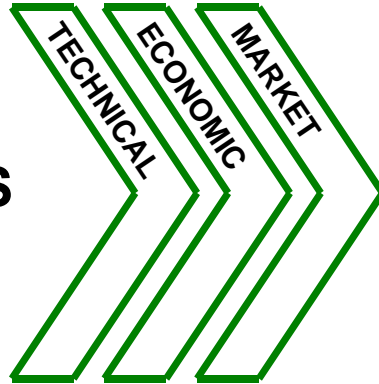

ANALYSIS



**Management
DECISIONS**

Robert Eller Associates LLC
CONSULTANTS TO THE PLASTICS AND RUBBER INDUSTRIES

AUTO INTERIOR TPOs: PROFITABLE POSITIONING IN A SHIFTING SUPPLY CHAIN

PRESENTED BY:

Bob Eller

Robert Eller Associates LLC

Phone: 330-670-9566

E-mail: bobeller@prodigy.net

www.robortellerassoc.com

PREPARED FOR:

SPE TPO 2007

DETROIT, MI

OCTOBER 8, 2007

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PRESENTATION OUTLINE



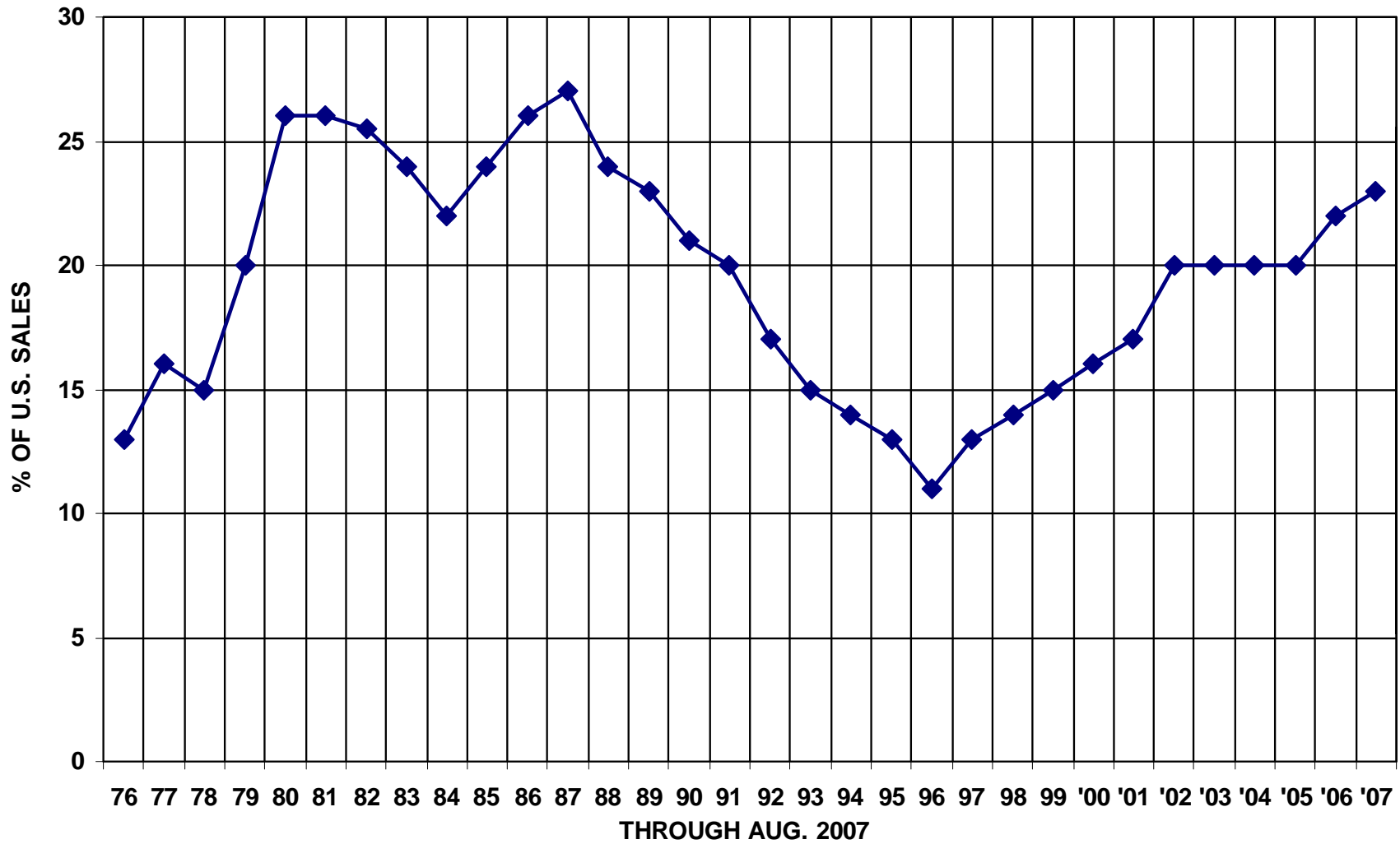
- **N. American auto marketplace/TPE effects**
- **Globalizing TPE marketplace**
- **Key TPE marketplace trends**
- **TPE industry structure shifts**
- **Expanding properties envelope**
- **New materials fabrication technologies**
- **Automotive supply chain implosion effects**
- **Talc effects**
- **Body/glazing seals**
- **The rubber attack**
- **Paths to profitability**

