THE TPE INDUSTRY: GLOBALIZATION, STRUCTURAL CHANGES AND CHALLENGES

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PRESENTED AT:
SMITHERS RAPRA TPE 2012
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Bob/papers/tpe berlin 2012
• TPE life cycle: maturity and commoditization

• Globalization effects/regional market differences

• Role of Asia in global TPE markets

• TPE industry structure shifts

• Growth opportunities:
  - Key forces driving/limiting TPE growth
  - The next TPE growth phase: drivers and barriers
  - Example growth markets: health care, automotive
  - Expanding the performance envelope: s-TPVs, property range

• TPE challenges and value-add strategies
### MARKET MATURITY: SOME TPEs EVOLVING TOWARD COMMODITIES

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>COMMODITY</th>
<th>SPECIALTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of grades</td>
<td>- Many standard grades</td>
<td>- Few grades</td>
</tr>
<tr>
<td></td>
<td>- Compete for same business</td>
<td>- Highly targeted</td>
</tr>
<tr>
<td>Major TPE suppliers</td>
<td>Continue supply or exit</td>
<td>Enter compounding</td>
</tr>
<tr>
<td>Competitive basis</td>
<td>Price. Trend toward global price</td>
<td>Performance (tailored)</td>
</tr>
<tr>
<td>Property differentiation</td>
<td>None → minor</td>
<td>Highly differentiated</td>
</tr>
<tr>
<td>Sales/marketing approach</td>
<td>- Pursue existing markets</td>
<td>“Shape” new markets</td>
</tr>
<tr>
<td></td>
<td>- Take orders/Use distributors</td>
<td></td>
</tr>
<tr>
<td>Tech support, Applications dev.</td>
<td>Minimal</td>
<td>Substantial</td>
</tr>
<tr>
<td>Brand recognition</td>
<td>- Incumbent TPE suppliers (have it)</td>
<td>No: must be built</td>
</tr>
<tr>
<td></td>
<td>- New entrants without it (e.g. Sinopec, TSRC)</td>
<td></td>
</tr>
<tr>
<td>TPE examples</td>
<td>- Standard SEBSs, SBS, TPO</td>
<td>- New SEBS grades</td>
</tr>
<tr>
<td></td>
<td>- Some o-TPVs, TPUs</td>
<td>- s-TPVs, Bio-TPEs</td>
</tr>
<tr>
<td></td>
<td>- Some COPEs</td>
<td>- Health care grades</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- New acrylic grades</td>
</tr>
</tbody>
</table>

**SOURCE:** ROBERT ELLER ASSOCIATES LLC, 2012
EXAMPLE PRODUCT LIFE CYCLE POSITION OF TPEs

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2012
Manufacturing Share of GDP
Current National Currency Units
1970 to 2010

Source: United Nations
GLOBAL MANUFACTURING: EUROPE DECLINE IN 2011 - 2012

HSBC Manufacturing PMI

Euro Zone

China

India

South Korea

USA = 51.5(a)

(a) USA down from PMI = 55 in Jan 2012
THE ASIA SHIFT

• TPE demand effects:
  - Decreases TPE demand in Europe/N. America
  - Especially for consumer product-related TPEs

• Supply chain effects as Asia infrastructure matures:
  - Western companies dependent on Asian supply chain
  - Western investment (resin production, compounding) in Asia
  - R/D shift to Asia region
  - Asia plant scale → competitive

• Investment flow coming out of Asia. Some into TPE sector (e.g. TSRC)

• “Re-shoring” starting in U.S. (still a minor driver-shale gas effect)
Auto sales averaged, 20%/yr, last 5 years

Auto sales forecast to grow 7-8%/yr, next 5 years

CHINA GDP SLOWING → SLOWS TPE GROWTH (AUTO REMAINS GROWTH DRIVER)
### THE ASIA SHIFT AFFECTS WESTERN TPE MARKETS DIFFERENTLY

