



Robert Eller Associates, Inc.

CONSULTANTS TO THE PLASTICS AND RUBBER INDUSTRIES

INTRA-TPE COMPETITION IN AN EXPANDING GLOBAL MARKET

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HIGHLIGHTS

- **NEW TPE FAMILIES**
- **POTENTIAL ROLE FOR NANO FILLERS**
- **NEW SUPER-TPV TECHNOLOGIES**
- **DRIVING FORCES FOR AUTOMOTIVE TPE GROWTH**
- **SHIFT IN THE PATH TO MARKETS**
- **GLOBAL PRICE AND SOURCING PRESSURES**
- **CURRENT AND POTENTIAL ROLE OF CHINA IN THE TPE MARKETPLACE**

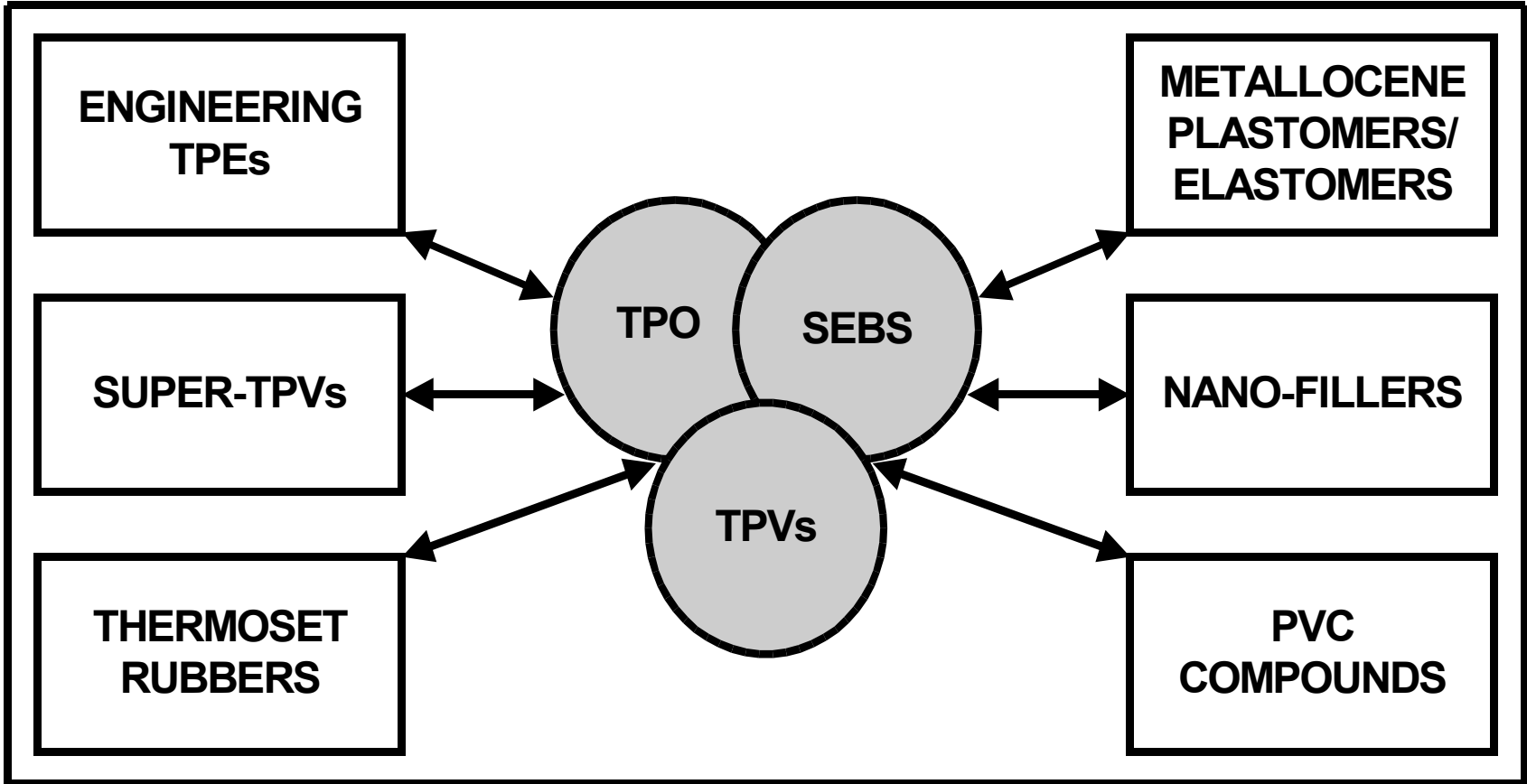
PRESENTATION BASIS

REA MULTICLIENT STUDIES:

