Robert Eller Associates LLC
CONSULTANTS TO THE PLASTICS AND RUBBER INDUSTRIES

EFFECTS OF GLOBAL ECONOMIC CONDITIONS ON AUTOMOTIVE TPOs

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mydox/papers/SPE TPO 09 ppt.ppt
PRESENTATION OUTLINE

• Global Macroeconomic Situation
• Automotive Market Impacts
• Fuel Price/Environmental/Demographic Effects
• TPO Materials/Fabrication Technology Responses and Growth Applications
• Future Vision/Summary
MACROECONOMIC IMPACTS ON GLOBAL MARKETS

• Global GDP slowdown – 2-year trough in West
• Wage deflation/high unemployment (Europe/U.S.)
• Credit lockdown (despite U.S. stimulus):
  - erosion of consumer purchasing power
  - lending re-starting slowly, under difficult terms
MACROECONOMIC IMPACTS: CHINA/INDIA

- Slowed, but continued high growth
- Shift to domestic markets:
  - supported by strong exports to the West
  - impacted by recession conditions in West

- Will previous rush to invest in China/India pay off for auto suppliers?
- Can Western transplant auto suppliers shift target to domestic (China/India) customers?
- Ability to compete with domestic (China/India) suppliers?
MACROECONOMIC IMPACTS ON AUTO MARKETS

- Petrodollar export/oil consumption:
  - terrorism
  - economic impacts
  - environmental impacts

- Responses:
  - alternative energy investments
    (battery/electric drive programs)
  - U.S. CAFE rise
  - CO$_2$ legislation (Europe)

- Substantial auto OEM/supplier overcapacity in West
U.S. CAFE SHIFT: MINIMAL
(FLEET MIX & MATERIALS IMPLICATIONS)

AVERAGE FLEET FUEL ECONOMY BY GLOBAL REGION

HIGHER CAFE DRIVES PLASTICS & TPO SUBSTITUTION

U.S. CAFE LAG CONTINUES

SOURCE: PEW CENTER, 2008
b/mydox/Fuel/Avg Fleet Fuel Economy 08.xls
MACROECONOMIC IMPACTS ON AUTO MARKETS

• Cash for Clunkers vehicle demand effects:
  - stimulated 2009 vehicle demand
  - 2010 Clunker hangover?

  Can your liquidity and working capital sustain 2010 sluggish recovery?

• N. American auto market share shift to Asian/European OEMs continues; supply chain follows

  Your competitive position?
  Which Tier 1s will survive?

• Fleet composition shift to smaller vehicles

  Is your materials/fabrication technology suitable for smaller vehicle components?
SUPPLY CHAIN WINNER CHARACTERISTICS

• Lean path to market
• Favorable (global) raw materials technology/purchasing position
• Critical mass/global marketing reach?
• Advanced fabrication technologies
• Efficient parts consolidation technologies
• Liquidity position
• Viable position in consolidated supply chain
GLOBAL VEHICLE SALES OUTLOOK

**Annual Growth**
- 1990-2000 2.4%
- 2000-2005 3.6%
- 2005-2015 1.3%

**2000:** 57

**2009:** 9% DECLINE FOLLOWED BY RECOVERY IN 2010/2011

**2015:** 77%

42% in 15 emerging markets; 58% in Europe/U.S./Japan

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2009

r/mydox/Auto Industry/Global Ind Volume TW 081209.xls
U.S. AND EUROPE LIGHT VEHICLE SALES

SALES, MM UNITS

SOURCE: DEUTSCHE BANK, 2009

B/mydox/auto industry/NA and EUR sales.xls
U.S. MARKET SHARE BY OEM

SOURCES: MOTOR INTELLIGENCE; ROBERT ELLER ASSOCIATES LLC, 2009

GM
FORD
CHRYSLER
TOYOTA
HONDA
NISSAN
HYUN/KIA
Wilbur Ross’ Predictions for (’08/’09) On Target –

• 2009 N. American production decline to < 9MM
• U.S. highly saturated: replacement market, little growth potential
• Unemployment: ~ 10%
• U.S. median per capita income: stalled at ~ $45K
• Housing foreclosures
• Net worth decline
AUTOMOTIVE MARKET: NEXT 10 YEARS

- U.S./Europe driving age population 496MM:
  - 1/2 the number in China
  - 2/3 size of the same population in India