N. AMERICAN AUTO MARKET SHIFTS



- **Market shifts will affect TPE industry**
- **GM agreement:**
 - **Frees up capital for new model investment**
 - **Increases incentive for new technology invest.**
- **Dollar value decline (40% against euro)**
- **Increased investment in N. America by non-domestic supply chain**
- **Gain in foreign-produced vehicles**
- **Fleet composition shift (smaller B-Class & CUVs)**
- **The CAFE battle**
- **Vehicle sales stagnation/decline**
- **Low priced vehicles (\$2,500-9,000) from Tata, others entering global fleet**

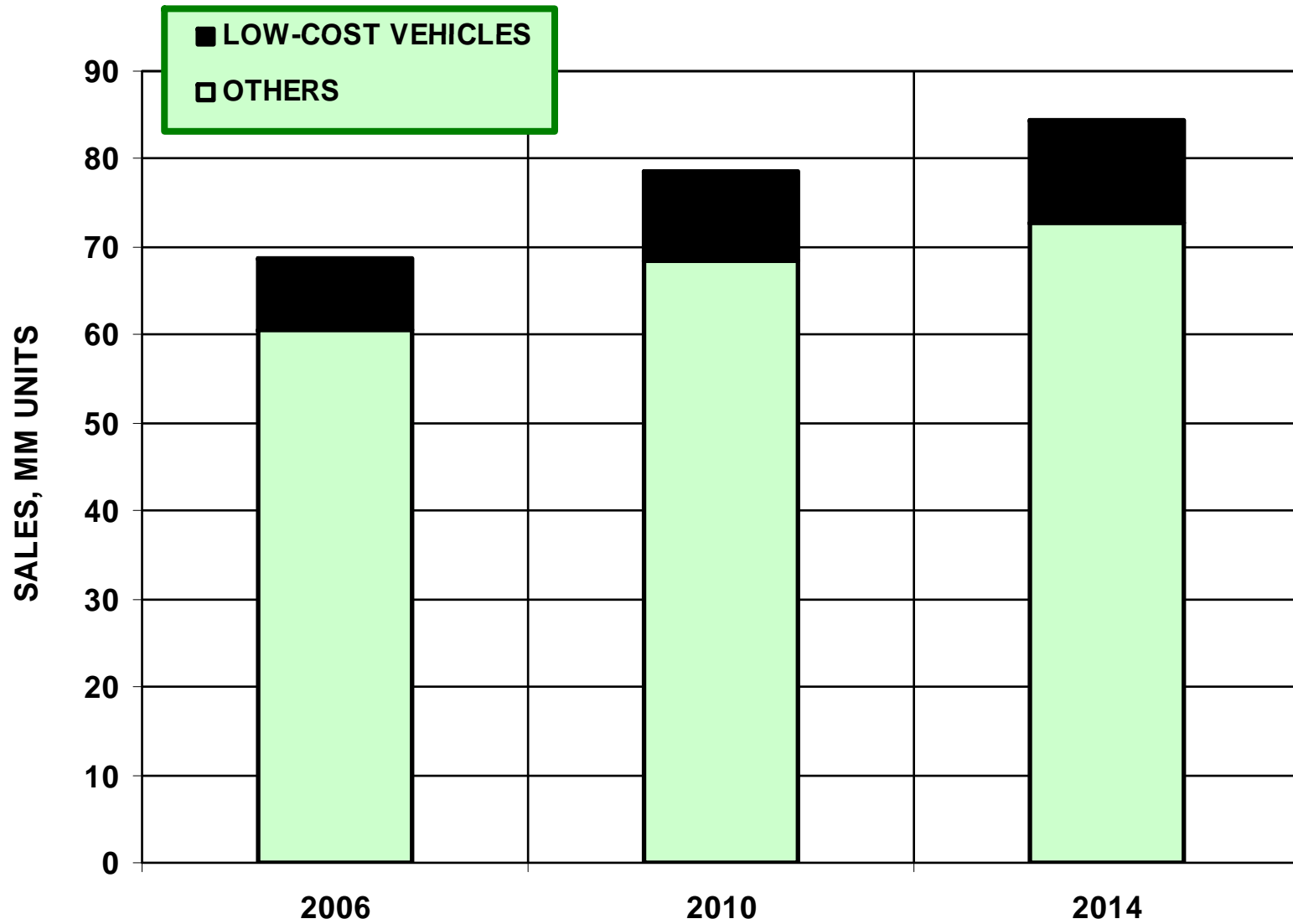
% OF CARS SOLD IN THE U.S., MANUFACTURED OUTSIDE OF N. AMERICA



SOURCE: MOODY'S ECONOMY.COM

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GROWTH OF LOW COST VEHICLES IN THE GLOBAL FLEET



SOURCE: ROBERT BOSCH GmbH

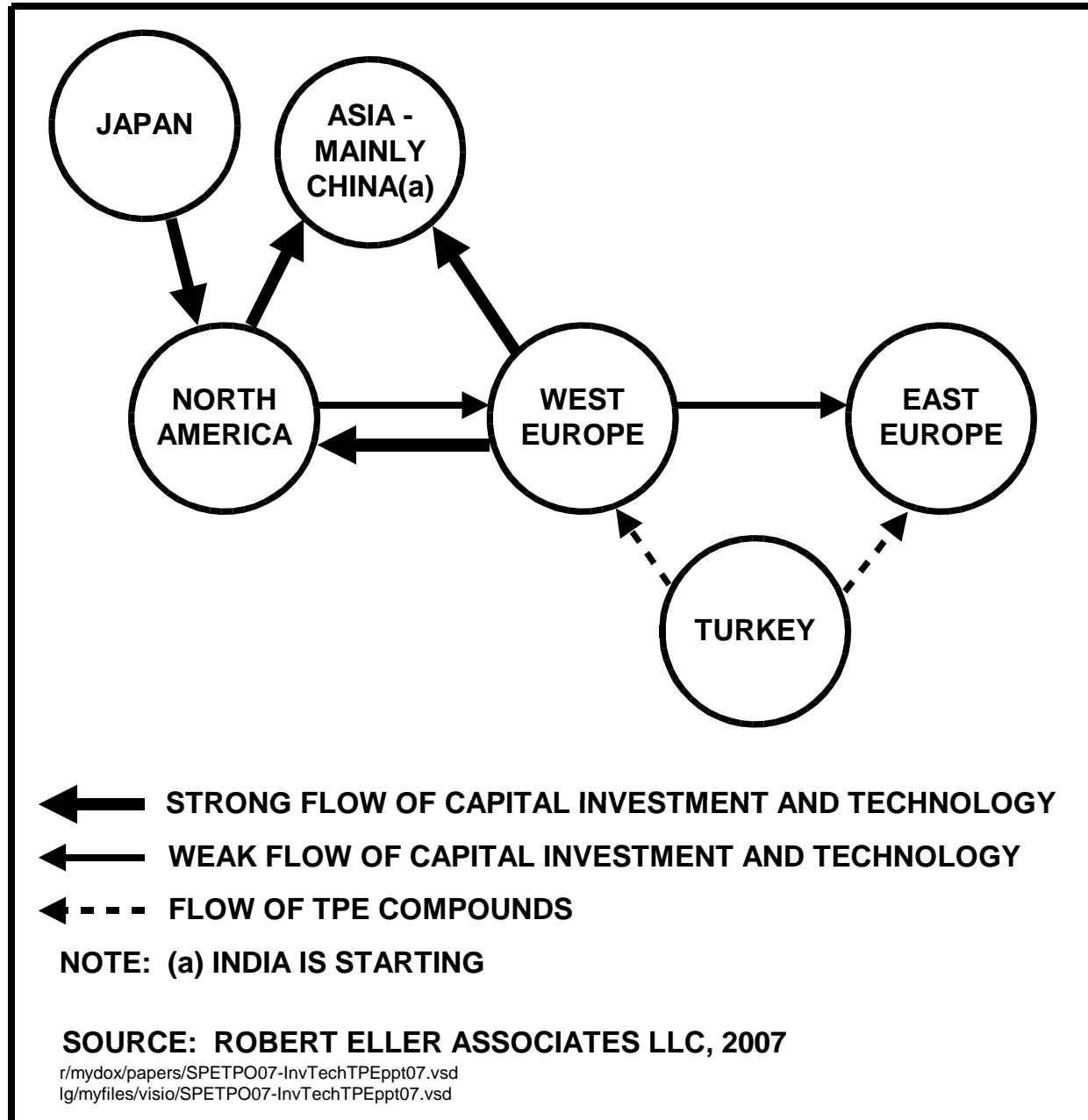
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GLOBALIZING TPE MARKETPLACE