- **TPE II IN EUROPE/N.AMERICA**
- **AUTO INTERIOR SOFT TRIM**
- **AUTOMOTIVE NONWOVENS**

OPERATING HYPOTHESES

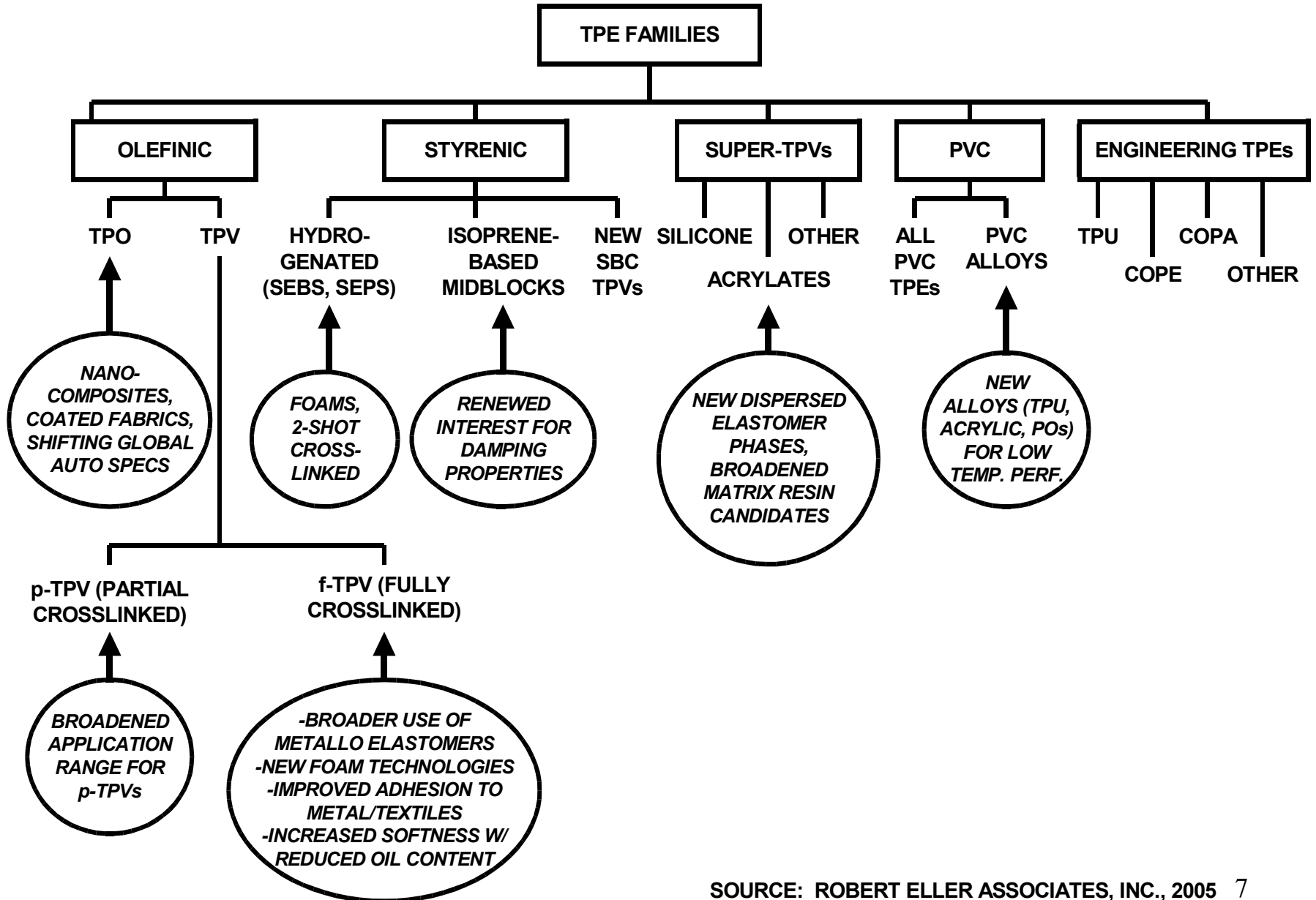
- **TPE DEMAND IS GROWING.**
- **TPE PROPERTIES RANGE INCREASING.**
- **PROCESS TECHNOLOGIES ARE OPENING NEW APPLICATIONS.**
- **TPE PENETRATION INTO RUBBER APPLICATIONS POISED TO PROVIDE SUBSTANTIAL TPE DEMAND INCREASES.**
- **GLOBAL ECONOMIC PRESSURES RESHAPING MARKET AND PATHS TO MARKET.**
- **SEBS AND TPV CHALLENGED BY:**
 - **PLASTOMERS & PVC IN LOW END MARKETS**
 - **TPU IN HIGH END MARKETS**