- High demographic/middle class growth rates in China/India

- Auto industry growth/volume will benefit China/India

- Regional market shift accelerating
GLOBAL REGION MARKET SHIFT UNDER WAY

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>2009 YTD SALES GROWTH/DECLINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe*</td>
<td>-18%</td>
</tr>
<tr>
<td>N. America*</td>
<td>-26%</td>
</tr>
<tr>
<td>Japan*</td>
<td>-21%</td>
</tr>
<tr>
<td>Brazil</td>
<td>+ 5%</td>
</tr>
<tr>
<td>India</td>
<td>+ 5%</td>
</tr>
<tr>
<td>China</td>
<td>+42%</td>
</tr>
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</table>

* = Mature markets represent about 60% of global sales

Source: Robert Eller Associates LLC, 2009
AUTOMOTIVE MARKET: FUEL PRICE EFFECTS

• Fuel price tipping points:
  - shifts in vehicle preference
  - 2008:$3.50-4.00/gal. \(\rightarrow\) 100BN fewer miles driven (U.S.)

• Likely fuel price rise? \(\rightarrow\) Changes auto and autoplastics paradigms:
  - rising oil demand/decreasing production?
  - easy-to-get oil has gotten harder to find
  - economic recovery
  - global population jump by 1.0BN in next 12 years
  - “middle class” increase by 1.8BN (600MM in China)
  - gas taxes in U.S. (remain constant at 0.18/gal.?)
  - diesel pricing policy
THE OIL PRICE ROLLER COASTER

Have the 2008 fuel price spike and tipping point permanently shifted:

- fleet composition
- lightweighting incentives
- Break-even volumes

AUTOMOTIVE MARKET: FUEL PRICE EFFECTS

• Plug-in hybrids: bridge to a (composite intensive) electric car/alternative propulsion world

• Diesel future: still uncertain

• Global Li-ion auto battery sales:
  - $12BN in 2010
  - $35BN in 2015

• Fuel price increases/environmental legislation increases:
  - emphasis on light weight solutions
  - $/kg saved increases
  - TPO demand via new applications

Are you positioned for new opportunities?
CURRENT AND FORECAST HYBRID AND ELECTRIC VEHICLE SALES - N. AMERICA, 2006-2015

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2009

b/mydox/auto industry/hybrid and electric cars.xls
POST-RECESSION PARADIGM SHIFT

• Restructured OEM market shares (esp. N. America)
• Restructured autoplastic supply chain
  - emphasis on leaner manufacturing
  - shorter path to market
  - narrowed supplier selection
• Shifted vehicle sourcing towards OEMs with smaller, fuel efficient vehicles

Have you shifted your business planning paradigm?
AUTO TPO DEMAND

- TPO fabrication economics substantially improved last 5 years
- New applications (despite small-vehicle share gain) → increased kg/vehicle
- TPO demand shares:
  - Exterior fascia/cladding: major share, mature
  - Exterior panels: growth target (material innovations)
  - Interior: process innovation opportunity
# AUTO TPO DEMAND: N. AMERICA

<table>
<thead>
<tr>
<th>YEAR</th>
<th>VEHICLE PROD’N., MM UNITS</th>
<th>AUTO TPO DEMAND</th>
<th>NOTE</th>
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<tr>
<td></td>
<td></td>
<td>MM LBS.</td>
<td>kT</td>
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<tr>
<td>2007</td>
<td>15.3</td>
<td>500</td>
<td>227</td>
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<tr>
<td>2009</td>
<td>8.8</td>
<td>300</td>
<td>136</td>
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<tr>
<td>2015</td>
<td>15.0</td>
<td>550?</td>
<td>250?</td>
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- Continued OEM share shift
- Depressed market
- Vehicle fleet shift to smaller vehicles
- Increased TPO penetration in exteriors/thermoset competition?
- TPO synergy from LGF-PP compounds
- Interiors penetration continues

Source: Robert Eller Associates LLC, 2009
GLOBAL RECESSION DRIVERS FOR AUTO TPO

AUTO SALES DECLINE, SLUGGISH RECOVERY

OEM MARKET SHARE SHIFT

SUPPLY CHAIN CONSOLIDATION, REORGANIZATION

SHIFT OF TECHNICAL CHOICES

AVOID CAPEX

LEAN SUPPLY CHAIN CHOICES (REDUCE UNIT OPERATIONS)

MAXIMIZE EXISTING TECHNOLOGY

IN-MOLD DECORATION SURFACING METHODS

- DIRECT COMPOUNDING (a)
- 2-SHOT MOLDING
- IN-MOLD FOAMING

NOTE: (a) DIRECT COMPOUNDING = D-LFT, AT-PRESS FILLER ADDITION, ETC.

