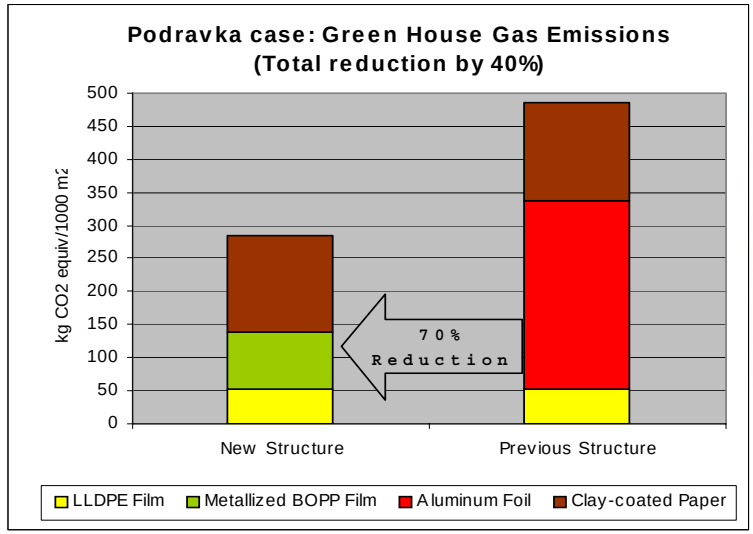
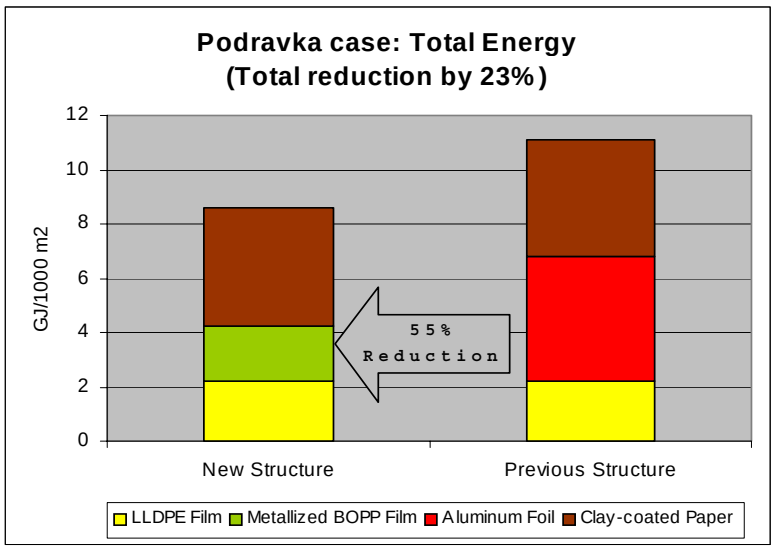
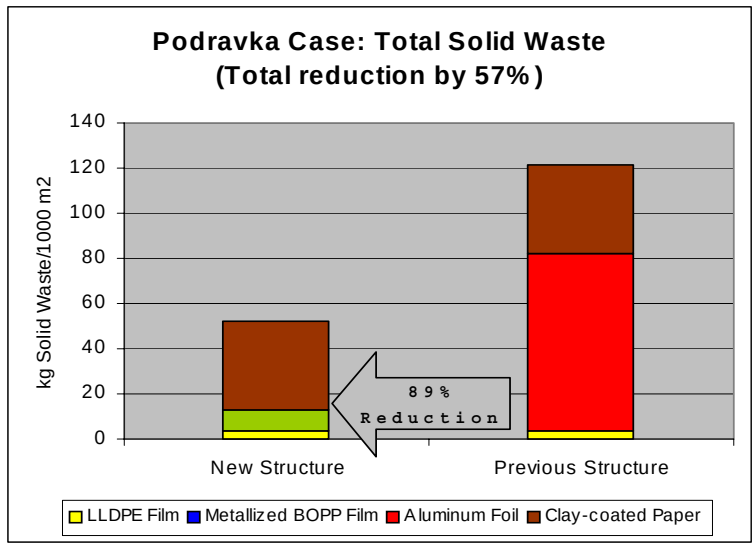
LCI Comparison: Structure Replacement (Dry Soup Pouch)









Previous

50g C1S Paper

7µm Foil

30PE

New

50g C1S Paper

18MM883

30PE

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Barrier Metallyte™ Films Solutions for Foil Replacement