<table>
<thead>
<tr>
<th>TPE SECTOR</th>
<th>HIGH ASIA GROWTH INDEPENDENT OF WESTERN CONDITIONS</th>
<th>ASIA GROWTH DECREASES WESTERN TPE MARKETS</th>
<th>ASIA GROWTH NO EFFECT ON WESTERN TPE</th>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto</td>
<td>×</td>
<td></td>
<td></td>
<td>High Asia TPE growth market</td>
</tr>
<tr>
<td>Footwear</td>
<td></td>
<td>X (a)</td>
<td></td>
<td>Shifted long ago</td>
</tr>
<tr>
<td>Bldg/Const.</td>
<td></td>
<td></td>
<td>X</td>
<td>A classical stay at home market</td>
</tr>
<tr>
<td>Consumer</td>
<td></td>
<td>X (a)</td>
<td></td>
<td>Shifted long ago</td>
</tr>
<tr>
<td>Wire/Cable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food/Pharma</td>
<td></td>
<td></td>
<td>X</td>
<td>Packaging</td>
</tr>
<tr>
<td>Health care</td>
<td>X</td>
<td></td>
<td>X</td>
<td>High growth West/Asia TPE market</td>
</tr>
<tr>
<td>Appliance/Tool</td>
<td></td>
<td>X (a)</td>
<td></td>
<td>Re-shoring candidate</td>
</tr>
<tr>
<td>Personal Care/</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cosmetics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluid Handling</td>
<td></td>
<td></td>
<td></td>
<td>-Rubber hose is a recent o-TPV target</td>
</tr>
<tr>
<td>/Industrial</td>
<td></td>
<td></td>
<td></td>
<td>- Re-shoring candidate</td>
</tr>
<tr>
<td>Sports/Leisure</td>
<td></td>
<td>X (a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coated Fabrics</td>
<td></td>
<td></td>
<td></td>
<td>Asia very dominant in textiles</td>
</tr>
<tr>
<td>Elec/Electronic</td>
<td></td>
<td></td>
<td></td>
<td>Major shifts already occurred</td>
</tr>
</tbody>
</table>

Note: (a) market shift to Asia has already affected Western markets

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2012
Wage stagnation and lower raw material costs could lead to re-shoring

RE-SHORING EFFECTS ON TPE REGIONAL DEMAND

• Starting in U.S.: still very minor, could shift regional TPE structure

• European conditions currently less favorable for re-shoring

• Manufacturing cost drivers narrowing the landed cost gap:
  - shale gas/energy cost and TPE raw materials cost decline potential
  - U.S. labor cost stagnant or declining/China wage rate inflation
  - market proximity
  - rapid response time
  - logistics cost save
  - currency exchange rate shift favors re-shoring
  - automation/product quality control

• Speed to market

• Anti-dumping laws and duties(U.S. and Europe)

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2012
• **Sports/leisure:** Buck knives (U.S. - formerly outsourced 30% to Chinese suppliers)

• **Footwear:** Picolino Shoes (Spain), several footwear companies (Italy)

• **Auto:** U.S.: European overcapacity = ~ 30%

• **Audiovisual mounting products/accessories:** Peerless Industries; Sleek Audio

• **Industrial equipment:** Caterpillar, GE

• **Mobile electronics:** Google(Nexus Q music/video player )

• **Plastics molding:** Intertech Plastics (U.S.)

• **Note:** 34% of U.S. companies surveyed in M.I.T. study indicated plans to re-shore

**SOURCE:** ROBERT ELLER ASSOCIATES LLC, 2012
• **Region**: shifted to global 4-5 years ago, key China role, re-shoring effects

• **Concentration**: bipolar, 10-12 large suppliers, many small compounders

• **Entry barriers**: easy to enter, IP not critical (formulation driven)

• **Entry paths**: multiple: captive resin suppliers, distributors, compounders, back integrated fabricators

• **Target markets**: auto (dominates), broad range of low volume markets

• **Growth dynamics**:
  - EPDM, PVC substitution, automotive systems cost/weight save
  - Strong intra-TPE competition, cascade to lower cost TPEs
  - Broadening property envelope
  - Bio-TPEs entering
  - Applications development shifted to tier 1s, end users
  - Growth: tied to unit volume growth (e.g. auto) and substitution