NEW TPE FAMILIES

- **ACRYLIC, NITRILE, AND SILICONE BASED SUPER TPVs**
- **SBC-BASED TPVs IN WHICH SEBS IS CROSSLINKED TO IMPROVE HEAT AND CHEMICAL RESISTANCE AND COMPRESSION SET PROPERTIES**
- **TPU AND SEBS-TYPE TPE ALLOYS**
- **NANO-TPOs AND TPVs**

EXHIBIT 1: THE TPEs -- NEW FAMILY MEMBERS/BROADENED PERFORMANCE ENVELOPE



POTENTIAL IMPLICATIONS OF NANO-MATERIAL FILLERS

- **SOME N. AMERICAN PENETRATION OF NANO-CLAYS IN TPO**
- **CAN PREVENT DAMAGE TO THE COMPOSITE MORPHOLOGY THAT RESULTS FROM CONVENTIONAL-SIZED FILLER**
- **BENEFITS OF LOWER VOLUMETRIC COSTS, EASIER PROCESSABILITY, REDUCED SCRAP RATE, AND THIN WALL MOLDING CAPABILITY**
- **IMPROVED SCRATCH/MAR RESISTANCE**
- **LOWER CLTE, BETTER DIMENSIONAL TOLERANCE**

POTENTIAL IMPLICATIONS OF NANO-MATERIAL FILLERS (CONT'D)

- **PENETRATION INTO N. AMERICAN AUTO FLEET IN BODY SIDE MOLDINGS, STEP ASSISTS, EXTERIOR COMPONENTS**
- **CLAY IS DOMINANT INCUMBENT NANO-MATERIAL**
- **NANO-TALC IS POTENTIAL COMPETITOR**

NEW SUPER-TPV TECHNOLOGIES

- **SILICONE-BASED S-TPVs**
- **ACRYLIC ELASTOMER-BASED SUPER-TPVs**
- **STYRENIC ELASTOMERS**

EXHIBIT 2: THE SUPER-TPV CANDIDATES

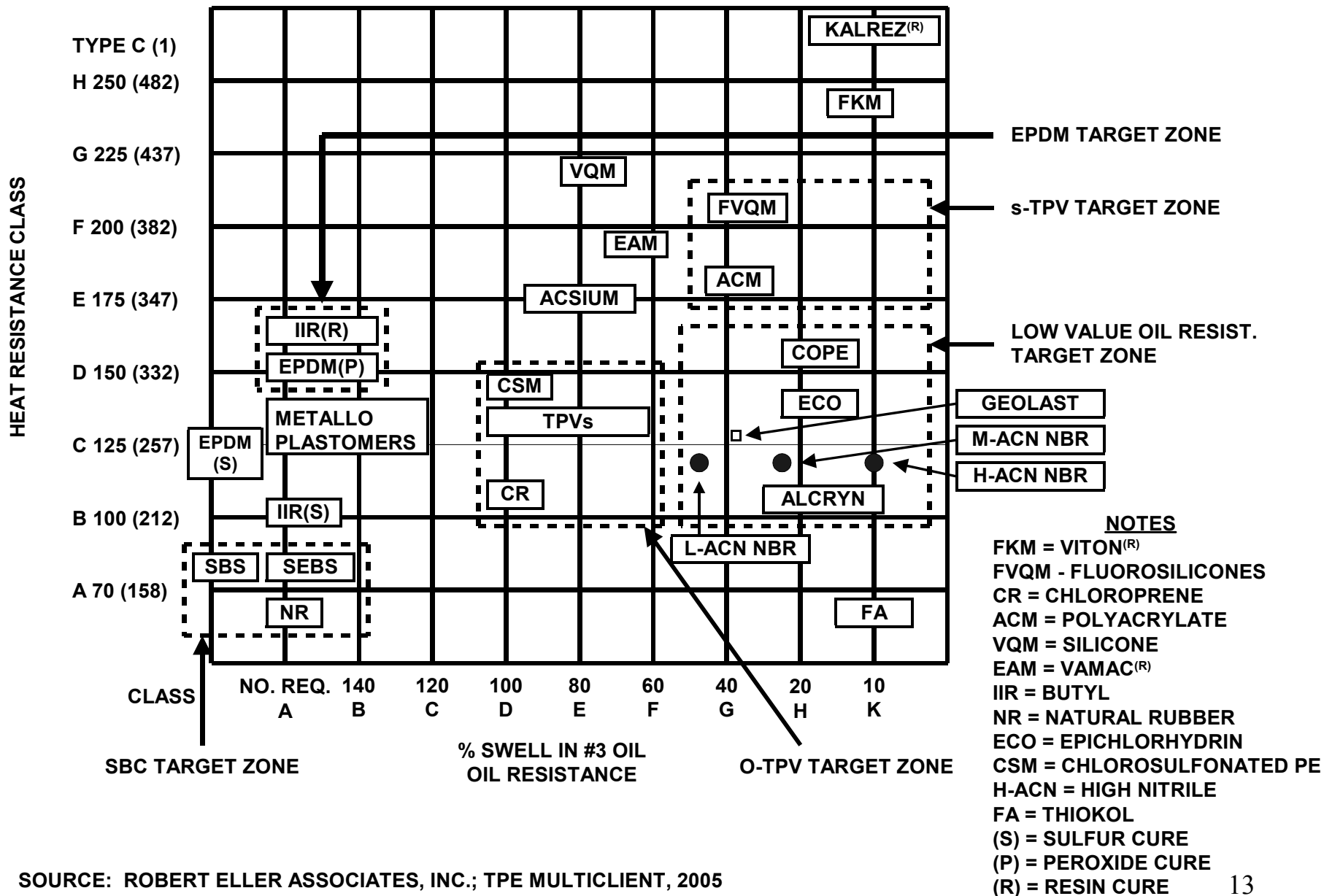
GRADE NAME	ELASTOMER TYPE	MATRIX RESIN(S)	SUPPLIER
TPSiV	SILICONE	PA, TPU	DOW CORNING
	SILICONE	SEVERAL	WACKER
ZEOTHERM	POLYACRYLATE (ACM)	PP, PA, POLYESTER	ZEON
E-TPV	ETHYLENE ACRYLATE (AEM)	COPE	DUPONT
FLUOROPRENE	FLUOROELASTOMER	FLUROPOLYMER	FREUDENBERG-NOK