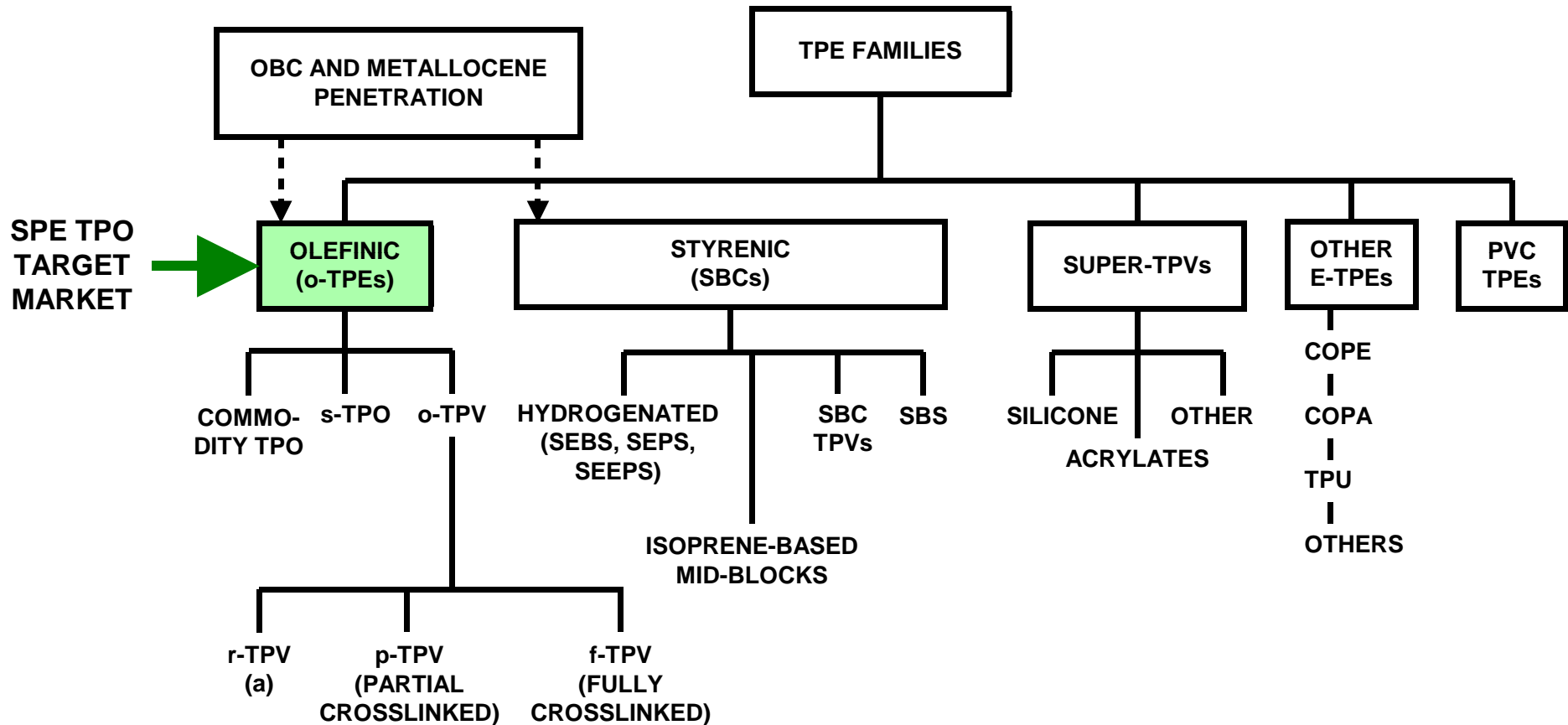
- **China: fastest vehicle production growth region.**
- **The TPE marketplace is rapidly globalizing.**
- **Most major TPE compounders have established Asia (China) operations.**
- **Investment and technology flows are following the globalization pattern of the TPE compounding industry.**
- **A new class of Asian TPE compounders is emerging (eventually global competitors?).**

GLOBAL INVESTMENT FOLLOWS THE TPE MKTS.



TPE FAMILIES . . .

CHANGING STRUCTURE, INCREASED INTRA-TPE COMPETITION



NOTE: (a) RECYCLATE-BASED TPV

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007

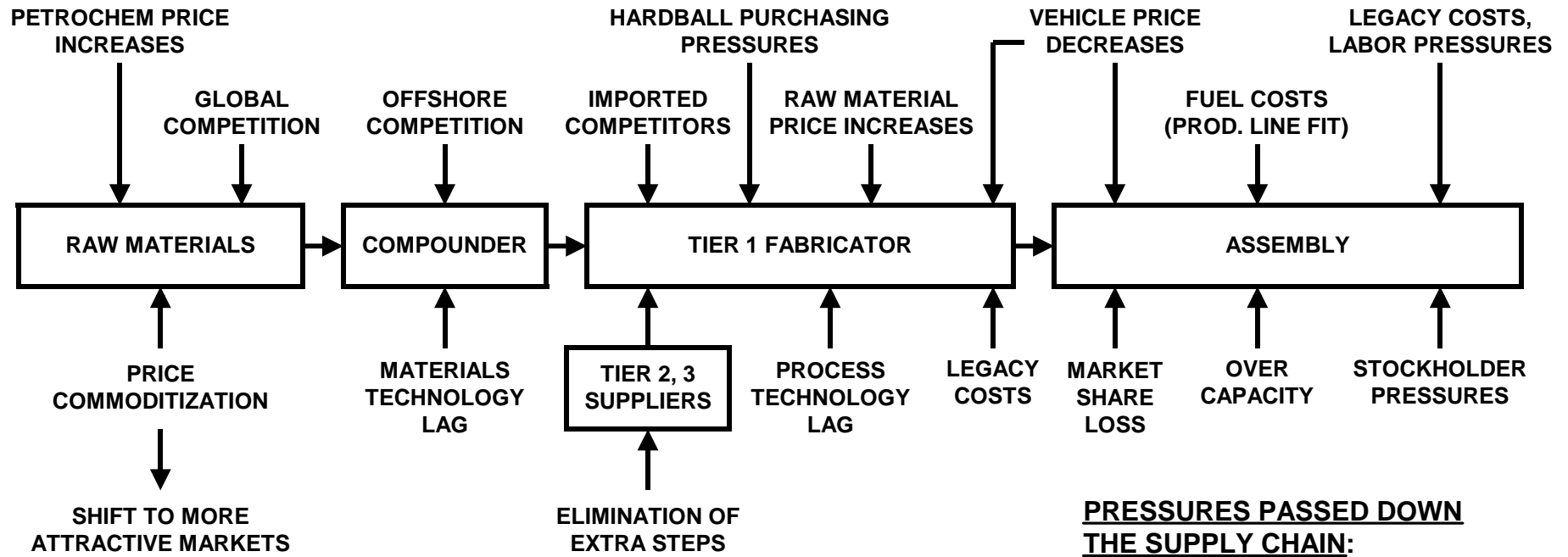
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A CHANGING TPE MARKETPLACE