- Replaced 7µm aluminum foil
- Excellent moisture, oxygen & aroma protection:
  - Instant dry food with 1 year shelf life
  - Contains Hazelnuts, Chocolate, Antioxidants and Multi-Vitamins
- Benefits to brand:
  - Improved packaging quality with SUP format using zipper
  - Cost-effective solution
  - Efficient converting process
  - Barrier/Puncture in bottom gusset

Market Segment: Dehydrated Foods

Film Type: METALLYTE 18MM883

Key Attribute: Barrier

*Structure: 12PET // **18MM883** // 60PE*

Format: Stand-up Pouch (SUP) with zipper

Instant Flavored Infant Cereal Food with Multi-Vitamins

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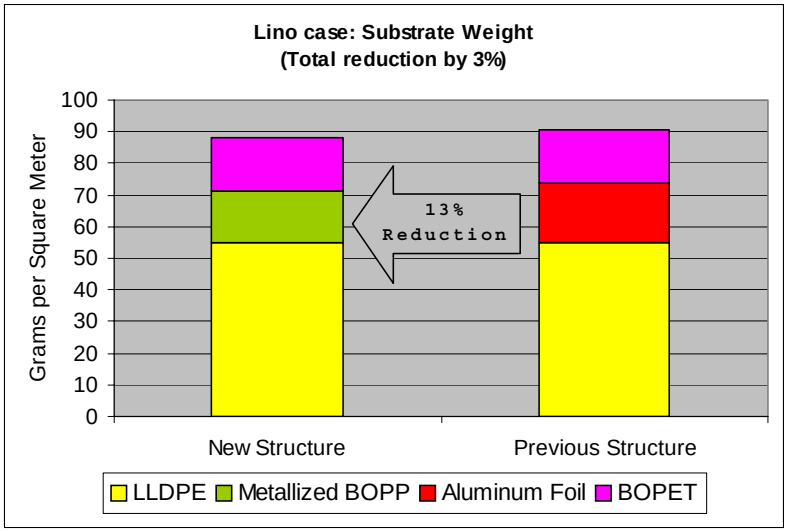
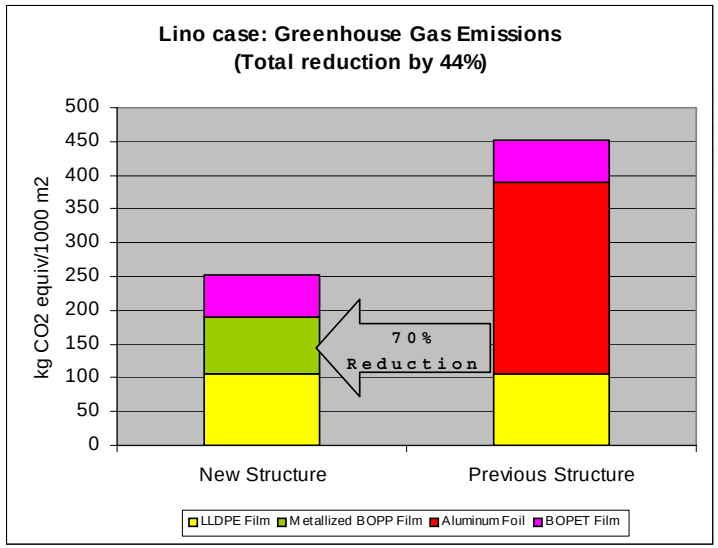
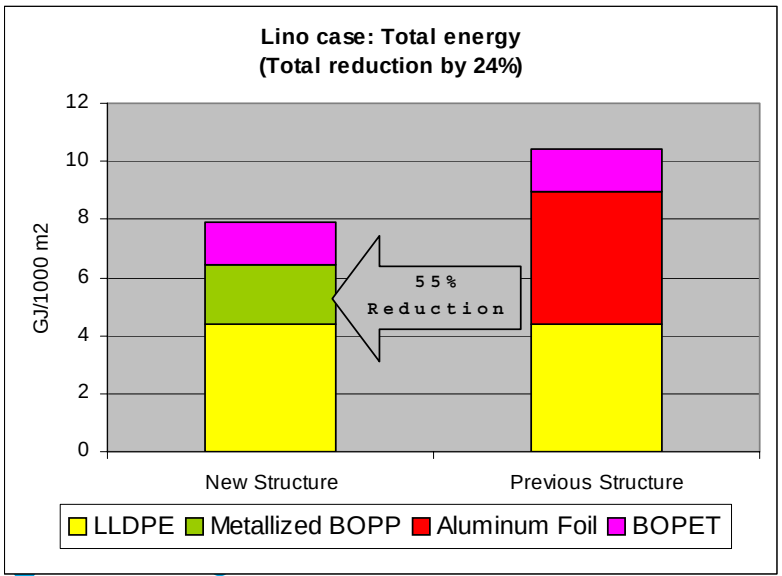
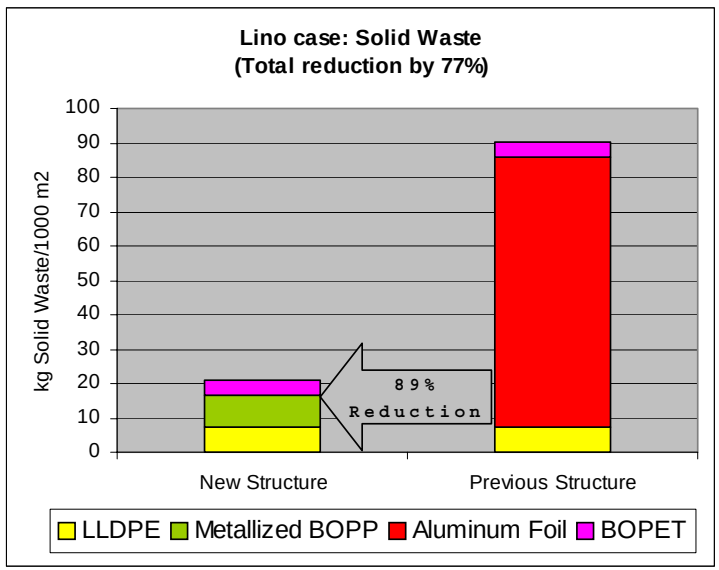
LCI comparison: Substrate Replacement (Infant Cereal)