NEW SUPER-TPV TECHNOLOGIES (CONT'D)

THE DRIVING FORCES FOR TPE SUBSTITUTION INCLUDE:

- **INCREASED UNDER-HOOD TEMPERATURES**
- **INCREASED FUEL EMISSIONS CONTROL REGULATIONS**
- **INCREASED REQUIREMENTS FOR DYNAMIC SEAL PERFORMANCE AS WARRANTY PERIODS ARE EXTENDED**
- **POTENTIAL COST SAVINGS VIA INTEGRATION OF THE CONNECTOR FUNCTION WITH THE BODY OF THE PART**

EXHIBIT 3: OIL RESISTANCE/HEAT RESISTANCE OF TPEs AND THERMOSET RUBBERS



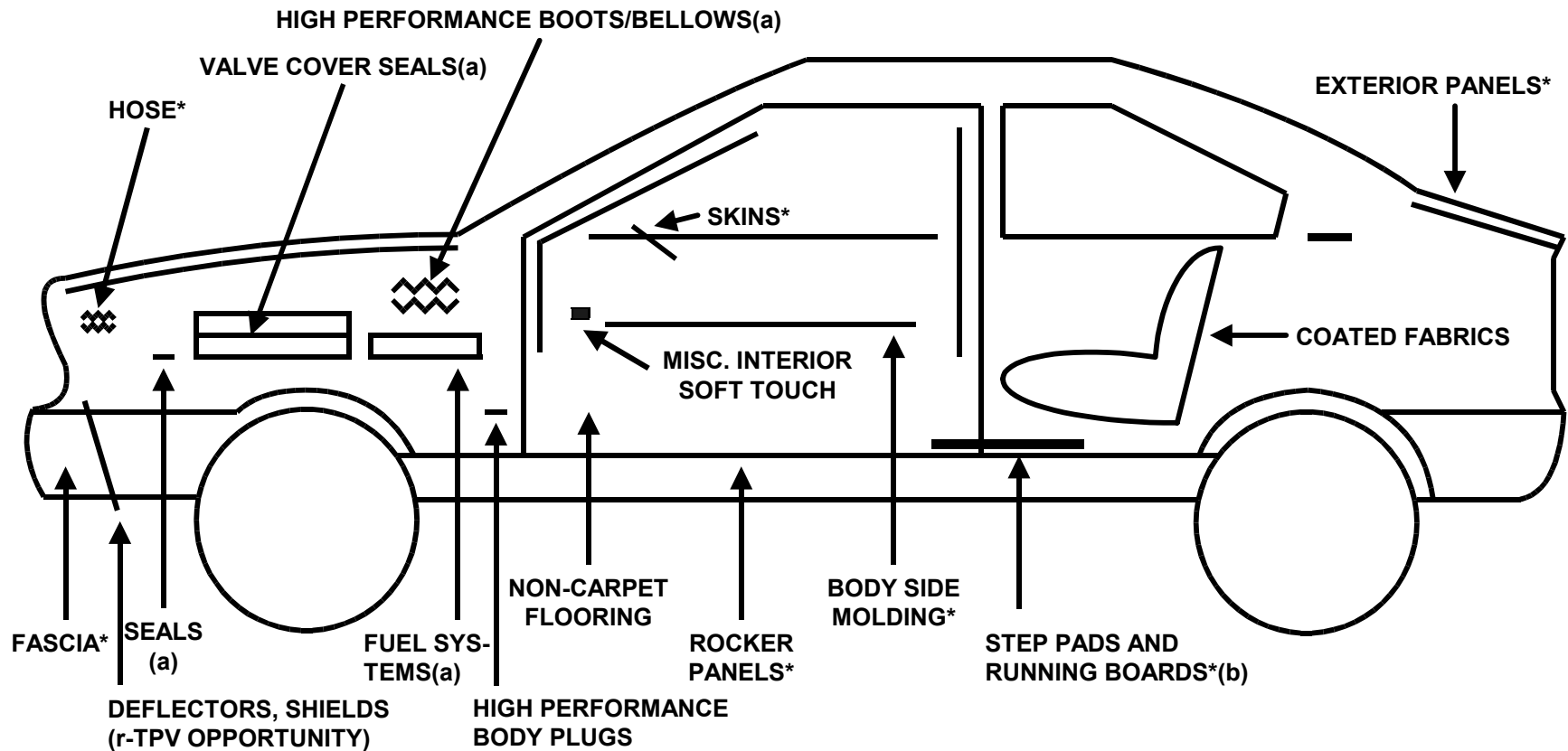
SOURCE: ROBERT ELLER ASSOCIATES, INC.; TPE MULTICLIENT, 2005

NEW SUPER-TPV TECHNOLOGIES (CONT'D)

SOME TARGET AUTOMOTIVE APPLICATIONS FOR THE s-TPVs INCLUDE:

- **CVJ BOOTS**
- **SPARK PLUGS BOOTS**
- **BRAKE AND FUEL HOSE**
- **FUEL VENT HOSE**
- **HIGH TEMPERATURE DUCTING**
- **HIGH PERFORMANCE BODY PLUGS, ELECTRICAL CONDUCTORS AND ELECTRICAL INSULATION**
- **SOFT TOUCH INTERIORS**
- **IGNITION SEALS AND COILS**
- **TUBING IN HIGH TEMPERATURE OR OIL RESISTANT APPLICATIONS**

EXHIBIT 5: EXAMPLE APPLICATIONS FOR RECENTLY DEVELOPED TPEs



NOTES:

-DOES NOT SHOW BODY/GLAZING SEALS, A CONTINUING GROWTH OPPORTUNITY

* INDICATES NANO-TPE OPPORTUNITY