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2009
ENERGY/ENVIRONMENTAL DRIVERS FOR AUTO TPO

- FUEL EFFICIENCY
- CO₂ DISCHARGE LEGISLATION
- ELECTRIC DRIVE
- HYBRIDS

FUEL PRICE INCREASE (DEMAND, TAXATION)

GLOBAL FLEET COMPOSITION
SHIFT TO SMALLER VEHICLES

INCREASED VALUE FOR LIGHTWEIGHT SOLUTIONS

INCREASED VALUE FOR PERCEIVED INTERIOR LUXURY

BATTERY-RELATED SUBSTITUTES
LGF-PP BODY STRUCTURE
TPO OUTER SKINS
IMPROVED ENERGY ABSORBERS (CARBON FIBER?)
SOFT TOUCH VIA SEVERAL TECHNOLOGIES

NEW THERMOSET CONTENDERS?

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2009
EMERGING MARKET SHIFTS FOR AUTO TPO

EMERGING MIDDLE CLASS

ECONOMICALLY TRAILING CLASS

- LOW COST VEHICLE DESIGNS
- 2-WHEELERS

TPO DEMAND SHIFT TO EMERGING REGIONS

THERMOFORMED TPO SHEET, LOW COST TOOLING

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2009

r/mydox/auto industry/AutoTPO EmergingMktShifts09.vsd // lg/myfiles/visio/AutoTPO EmergingMktShifts09.vsd
MAJOR FACTORS AFFECTING AUTO TPO DEMAND

FUEL PRICES, CO₂ LEGISLATION

FLEET SHIFT TO SMALLER VEHICLES

GLOBAL MARKET SHIFT

LIGHT WEIGHT

LUXURY

AUTO TPO OPPORTUNITIES:

MULTIPLE APPLICATIONS; COMPLEMENT LGF-PP

SOFT TOUCH, SMALLER PARTS, SURFACE DECORATION COST SAVE

- MARKET SHIFT TO CHINA/INDIA
- THERMOFORMED SHEET

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2009

r/mydox/auto industry/AutoTPO FactorsAffectingDemand09.vsd
lg/myfiles/visio/AutoTPO FactorsAffectingDemand09.vsd
TPO EMERGING FROM HIGH AUTO CONCENTRATION?

AUTO TPO COMPOUND TECHNOLOGIES

NEW NON-AUTO MARKETS, e.g., BUILDING/CONSTRUCTION
AUTO TPO SUPPLY CHAIN SHIFTING

- Resin supplier share gain (reactor TPOs, captive compounding)
- Regional resin production shift (to petroleum-rich regions)
- Lean (direct) fabrication technologies
- Direct compounding
- Non-domestic OEMs importing suppliers (to U.S., Mexico)
- Supplier shifts to low cost regions
TPOs AND FIBER-REINFORCED PLASTICS

• Fiber-reinforced plastics (esp. long-glass reinforced PP [LGF-PP]) will increase share and be among the drivers for TPO demand for:
  - hatchback doors
  - front end modules
  - under body shields
  - door hardware modules

• LGF-PP structural inner panel/micro talc-TPO exterior skin (e.g., Ford Kuga)

• Movement into monocoque construction (thermoset competition?)
HATCHBACK DOOR: GROWTH APPLICATION FOR TPOs

Application: Roof spoiler, tailgate outer panel
Grade: LyondellBasell Hifax TRC 280X
Molder: Plastal

REA Notes:
- Inner panel is LGF-PP compound (Stamax from SABIC)

Photo: Robert Eller Associates LLC
r/mydouxpapers/spetpo2009pix.ppt
**HATCHBACK DOOR INNER:**
**GROWTH APPLICATION FOR LGF-PP**

**Part:** Hatchback door inner panel  
**Material:** 40% LGF-PP  
**Status:** Prototype  
**Molder:** Plastal  
**Process:** D-LFT (injection)  
**Equipment:** Krauss Maffei  
**Note:** Competes with LGF-PP compound  

**Photo:** Krauss Maffei

r/mydox/papers/spetpo2009pix.ppt
MERCEDES SMART FORTWO TAILGATE: PRECURSOR FOR LGF-PP AND TPO IN BODY STRUCTURES?

• 20% stiffness increase vs. earlier version
• LGF-PP move into body structures
• Early use of E-LF-PP (endless long fiber polypropylene)
• Mineral-filled TPO exterior skin

• E-LF-PP gives high load bearing and impact absorbency
• Translation potential for rear seat backrest

Source: Weber Automotive; ESORO AG
DESIGN CONCEPT FOR E-LGF-PP BASED COMPACT CAR BODY STRUCTURE

Thermoset competition?