**SOURCE**: ROBERT ELLER ASSOCIATES LLC, 2012
<table>
<thead>
<tr>
<th>SHIFT TYPE</th>
<th>EXAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition by major TPE supplier</td>
<td>Merquinsa acquisition by Lubrizol</td>
</tr>
<tr>
<td>Distributor entry into TPEs</td>
<td>-Albis → TPV entry. Ravago acquisitions</td>
</tr>
<tr>
<td>Resin supplier → compounding</td>
<td>TSRC, PP resin suppliers, others</td>
</tr>
<tr>
<td>Target U.S. markets</td>
<td>TSRC, Ravago, Albis, CTS, Polymax, Hexpol</td>
</tr>
<tr>
<td>Investment and imports: Asia to West</td>
<td>- Nantong Polymax (TPE compound supply), LCY - TSRC acquisition of Dexco*</td>
</tr>
<tr>
<td>Product line diversification</td>
<td>- Teknor Apex acquisition of DSM’s Sarlink®* - Kraiburg: high temp TPV (Hipex®); silky touch</td>
</tr>
<tr>
<td>Major TPE supplier emphasizing specialty vs commodity grades</td>
<td>- Kraton entry into higher performance grades - Kuraray entry into di-block/tri-block acrylic TPEs</td>
</tr>
<tr>
<td>Shifts to Asian production and market development</td>
<td>Many TPE suppliers, recently: CTS, Hexpol, Dow Corning/Multibase</td>
</tr>
<tr>
<td>TPE entry from other sectors</td>
<td>-Hexpol acquisitions: Elasto, Horst Mueller</td>
</tr>
</tbody>
</table>

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2012
NEXT TPE GROWTH PHASE: TECHNOLOGY PUSH/MARKET PULL

TECHNOLOGY PUSH
E.G.
- HEAT RESIST
- ADHESION
- SCRATCH RESISTANCE
- FOAMING
- CONDUCTIVE
- HMS (SBCs)
- CO-PROCESSING

MARKET PULL
E.G.
- ANTI-PVC PRESSURES
- AUTO DRIVERS
  - WEIGHT
  - COST SAVE
  - LUXURY LOOK/FEEL
  - GLOBAL SUPPLY
  - GREEN INITIATIVES

• Entrenched incumbent technology
• Low cost incumbents (e.g. PVC)
• In-house compounding by fabricators (e.g. rubber)
• Shift to commodity strategy by major TPE suppliers

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2012
<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TPE TYPES</th>
<th>EXAMPLE MARKET SECTORS</th>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet grip</td>
<td>SBS → SEBS?</td>
<td>- Health care</td>
<td>With/without tackifiers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Tools, sports/leisure</td>
<td></td>
</tr>
<tr>
<td>Foam</td>
<td>SBC, TPV COPE</td>
<td>- Auto: steering wheels</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Body seals, skins</td>
<td></td>
</tr>
<tr>
<td>High flow</td>
<td>TPV, SEBS, COPE</td>
<td>- Auto: glazing seals,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Skins (soft touch)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Pkg., housewares</td>
<td></td>
</tr>
<tr>
<td>High flow</td>
<td>TPO</td>
<td>- Auto bumper fascia</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Target $\rightarrow&lt;$3.2 mm</td>
</tr>
<tr>
<td>- Hi temp, Oil resist</td>
<td>s-TPV</td>
<td>Auto under-hood</td>
<td>Challenges specialty rubbers</td>
</tr>
<tr>
<td>- “Sustain ” “Green”</td>
<td>SBC, TPU COPE</td>
<td>- Auto</td>
<td>Achieved via: monomer, filler, oils</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Consumer</td>
<td></td>
</tr>
<tr>
<td>Transparency/</td>
<td>TPU, TPVs, SBCs</td>
<td>Med., consumer, pkg.,</td>
<td>Translucent TPU with long glass reinforcement</td>
</tr>
<tr>
<td>translucency</td>
<td></td>
<td>fluid delivery</td>
<td></td>
</tr>
<tr>
<td>Slush moldable</td>
<td>SEBS</td>
<td>Auto interior skins</td>
<td></td>
</tr>
<tr>
<td>High melt strength (HMS)</td>
<td>SEBS</td>
<td>Auto, Health care</td>
<td>HMS allows foaming, blow molding, film extrusion</td>
</tr>
<tr>
<td>Silky touch</td>
<td>SEBSs-TPV</td>
<td>Electronics, auto</td>
<td>Kraiburg, Multibase</td>
</tr>
</tbody>
</table>

