



Robert Eller Associates, Inc.

CONSULTANTS TO THE PLASTICS AND RUBBER INDUSTRIES

NEW ADDED VALUE AUTO INTERIOR MATERIALS AND PROCESS TECHNOLOGIES...IMPLICATIONS FOR ASIA SUPPLIERS

BY: ROGER K. YOUNG AND ROBERT ELLER

PRESENTED BY:

Roger Young

Vice President-Asia

Robert Eller Associates, Inc

Ph: 64 21 725 745

rogeryoung@robertellerassoc.com

www.robertellerassoc.com

PREPARED FOR:

PLASTICS IN AUTOMOTIVE

APPLICATIONS 2006

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HIGHLIGHTS

- **INTRA-TPE AND INTERMATERIALS COMPETITION**
- **NEW SUPER-TPV TECHNOLOGIES**
- **IMPLICATIONS OF DEMAND SHIFT FROM WEST TO EAST**
- **INDUSTRY STRUCTURE CHANGES**
- **CURRENT AND POTENTIAL ROLE OF CHINA IN THE GLOBAL TPE MARKETPLACE**
- **DRIVERS FOR TPE DEMAND GROWTH IN ASIA**



PRESENTATION BASIS

REA MULTICLIENT STUDIES:

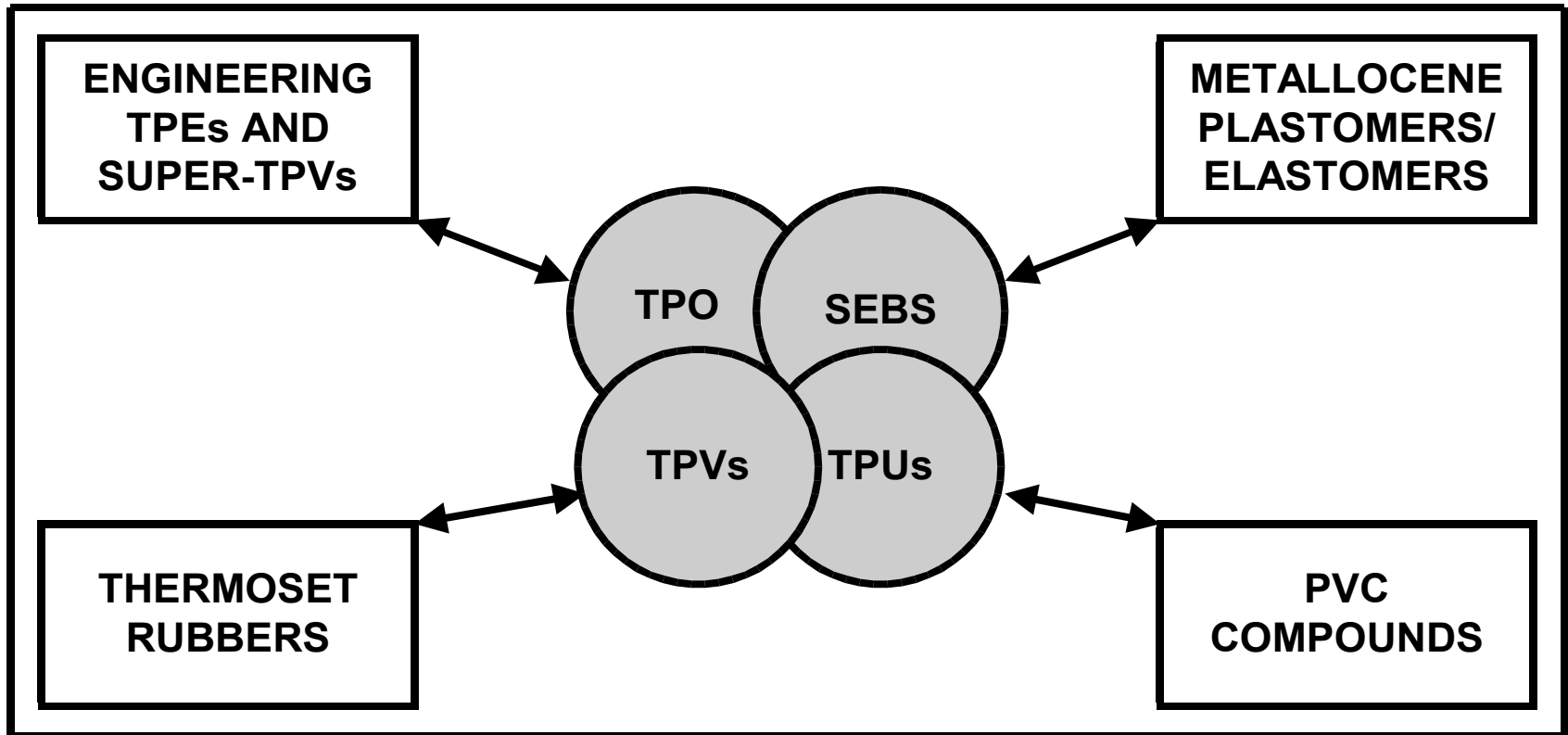
- **TPE II IN EUROPE/N.AMERICA**
- **TPEs IN CHINA**
- **AUTO INTERIOR SOFT TRIM**
- **AUTOMOTIVE NONWOVENS**