Metallic front and rear elements

Double shell floor

Source: Weber Automotive; ESORO AG
EXAMPLE OF LGF-PP & E-LF-PP DIRECT PROCESS

Source: Robert Eller Associates LLC, 2009
2-SHOT MOLDING AND SOFT TOUCH

• 2-shot molding:
  - established in consumer/health care
  - widely used in auto (lighting, lenses, multi-color)
  - auto soft touch starting

• 2-shot/TPO growth resulting from:
  - high flow grades
  - 3 layers (skin/foam/substrate) in 2 shots

• In-mold forming of TPO skin/back injection gaining share in capex constrained economy
SOFT TOUCH REINFORCED TPO

- Small vehicle share increase:
  - drives towards higher quality interiors
  - without high cost of multi-step processes
  - new generation of glass fiber reinforced, MIC TPOs with soft touch surface for interiors:
    -- improved scratch and mar
    -- low knit line visibility
    -- low gloss
    -- compete with soft touch paints/ thermoformed or slush molded skins
RENEWED EMPHASIS ON PAINT COST REDUCTION

Adpro elimination . . . Are we finally there?

Basis:
- Part size: 8 ft\(^2\)/part
- Cost/gal. for base coat, clear coat, and PC-25 are equal
- Equal cost for labor to apply each coat

<table>
<thead>
<tr>
<th></th>
<th>Adpro + SB Treatment + SB Base Coat + SB Clear Coat</th>
<th>Adpro Treatment + SB Base Coat</th>
<th>SWT-PC-25 + Clear Coat</th>
<th>SWT-PC-25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cost: $/Part</td>
<td>5.39</td>
<td>3.00</td>
<td>4.76</td>
<td>2.38</td>
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Notes:
- SB – solvent based
- Gallon – US gallon

Source: SWT Group
### RENEWED EMPHASIS ON PAINT COST REDUCTION

<table>
<thead>
<tr>
<th></th>
<th>Adpro</th>
<th>Base Coat</th>
<th>Clear Coat</th>
<th>PC-25</th>
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<tr>
<td><strong>Inputs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solids, %</td>
<td>10</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Dry film thickness, mils</td>
<td>0.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Transfer efficiency, %</td>
<td>60</td>
<td>70</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>Cost: Coating + Labor, $/ gallon</td>
<td>25</td>
<td>90</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td><strong>Outputs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coverage, ft.²/ gal.</td>
<td>320.8</td>
<td>302.3</td>
<td>302.3</td>
<td>302.3</td>
</tr>
<tr>
<td>Gallon/part</td>
<td>0.025</td>
<td>0.026</td>
<td>0.026</td>
<td>0.026</td>
</tr>
<tr>
<td>Cost: $/part</td>
<td>0.62</td>
<td>2.38</td>
<td>2.38</td>
<td>2.38</td>
</tr>
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</table>

Source: SWT Group
AUTO TPO LIFE CYCLE POSITIONS

HIGH

FIBER REINFORCED SOFT TOUCH

EXTerior BODY PANELS

BODY STRUCTURES(a)

2-SHOT SKIN/FOAM/SUBSTRATE

MEDIUM

AIRBAG DOORS

THERMOFORMED IP SKINS(b)

IP SUBSTRATE

THERMOFORMED DOOR TRIM SKINS(B)

LOW

ADV. R/D; INTRODUCTION

GROWTH

MATURE

BUMPER FASCIA

CLADDING

= ESTIMATED FUTURE DIRECTION

NOTES:

(a) LGF-PP = LONG GLASS FIBER PP; E-LF-PP = ENDLESS (E.G., TAPE REINFORCED) LONG FIBER PP

(b) INCLUDES THIN PP (TPO) FILM TECHNOLOGY INTRODUCED IN EUROPE (BY JCI, OTHERS)

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2009
FUTURE VISION/SUMMARY

• Global vehicle sales recovering slowly:
  - much faster in China/India
  - future volume shares shifting toward Asia

• TPO supply chain restructuring

• Supplier reduction programs continue,
  e.g., Ford’s Aligned Business Framework (ABF)
• TPO demand affected by:
  - shift to smaller vehicles, hybrids, electric vehicles
  - likely fuel price increases
  - CO$_2$ and CAFE legislation
  - increased value for lightweighting
  - new generation of TPO applications
  - synergy with fiber reinforced PP
  - new opportunities from micro-talc compounds

• Approaches to reducing/eliminating surface coating costs continue to gain share