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2012
EXTENDING THE SBC PROPERTY RANGE

• The challenges:
  - Steep melt viscosity decline with temperature (+ for high filler applications, high flow applications) limits processing /properties)
  - High compression set, especially at elevated temperatures

• High melt strength (HMS) grades allow:
  - Blow moldability
  - Foamability
  - Film extrusion/calendaring (for PVC film substitution)
  - Profile/tubing extrusion
  - Thermoformability

• Reduced compression set allows:
  - Competition with o-TPV rubber substitution (e.g. body/glazing seals)
  - Non-auto sealing applications (e.g. packaging, industrial)
### CO-PROCESSING DRIVES TPE GROWTH IN RIGID/FLEXIBLE SYSTEMS

<table>
<thead>
<tr>
<th>TYPE</th>
<th>STRUCTURE</th>
<th>NOTE/EXAMPLE APPLICATION</th>
</tr>
</thead>
</table>
| Overmold, Film coex, 2-shot mold | TPE Substrate (rigid segment) | - Soft touch phones  
- Some 2-tone applications  
- Vibration damping  
- Coex films (medical) |
| Side by Side                | TPE Rigid Segment  | - 2-tone  
- Door trim, console, IP  
- Bumper fascia |
| Edging                      |                    | - Body/glazing seals (profiles)  
- Cowl vent seals  
- Co-extrusion or 2-shot |
| Co-blow Mold                | TPE (flexible) Rigid | - Auto: Boots/bellows, hose  
- Medical |
| Co-extrusion Blow Mold or Co-extrusion | o-TPV s-TPV or ETP inner | Under-hood:  
- Hose (e.g. fuel)  
- Duct |

Source: Robert Eller Associates LLC,, 2012

r/mydox/Visio/Two Shot OM approaches 2012.vsd
BROADENING THE TPE APPLICATIONS ENVELOPE (EXAMPLE)

- **Application:** high temp hose
- **Target markets:** auto under hood, industrial hose
- **TPE type (candidates):** several depending on heat resistance level (COPE, TPEE, s-TPV)
- **Key properties:** temp resistance, low stiffness
- **Process:** water Injection molding technology (WIT)
- **TPE enabling technology:** temp resist (s-TPVs)
- **Note:**
  - example of fabrication/TPE couple
  - woven mesh inserted during molding process
  - mesh insertion developed at IKV
SOURCE: ROBERT ELLER ASSOCIATES LLC, 2012
b/mydox/papers/TPE sectors 12.xls
AUTOMOTIVE: KEY TARGET MARKET FOR NEW TPEs

THE AUTO MARKET
- 40-50% of current TPE demand
- Key incumbents: EPDM, PVC, TPO
- Global footprint

- Role for lightweighting, systems cost-save
- Key target properties: low V.O.C., thin wall, low odor, oil/fuel resistance, heat resistance, sustainable
- Role for process technology, co-processing innovations

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2012
VEHICLE PRODUCTION GROWTH IN CHINA \(\rightarrow\) MAJOR TPE OPPORTUNITY

- 10 MM UNIT GAIN = TPE GROWTH OPPORTUNITY
- CAGR = 7-8%/YR
- SATURATION/CAPACITY GLUT?
- VEHICLE PRICE PRESSURES

PRODUCTION SHIFT (HIGH WON/YEN)

PROD’N, MM UNITS

- 3.2%/YR ?
- 3.7%/YR

DATA SOURCE: IHS
auto/global prod volumes 2012-2017
E.U. CAR SALES: 20% DECLINE SINCE 2007. OVERCAPACITY (~ 30%)
• Rollout of MQB (modular architecture) platform:
  - Cost savings (plant flexibility, reduced production time)
  - 6MM units/40 models by 2020
  - More integrated systems/modular constructions