(a) s-TPV TARGET

(b) NOTE COMPETITION WITH LGF-PP

SOURCE: ROBERT ELLER ASSOCIATES, INC., 2005

DRIVING FORCES FOR AUTOMOTIVE TPE GROWTH

- **AUTOMOTIVE ACCOUNTS FOR 40-50% OF DEMAND FOR TPEs**
- **MATERIALS TECHNOLOGY DRIVER**
- **MAJOR CONCENTRATION OF HIGH VOLUME RUBBER APPLICATIONS**
- **PRICE REDUCTION PRESSURES HAVE INTENSIFIED AS RESULT OF GLOBAL SOURCING**
- **VALUE ADDED OPPORTUNITIES**

EXHIBIT 4: TPE GROWTH/VALUE OPPORTUNITIES FROM SHIFTING AUTOMOTIVE REQUIREMENTS

AUTOMOTIVE REQUIREMENT	TPE GROWTH/VALUE OPPORTUNITY
WEIGHT SAVINGS	<ul style="list-style-type: none"> - FOAMING OF SEBS - RAPID GROWTH OF NANO-TPOs
SYSTEMS COST SAVINGS	<ul style="list-style-type: none"> - RIGID/FLEXIBLE COMBINATIONS - TPV AND SEBS BODY SEALS - TWO-SHOT MOLDING OF LARGE PARTS
IMPROVED FIT/FINISH	<ul style="list-style-type: none"> - LOW CLTE NANO TPEs - PROCESS CRAFTSMANSHIP SOLUTIONS
ZERO-GAP (EXTERIOR/INTERIOR)	<ul style="list-style-type: none"> - FAVORS NANO-TPOs
SOFT TOUCH	<ul style="list-style-type: none"> - TWO-SHOT MOLDING (LARGE PARTS)
IMPROVED SCRATCH/MAR RESIST.	<ul style="list-style-type: none"> - NANO-TPOs