- **Auto stagnation in Europe and N. America**
- **SEBS compounds challenging o-TPVs**
- **Entry of new polyolefin candidates**
- **New transparent grades (SEBS and TPO)**
- **Renewed o-TPV and some SEBS attack on rubber**
- **Price erosion continues (commodity vs. specialty pricing)**
- **An imploding auto supply chain**
- **Use of single TPEs for multiple applications**
- **Resin capacity shift to monomer-rich regions**

AUTOPLASTIC SUPPLY CHAIN IMPLOSION (N. AMERICA)



PRESSURES PASSED DOWN THE SUPPLY CHAIN:

- ← PRICING PRESSURES
- ← SUPPLY CHAIN "MANAGEMENT"
- ← DEMAND SLOWDOWN
- ← REVISED SPECIFICATIONS
- ← GLOBALIZATION PRESSURES

ELIMINATE/REDUCE:

- MULTIPLE STEPS (2-SHOT MOLD, NEG.-FORM)
- EXCESSIVE LOGISTICS
- SCRAP GENERATION
- INEFFICIENT PROCESS TECHNOLOGIES
- SALES/MARKETING COSTS
- EXCESS LABOR COSTS
- OVER-GLOBALIZATION?

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007

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TPE INDUSTRY STRUCTURE SHIFTS



- **Strengthening of Japanese resin companies in N. America**
- **Korean TPE suppliers challenging the incumbents? (Hyundai EP)**
- **Renewed growth of European compounders in N. America**
- **Resin suppliers riding a wave of new reactor technology (direct access to TPE markets)**
- **Tier 1s shifting to o-TPE compounding in-house?**
- **Enhanced role for masterbatch**

EXPANDING/SHIFTING PROPERTIES ENVELOPE



- **Inroads into SEBS markets by advanced olefin technologies**
- **Market share shift between TPEs**
 - **Reactor TPO**
 - **Improved metallo-plastomers**
 - **Dow's Infuse™ OBC**
- **POEs with high melt strength, broadened service temperature, low gloss**
- **POE/branched PPs**
 - **Compete with o-TPVs**
 - **Profiles/thermoforming**
 - **Enhanced foam properties**

INTRA-TPE COMPETITION: ROLE OF IMPROVED POLYOLEFIN TECHNOLOGY



- **Broad range of new PO technologies becoming avail.**
- **SEBS and TPO compound ingredients**
- **POE displacement of EPDM in TPOs almost complete**
- **Will stimulate transparent TPO, elastic fibers, elastic films**
- **Versatile molecular architecture control**
- **Still young technologies with broad growth pot'l., e.g.,:**
 - **Nano morphology control (clear TPOs, e.g., from Mitsui)**
 - **Long-chain branching control**
- **Direct sale to fabricators or compounders?:**
 - **Dow**
 - **ExxonMobil**
 - **Borealis**
 - **Mitsui Chemical**
 - **Sumitomo**
 - **JPP**