• Global positions
  - On course toward retaining global #1 position
  - Very strong current position in developing markets (Brazil and China)
  - China expansion (300K capacity plant in Changsha), others → 4MM vehicles/yr by 2018
  - Benefit from structural changes in European auto sector (currently 25% share)
  - N. American turnaround (currently 5% share)

• Pricing power vs mass market competitors
TPEs STARTING IN COATED FABRICS

PVC: the dominant incumbent strongly entrenched, cost effective
SBC-TPEs: Phthalate-free, UV resistance, low temp properties, hand/drape range
Applications: Soft touch instrument panel, door trim, glove box
Vehicle: Daimler Actros
TPE type: COPE (TPEE)
Substrate: PC/ABS
Key benefits:
- Entire part in single injection machine (two barrel rotary platen) with expansion/decompression option
- 8 step process → 2 step
- Cost save vs off line skin forming (slush, thermoform or PU spray), substrate injection, PU foaming

Photo: So.F.Ter (Italy)
DOLPHIN INTERIOR TRIM STRUCTURE: INTEGRAL SKIN/FOAM /SUBSTRATE

PC/ABS CARRIER

SOLID INTERFACE

- LOW DENSITY TPEE FOAM CORE
- ADJUSTABLE THICKNESS/DENSITY

SOLID TPEE SKIN:
- WITH GRAIN
- THICKNESS ADJUSTABLE

PHOTOMICROGRAPH SOURCE: So.F.Ter; TREXEL
HEALTH CARE: A HIGH GROWTH TPE SECTOR

• High value market, driven by PVC replacement

• Example targets:
  - Multilayer films for range of bag and film applications
  - IV tubing sets
  - Respiratory therapy
  - Closures

• Key TPE properties:
  - Re-sealing
  - Bondability to polyolefins (e.g. for closures and multilayer films)
  - Clarity
  - Melt strength
  - Elastic properties

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2012
TPE IN HEALTH CARE: DRIVEN BY PVC REPLACEMENT PRESSURES

PHOTO: KRATON
Application: IV bag
TPE type: H-SBC (SEBS)
Key properties: Elasticity, low temp, clarity, PP compatibility, melt strength
Processing: Extrusion, calendering

PHOTO: KRAIBURG
Application: Infusion bottle closure
TPE type: H-SBC (SEBS)
Key properties: Re-sealing, bond to polyolefins
Processing: 2 component injection

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2012
SUPER-TPV FAMILIES

ACRYLIC RUBBER BASED

FLUOROPOLYMER BASED

SILICONE BASED

EVA BASED

ZEOTHERM® TPV (ZEON CHEMICALS-DOMINANT SHARE)

FluoroXprene® (FREUDENBERG-NOK)

TPSiV® (DOW CORNING-MULTIBASE)

HIPEX® (KRAIBURG)

Note: Withdrawn from market: DuPont™ ETPV; Daikin’s DAI-EL Fluoro TPV™

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2012
r/mydox/.../Super TPV Families 2012.ppt
## RENEWABLE BIO-TPEs BEGIN MARKET PENETRATION (EXAMPLES)