Previous

12PET

7µm Foil

60PE

New

12PET

18MM883

60PE

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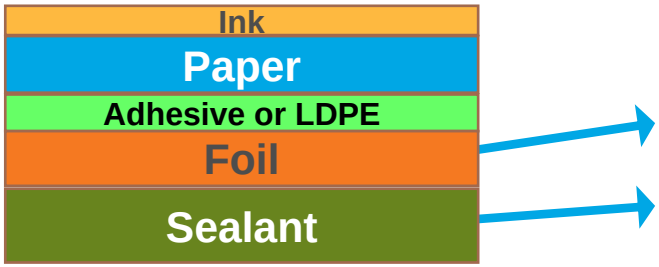
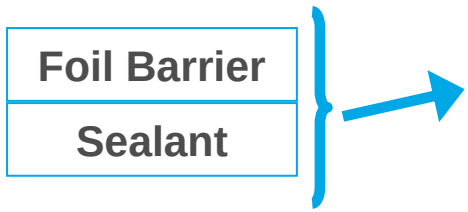
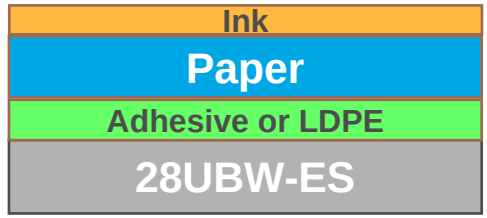
Structure Simplification: Moving from 3-ply to 2-ply

Three Layer Lamination





Two Layer Lamination



Control

Performance Comparison

- Lower raw material cost
- Lower overall basis weight
- Simpler converting process
- Improve functional barrier
  - WVTR and OTR
  - Flavor and aroma barrier
- Customer prefers “feel” (tactile)
- Maintain machine performance