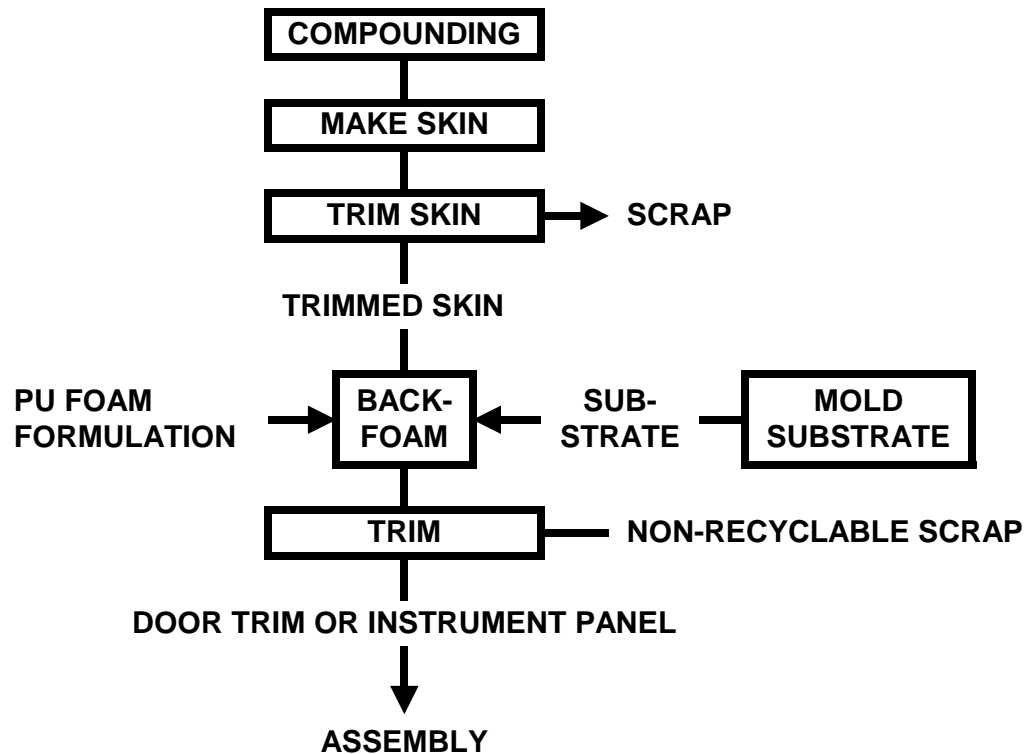
NEW MATERIALS/FABRICATION COMBINATIONS



- **Small part, 2-shot molding started**
- **Shift to large part, 2-shot molding**
 - **Competition with thermoformed skins**
 - **Evolving to 3-layer (skin/foam/substrate)**
 - **Shifts the supply chain**
- **Co-fabrication (blow, inject, profile extrude)**
- **Increased role for polyolefin foams**
 - **2-shot injection**
 - **Acoustics**
 - **Semi-structural applications**
 - **Role in all-PO constructions**

NEW TPE FABRICATION TECHNOLOGY: LARGE-PART, 2-SHOT MOLDING CHALLENGES SKINS

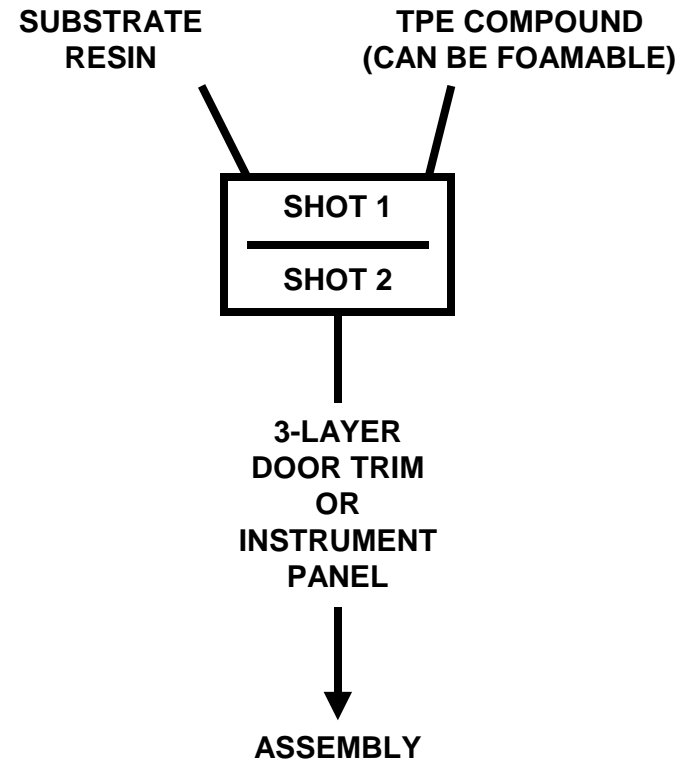
CURRENT PROCESS



- LABOR INTENSIVE
- HIGH SCRAP
- MULTI STEP
- MULTI MATERIAL
- NON-RECYCLABLE
- DIFFICULT CRAFTSMANSHIP

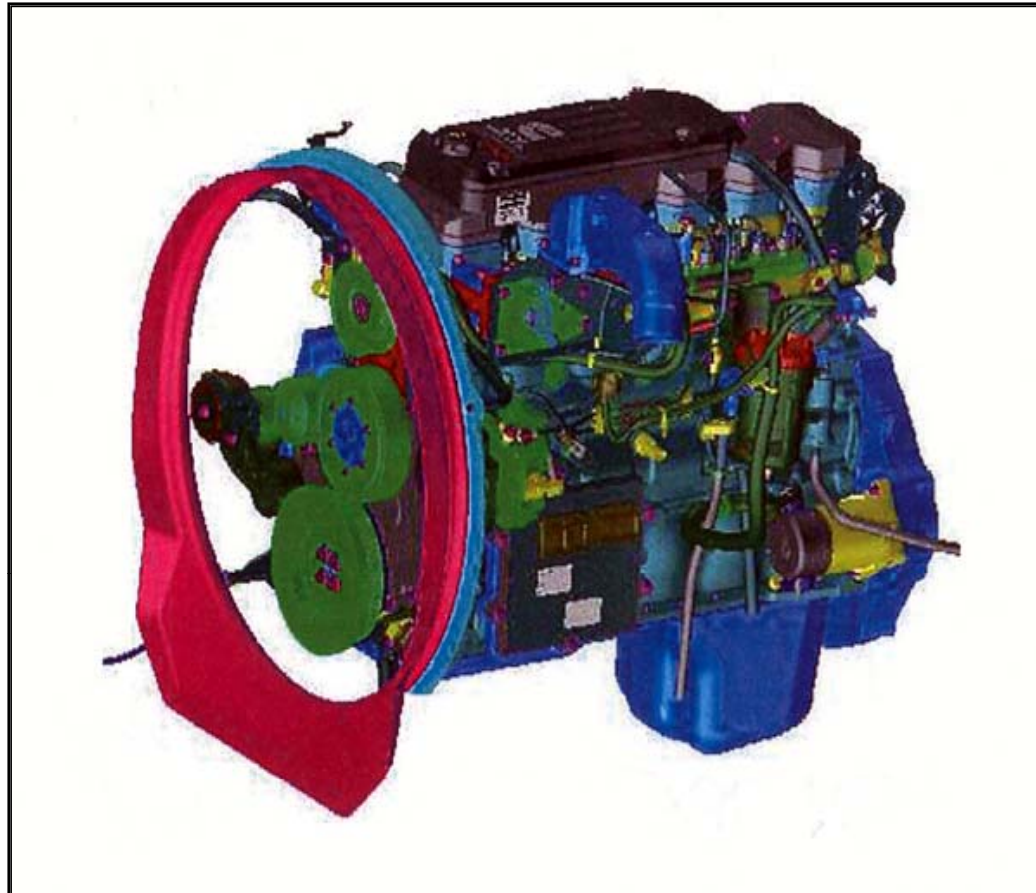
SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007