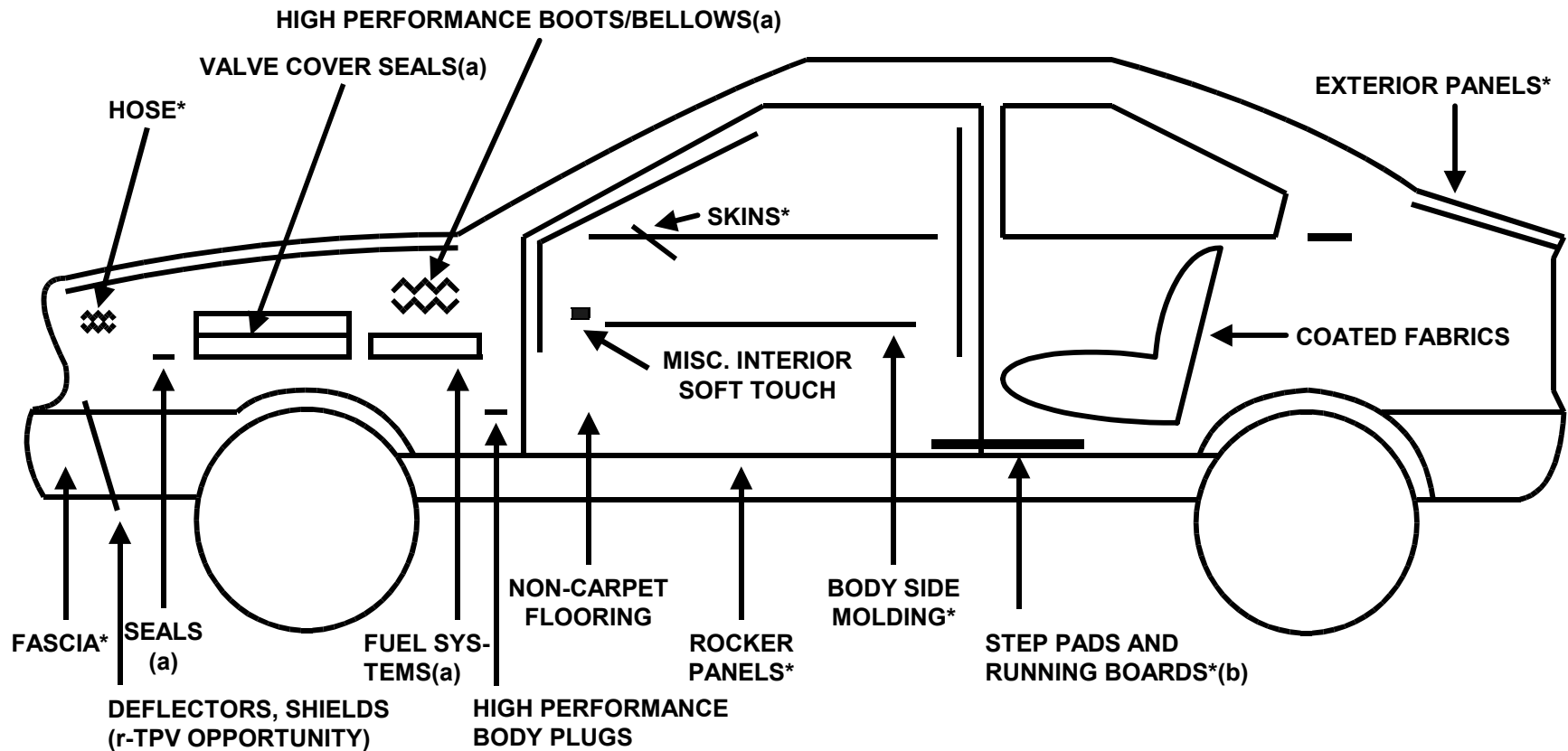
EXHIBIT 4: TPE GROWTH/VALUE OPPORTUNITIES FROM SHIFTING AUTOMOTIVE REQUIREMENTS (CONT'D)

AUTOMOTIVE REQUIREMENT	TPE GROWTH/VALUE OPPORTUNITY
LOW GLOSS INTERIORS FOR “EUROPEAN LOOK”	<ul style="list-style-type: none"> - A TPE BENEFIT FOR SEBS - NEGATIVE FOR NANO-TPOs
REDUCED FUEL VAPOR LOSS	<ul style="list-style-type: none"> - GROWTH OF NANO-TPES? - s-TPVs
OIL RESISTANCE	<ul style="list-style-type: none"> - STRONG GROWTH FOR SOME s-TPVs
INVISIBLE AIRBAG DOORS	<ul style="list-style-type: none"> - MAJOR DRIVER FOR p-TPV SKINS
ODOR-FREE INTERIORS	<ul style="list-style-type: none"> -PLASTICIZER REDUCTION -SUBSTITUTE OLEFINS FOR OTHER FAMILIES
COATINGS ELIMINATION	<ul style="list-style-type: none"> -IMPROVED SCRATCH/MAR TPO AND TPV GRADES -IN-MOLD DECORATION -INCREASED CO-EXTRUSION

EXHIBIT 4: TPE GROWTH/VALUE OPPORTUNITIES FROM SHIFTING AUTOMOTIVE REQUIREMENTS (CONT'D)