OPERATING HYPOTHESES

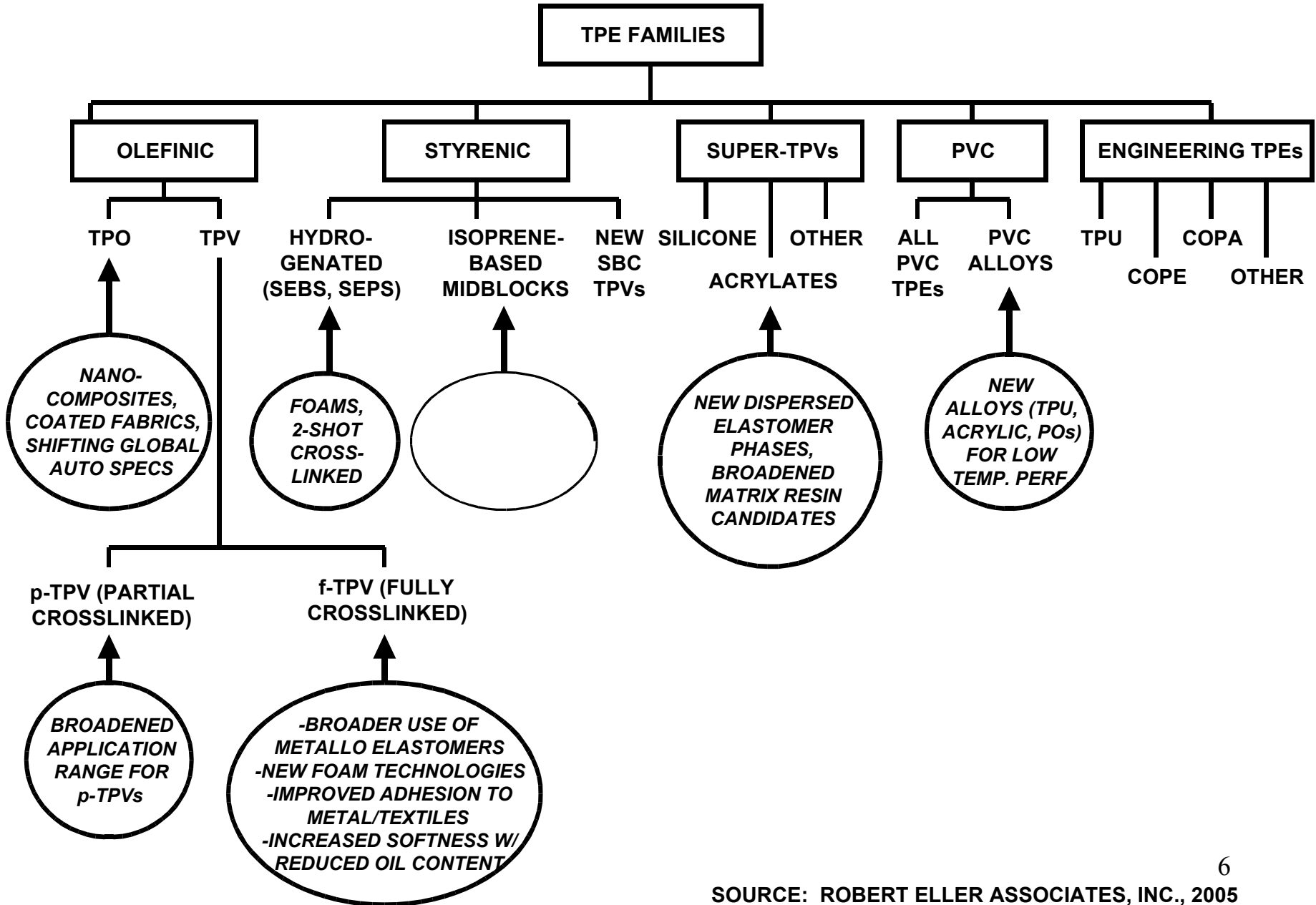
- **GLOBAL TPE DEMAND IS GROWING.**
- **TPE PROPERTIES RANGE INCREASING.**
- **PROCESS TECHNOLOGIES OPEN NEW APPLICATIONS.**
- **TPE PENETRATION INTO RUBBER APPLICATIONS POISED TO PROVIDE SUBSTANTIAL TPE DEMAND INCREASES.**
- **GLOBAL ECONOMIC PRESSURES RESHAPING MARKET AND PATHS TO MARKET.**
- **SEBS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

Specialty Thermoplastic Elastomers . . . Markets, Economics, Intermaterials Competition, and Industry Structure in China