2-SHOT



- LOW LABOR
- LOW SCRAP
- SINGLE STEP
- 1-2 CLOSELY RELATED MATERIAL FAMILIES
- EASILY RECYCLED
- HIGH CRAFTSMANSHIP

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Product: Fan shroud

Manufacturer: Sur-Flo

Material Type: TPV (Nexprene)

TPE Supplier: Solvay Engineering Polymers

Note: Used in Dodge Ram HD pickup

2-Shot Molded Door Medallion



Vehicle: Dodge Caliber ('07)

Molder: Lear

Material: Thermoplastic Elastomer On PP

LARGE-PART, 2-SHOT, SOFT TOUCH DEVELOPMENT



Part: Instrument Panel Upper
Skin Compound: COPE (Foamed Pibiflex from P Group)
Substrate: PBT/ASA (Ultradur^R S4090IGX from BASF)
Injection Machine: Engel
Foam Technology: Trexel
SOURCE: ROBERT ELLER ASSOCIATES LLC

LARGE-PART, 2-SHOT, SOFT TOUCH: TRUCK IP UPPER



Part: Truck IP Upper
Status: Prototype
Skin Compound: COPE (foamed Pibiflex from P Group)
Substrate: PBT/ASA (Ultradur^R S4090IGX from BASF)
Molding machine: Engel Duo Series (for Dolphin process)
Tier 1: IAC
SOURCES: *POLYMOTIVE*; ROBERT ELLER ASSOCIATES LLC



Door Panel Filler: improved acoustics & water barrier
Photo: Alveo



2- color door trim skin on single natural fiber panel substrate

Vehicle: BMW 5 Series

Tier 1: Johnson Controls

Photo: BMW

TALC EFFECTS



- **New micro-talcs broaden the properties envelope**
- **Exterior and interior applications**
- **For exterior applications:**
 - **Europe ahead (front-end modules, hatchback)**
 - **Could accelerate exterior panel penetration**
- **Role for masterbatch?**



BMW X5 Front-end Module

Compound: 30% talc-filled TPO

Molder: Plastic Omnium

Filler Type: Jetfine® 3CA (Rio Tinto Minerals)

Key Features: Class A finish, zero gap, low temp. (-40°C) impact, weight save, high scratch resistance, meets European pedestrian safety requirements

SOURCES: PLASTIC OMNIUM; ROBERT ELLER ASSOCIATES LLC, 2007

BODY/GLAZING SEALS



- **Rapid growth**
- **High volume potential**
- **In-house compounding vs. merchant supply**
- **Evolution to in-line compounding?**
- **Systems will be key to TPE penetration**
- **Will be o-TPV vs. SEBS battleground**
- **2-shot molding opportunity**

BODY/GLAZING SEALS: EPDM SUBSTITUTION ACCELERATES



Vehicle: 2007 DCX Dodge Ram

Supplier: JYCO (compound, profile, design)

Material: o-TPV

- Little guy scoops the big guys

- First o-TPV dynamic body seal

SOURCE: JYCO

TPE/RUBBER SUBSTITUTION STATUS

APPLICATION	STATUS
BODY/GLAZING SEALS	<ul style="list-style-type: none"> - STARTED - WILL ACCELERATE - FOAMING REQUIRED?
HOSE	<ul style="list-style-type: none"> - NO SIGNIFICANT PENET. YET - REQUIRES PARADIGM SHIFT
TUBING	<ul style="list-style-type: none"> - o-TPV STARTING - TPU, SSBS WELL ADVANCED
BELTS	<ul style="list-style-type: none"> - UNLIKELY PENET. IN AUTO - MAJOR o-TPV, TPU TARGET
BOOTS/ BELLOWS/ DUCTING	<ul style="list-style-type: none"> - SUBSTANTIAL PENETRATION. - SHIFT TO HIGHER PERF. TPEs?
GROMMETS, BUMPERS, GASKETS	<ul style="list-style-type: none"> - MODERATE PENETRATION