AUTOMOTIVE REQUIREMENT	TPE GROWTH/VALUE OPPORTUNITY
MOLDED-IN COLOR	<ul style="list-style-type: none"> -TPEs WITH IMPROVED COLOR CONTROL -LOWER FILLER LEVELS
IMPROVED NOISE, VIBRATION, HARSHNESS CONTROL	<ul style="list-style-type: none"> -TPEs WITH INTEGRAL FOAM LAYERS -ISOPRENE-BASED GRADES
ACOUSTIC PERFORMANCE	<ul style="list-style-type: none"> -ISOPRENE-BASED GRADES -CONTROLLED DENSITY FOAMS -ELIMINATION OF HEAVY LAYER CONSTRUCTIONS
ENERGY ABSORPTION (OCCUPANT SAFETY)	<ul style="list-style-type: none"> -ON-BOARD FOAM CONSTRUCTIONS
RECYCLABILITY	<ul style="list-style-type: none"> -o-TPE ROLE IN ALL-POLYOLEFIN CONSTRUCTIONS -RE-INTRODUCTION OF TPO SLUSH SKINS

EXHIBIT 5: EXAMPLE APPLICATIONS FOR RECENTLY DEVELOPED TPEs



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SOURCE: ROBERT ELLER ASSOCIATES, INC., 2005

NON-AUTOMOTIVE MARKETS

THE MOVEMENT OF SOME NON-AUTOMOTIVE MARKETS TO ASIAN MANUFACTURING IS:

- **SHIFTING THE GEOGRAPHIC DEMAND PATTERN FOR TPEs**
- **BRINGING NEW BASE RESIN SUPPLIERS INTO THE MARKET**
- **INTRODUCING NEW COMPOUNDERS INTO TPE COMPETITION**
- **STRENGTHENING THE POSITION OF JAPANESE TPE SUPPLIERS IN ASIAN MARKETS**

CONCLUSION

THE TPE MARKET IS POISED FOR RAPID EXPANSION, GEOGRAPHIC SHIFT, SUPPLIER/CUSTOMER RELATIONSHIPS, AND OWNERSHIP SHIFTS AS:

- **SUPER-TPVs PENETRATE HIGH PERFORMANCE RUBBER SECTORS**
- **NANO-TPOs BROADEN THEIR PENETRATION OF BOTH EXTERIOR AND INTERIOR TRIM APPLICATIONS**
- **TPVs ENTER THE REINFORCED RUBBER BELTING AND DUCTING SECTORS VIA NEW BONDING TECHNOLOGIES**
- **BOTH TPVs AND SEBS COMPOUNDS PENETRATE THE AUTOMOTIVE BODY/GLAZING SEAL SECTORS VIA IMPROVED FOAMING METHODS AND BETTER DYNAMIC PERFORMANCE**

CONCLUSION (CONT'D)

- **TPEs BROADEN THEIR APPLICATIONS RANGE IN COATED FABRICS AND INTERIOR SOFT TOUCH APPLICATIONS**
- **COMMODITY, APPLIANCE, SPORTS/LEISURE SUPPLIERS ENTER THE TPE MARKET**
- **NEW ASIAN COMPOUNDERS AND BASE RESIN SUPPLIERS ENTER THE TPE MARKET**
- **PRIVATE EQUITY GROUPS CONTINUE ENTRY INTO THE TPE SECTOR**



Manufacturer: Black and Decker

TPE Type: SEBS

Bond Type: Chemical

Manufacturer Location: China



Manufacturer: Gillette
Product Name: Mach 3, Grip
TPE Type: SEBS
Bond Type: Physical
Manufacturer Location: China
Note: Grip and head with different TPEs

Manufacturer: Gillette
Product Name: Venus 3
TPE Type: SEBS
Bond Type: Chemical
Manufacturer Location: Poland



Manufacturer: P&G

Product Name: Pantene

Note: TPEs expensive vs. incumbents. Plastomers entering competition with EVA cap liners



Manufacturer: Moen

Product: Faucet Mounting Plate

TPE Type: TPV

Bond Type: Physical

Manufacturer Location: USA

Note: 2-Shot Nylon-Bonding TPV.