UBW-ES

Reduce to improve

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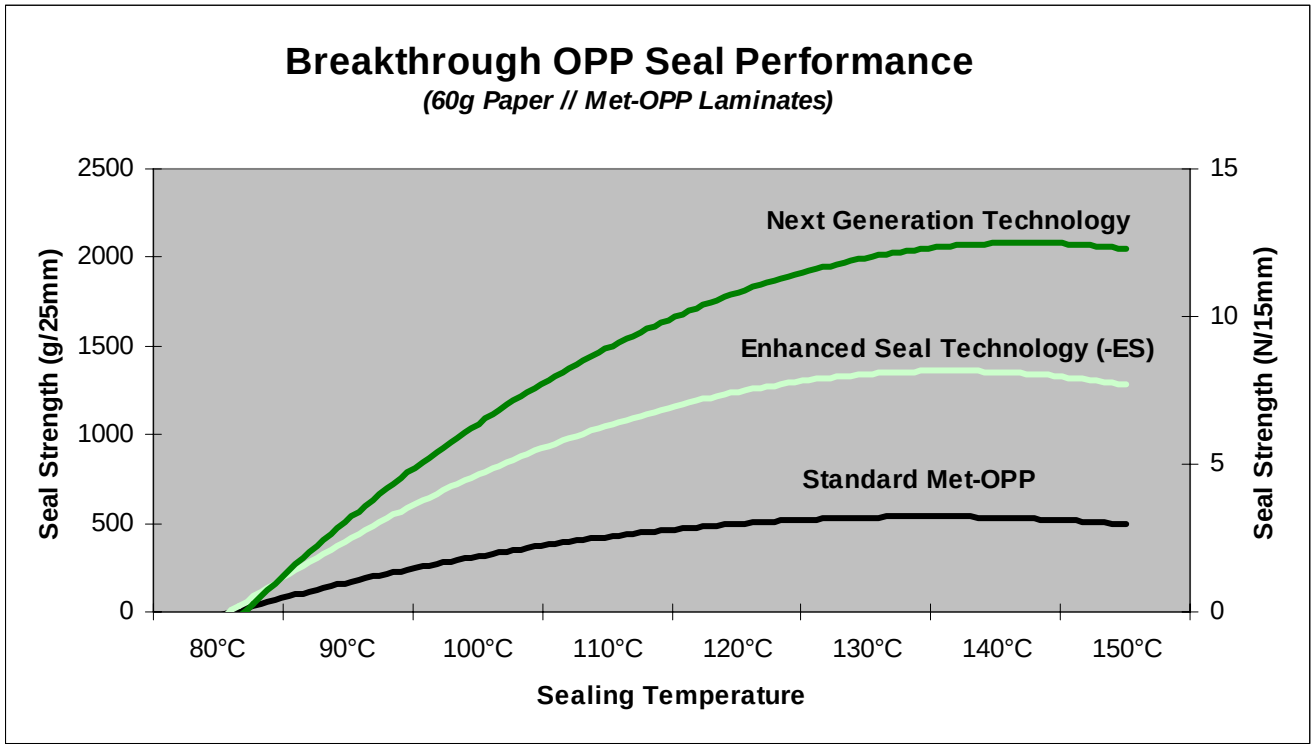
Combining Barrier & Sealant Functionality



Benefits:

- 3 to 4-fold better OPP seal strengths
- Combined with UHB (foil-level) barrier
- White seal aspect
- Low unit weight (cavitated film)
- Proven flat seal performance (i.e. sachets & pouches)

Reduce to improve

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Combining Barrier & Sealant Functionality

Market Segment: Dehydrated Beverages

- Replaced 3-ply laminate with 2-ply metallized OPP film
- Very high barrier to moisture, flavors and aromas for long shelf-life product
- Benefits to brand:
  - Improved operability and converting efficiencies
  - Improved flex-cracking
  - Improved appearance
  - Double digit cost savings

"Jugolin Drink Mix" from Fleson

Film Type: METALLYTE 28 UBW-ES
Key Attribute: Barrier & Seal Integrity
*Structure: 50µm OPP / ink / adhesive / **28UBW-ES***
Format: 4-side sealed pouch