Crank Case Ventilation Hose

TPE Grade Name: DuPont™ E-TPV

Material Type: s-TPV

Status: Concept

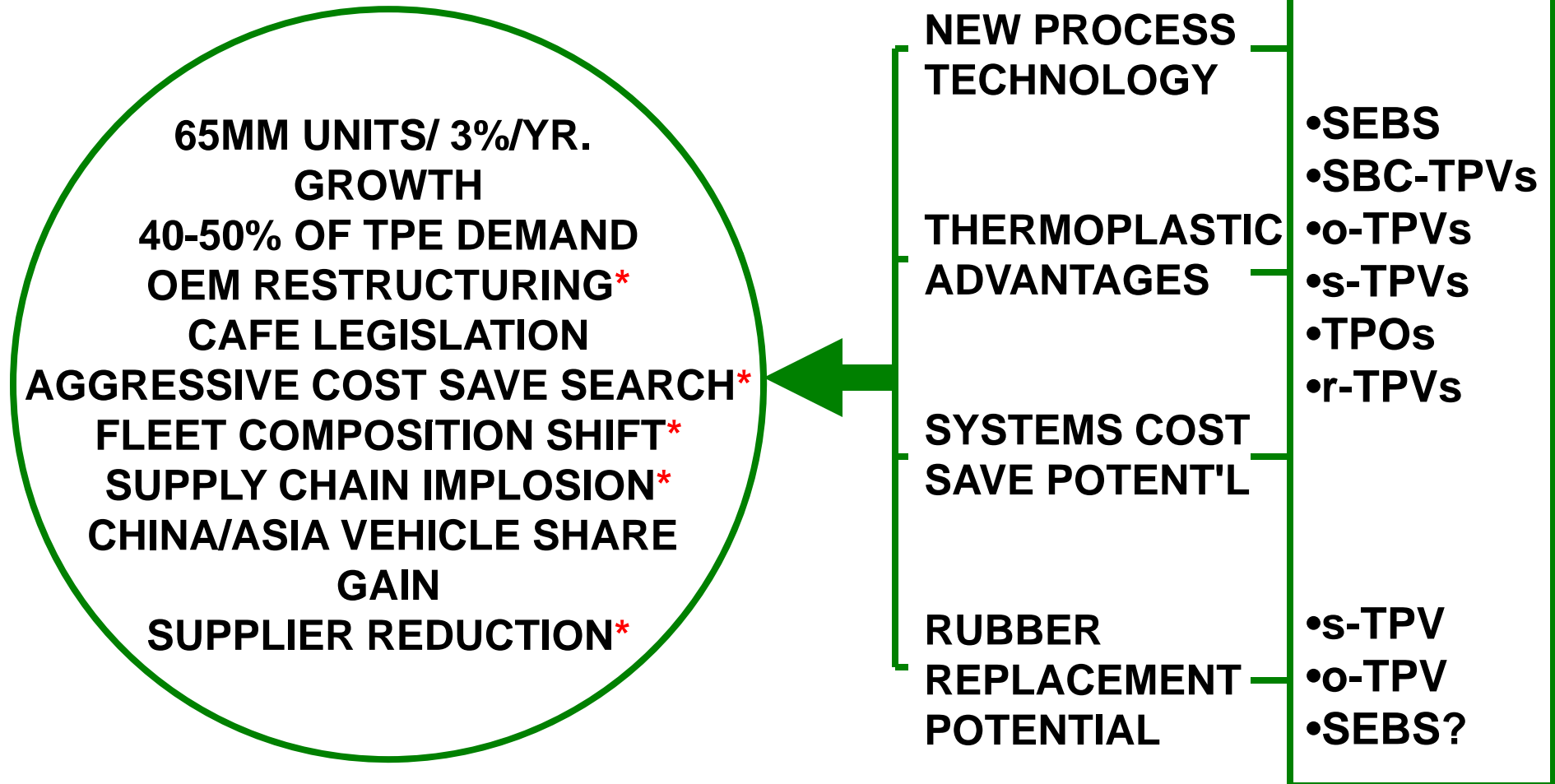
Process: Co-extrusion

Key Features: Blow-by gas resist.

AUTO DEMAND/ OPPORTUNITIES

ENABLERS

TPE CANDIDATE EXAMPLES



NOTE: * = STRONGEST IMPACT IN N. AMERICA

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007

SUMMARY



- **Fleet changes will impact N. American auto TPE industry structure**
- **2-shot molding:**
 - **Shift from small to large parts**
 - **Will become major TPE process**
 - **Shifts supply chain positions**
 - **SEBS, o-TPV, and TPO will compete**
- **The auto TPE supply chain is reconfigured**
- **Technology convergence (Europe/U.S./Asia?)**
- **TPEs positioned for renewed attack on rubber**

SUMMARY (Cont'd.)



- **Intensified intra-TPE competition**
- **Enhanced PO technology is shifting TPE competitive positions**
- **Enhanced role for talc**
- **Paths to profits:**
 - **Systems cost savings**
 - **Eliminating supply chain steps**
 - **Scrap reduction**
 - **Labor saving technology**
 - **Combine functions**
 - **Combine processes**
 - **Win global platform business**