Manufacturer: Stanley

TPE Type: SEBS

Bond Type: Chemical

Manufacturer Location: China

Note: Two color



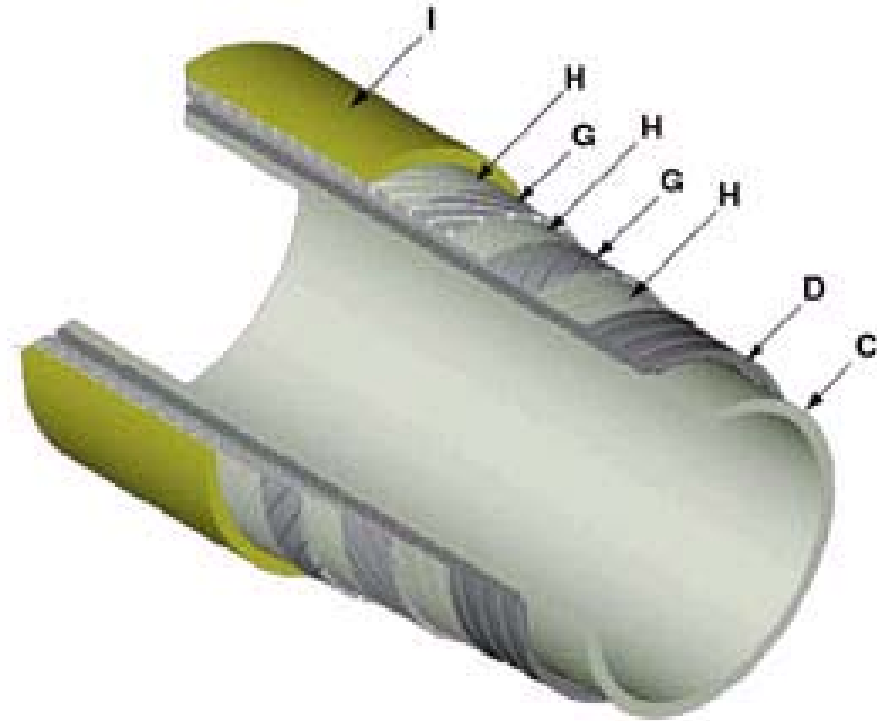
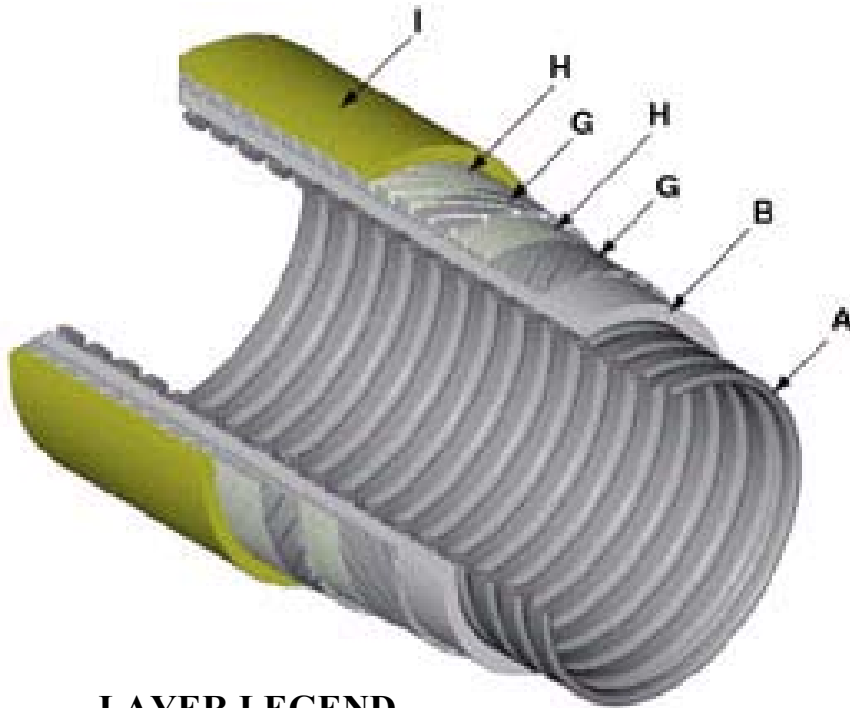
Manufacturer: Valeo

TPV Type: TPV

Manufacturer Location: Europe

Note: Example of boots/bellows and EPDM replacement.

EXAMPLE TPV USAGE IN FLEXIBLE PIPE



LAYER LEGEND

- A FLEXBODY – INTERLOCKING METAL CARCASS
- B FLEXBARRIER – POLYMER FLUID BARRIER (PVDF)
- C FLEXLINER – POLYMER FLUID BARRIER (PVDF)
- D FLEXLOK – STEEL HOOP STRENGTH LAYER
- G FLEXTENSILE – HELICAL STEEL ARMORS
- H FLEXTAPE – POLYMER TAPE LAYER (PP TAPE)
- I FLEXSHIELD – EXTRUDED POLYMER LAYER (TPV, DYMANIC ONLY; PE, STATIC ONLY)

SOURCE: WELLSTREAM, ROBERT ELLER ASSOCIATES, INC.



Manufacturer: Tupperware

Product Type:

TPE Type: SEBS

Note: Sold in Europe



Product Type: Jeep rear tailgate seal

Note: Sponge w/dense EPDM