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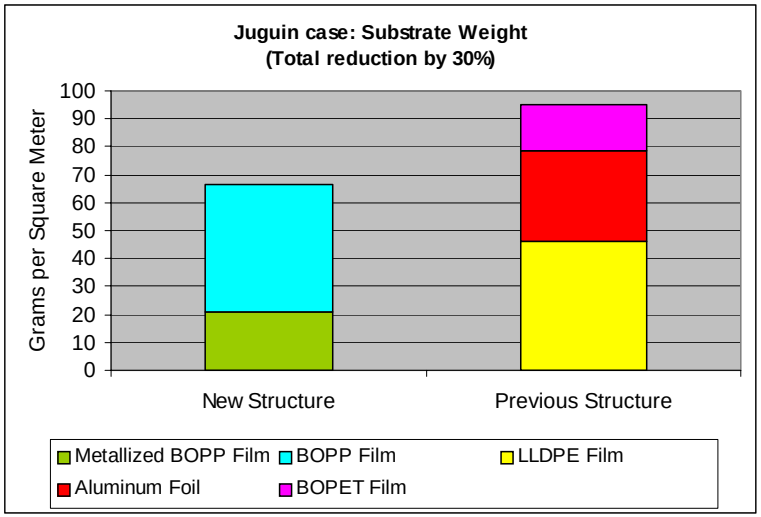
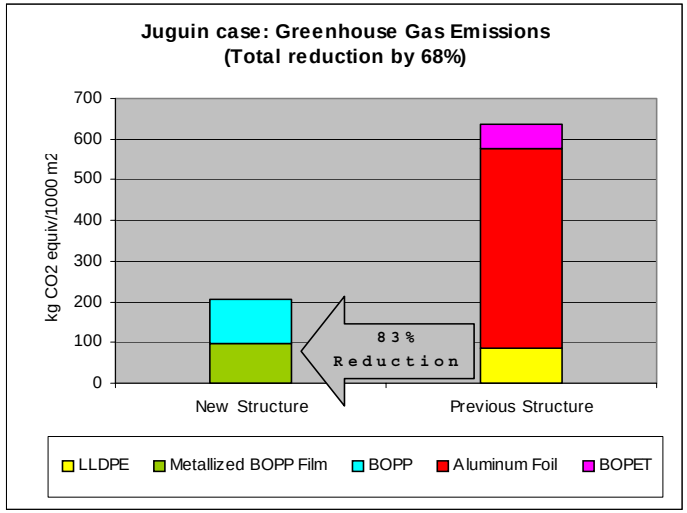
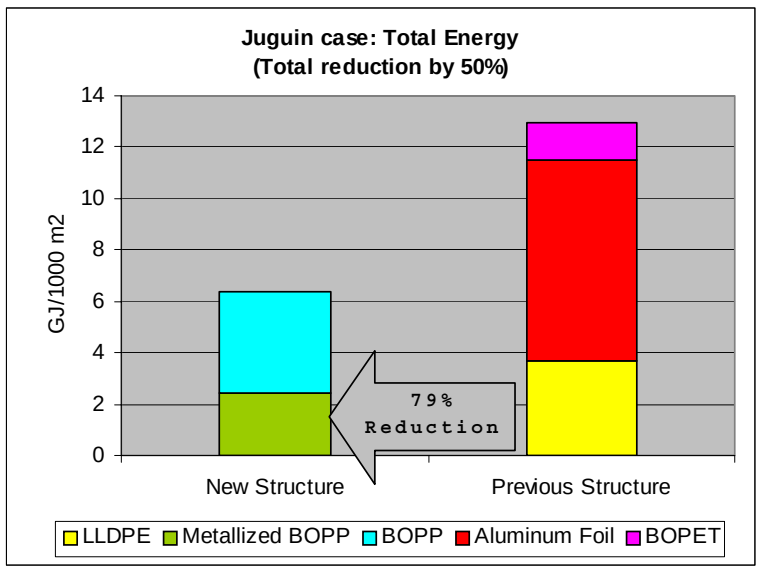
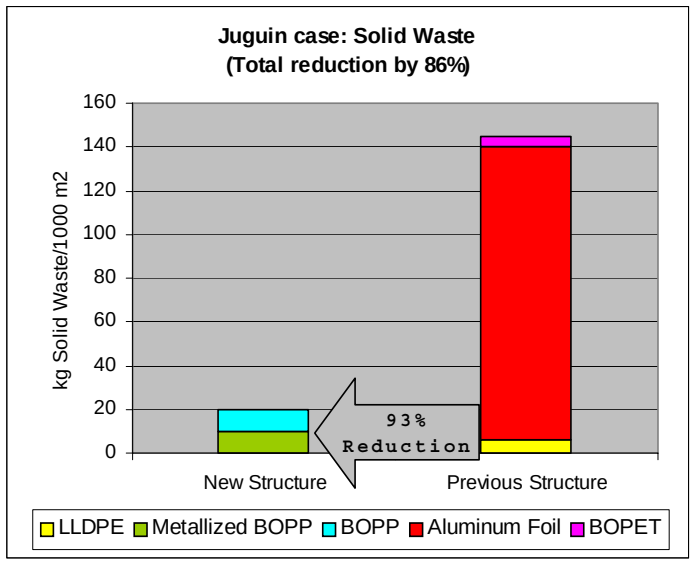
LCI Comparison: Structure Simplification (Dry Juice Pouch)









Previous

12PET

12µm FOIL

50PE

New

50OPP

28UBW-ES

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Case for Action – Summary

- Economics
  - Al Foil pricing at sustained historical highs
  - ExxonMobil Metallyte™ Met OPP delivers lower material and total cost solutions
- Performance
  - The flat sheet barrier of Metallized OPP is approaching thin aluminum foil
  - Metallyte™ Met OPP provides maintenance of barrier after packaging and handling
  - The puncture & flexcrack resistance of Met OPP is superior to Aluminum foil
- Environmental
  - Metallyte™ Met OPP solutions offer significant basis weight/ source reduction opportunities and potential sustainability advantages (LCI)

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