<table>
<thead>
<tr>
<th>TPE FAMILY OR COMPONENT</th>
<th>RENEWABLE RESOURCE EXAMPLE</th>
<th>EXAMPLE SUPPLIERS</th>
<th>NOTE/RENEWABLE CONTENT, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>COPA</td>
<td>Castor oil</td>
<td>Arkema, Evonik</td>
<td>25 – 94</td>
</tr>
<tr>
<td>COPE, (TPEE)</td>
<td>Polyols from corn</td>
<td>DuPont, DSM</td>
<td>20 – 60</td>
</tr>
<tr>
<td>TPU</td>
<td>Polyols from corn</td>
<td>Lubrizol, BMS, GLS</td>
<td>20 - 70</td>
</tr>
<tr>
<td></td>
<td>Bio-propylene glycol</td>
<td>BASF/Oleon</td>
<td>From fats/oils</td>
</tr>
<tr>
<td>PP</td>
<td>Ethanol from sugar</td>
<td>Dow, Braskem</td>
<td>In TPE formulations</td>
</tr>
<tr>
<td>Butadiene</td>
<td>Biomass</td>
<td>Versalis (ENI – Italy)</td>
<td>2 step via butanediol</td>
</tr>
<tr>
<td></td>
<td>Waste gas CO</td>
<td>Invista/Lanza Tech</td>
<td></td>
</tr>
<tr>
<td>SEBS (H-SBC)</td>
<td>Oyster shells</td>
<td>CTS</td>
<td>Other renewable fillers</td>
</tr>
<tr>
<td>SEBS (H-SBC)</td>
<td>Starch/Hydrocarbon</td>
<td>CTS using Gaialene®/Roquette</td>
<td>Substitute for PP in formulations</td>
</tr>
<tr>
<td>Starch/TPE</td>
<td>Starch</td>
<td>Cereplast</td>
<td>30 – 50% starch</td>
</tr>
<tr>
<td>PP carbonate</td>
<td>(CO$_2$+ PP oxide copolymer)</td>
<td>Novomer</td>
<td>- 40% CO$_2$ by weight</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- PP substitute?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Clarity/O$_2$ barrier</td>
</tr>
</tbody>
</table>

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2012
### VALUE ADD TPE STRATEGIES

<table>
<thead>
<tr>
<th>TPE TYPE&lt;sup&gt;+&lt;/sup&gt;</th>
<th>+FABRICATION TECH</th>
<th>+COATINGS</th>
<th>+ FIRE RETARD</th>
<th>+ FOAMING</th>
<th>+ ADHESION</th>
</tr>
</thead>
<tbody>
<tr>
<td>s-TPV</td>
<td>2 shot (c)</td>
<td>Aero gels (a)</td>
<td>Non-hal</td>
<td>Core back</td>
<td>To ETPs</td>
</tr>
<tr>
<td>• High heat</td>
<td>• Core back (c)</td>
<td>• Slip coat (b)</td>
<td>• Low smoke</td>
<td>• MuCell</td>
<td>• To rubber</td>
</tr>
<tr>
<td>• Soft touch</td>
<td>• 3D blow (c)</td>
<td></td>
<td></td>
<td>• Dolphin</td>
<td></td>
</tr>
<tr>
<td>• Co-processing</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

(a) For example: polyimide aerogels. Adapted from space research (crosslinked, light weight, porous). Improve acoustics, thermal insulation

(b) Adjust COF, feel, systems cost save (e.g. in body/glazing seals)

(c) Offer systems cost savings

**SOURCE:** ROBERT ELLER ASSOCIATES LLC, 2012
SUMMARY

• TPE life cycle: maturing to commodity and specialty segments. Paths to value add

• Asia shift:
  - Decreased Western TPE demand
  - Large multinationals adapting to broader range of Asian quality/price tiers
  - China slowed GDP growth (auto growth remains high)
  - Re-shoring of TPE customer base to West (primarily starting in U.S.)

• TPE industry structure shifting in response to:
  - Maturing supply side (maturing of some TPE grades)
  - Low cost raw materials search (shale gas abundance in U.S., affect European competitiveness in EPDM and POEs?)
  - Global market shifts toward Asia (partially modulated by re-shoring to U.S.)

• TPE properties envelope expanding:
  - New applications in auto, health care, packaging, consumer
  - SBCs, most rapid properties expansion
  - Many opportunities for value add
  - Role for process/materials combinations
• Auto remains major global demand driver:
  - Recovery in U.S., severe auto recession in Europe
  - EPDM substitution (e.g. hose, body/glazing seals)
  - Interior skins/soft touch remain battleground
  - “Green” demands stimulate TPE substitution

• Global recession effects:
  - Decline of China exports → Europe, U.S. shifts to domestic markets
  - Some TPE raw material price declines

• Health care:
  - Fast growth TPE market
  - PVC replacement decisions (China and West)

• s-TPVs: Reaching for high performance specialty rubber markets

• Bio-TPEs: Momentum starting. Capable of competing in the marketplace
THANKS FOR YOUR ATTENTION

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