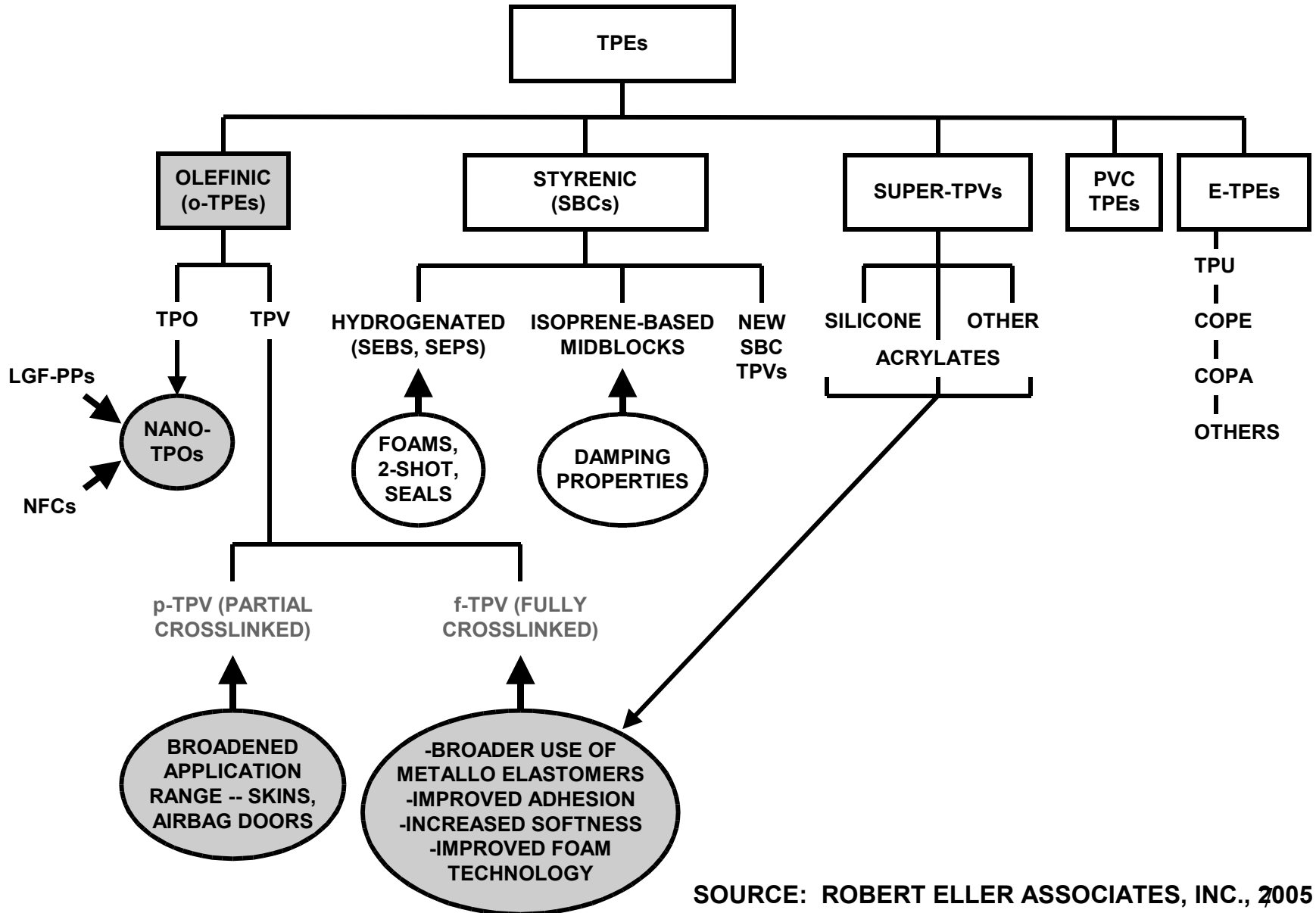


Prospectus for a Multiclient Analysis

THE TPEs -- NEW FAMILY MEMBERS/BROADENED PERFORMANCE ENVELOPE



NEW TPE COMPETITORS, TECHNOLOGIES, AND TARGETS



SOURCE: ROBERT ELLER ASSOCIATES, INC., 2005

NEW TPE FAMILIES

- **ACRYLIC, SILICONE, FLUOROPOLYMER BASED SUPER TPV DRIVING FORCES**
 - UNDER HOOD TEMP INCREASE
 - NEW FUEL EMISSIONS REG'S
 - DYNAMIC SEAL PERFORMANCE
 - COST SAVINGS
- **SBC-BASED TPVs IN WHICH SBC IS CROSSLINKED TO IMPROVE HEAT AND CHEMICAL RESISTANCE AND COMPRESSION SET PROPERTIES**
- **SOFT TPUs AND SEBS/TPU ALLOYS**
- **NANO-TPOs AND TPVs**

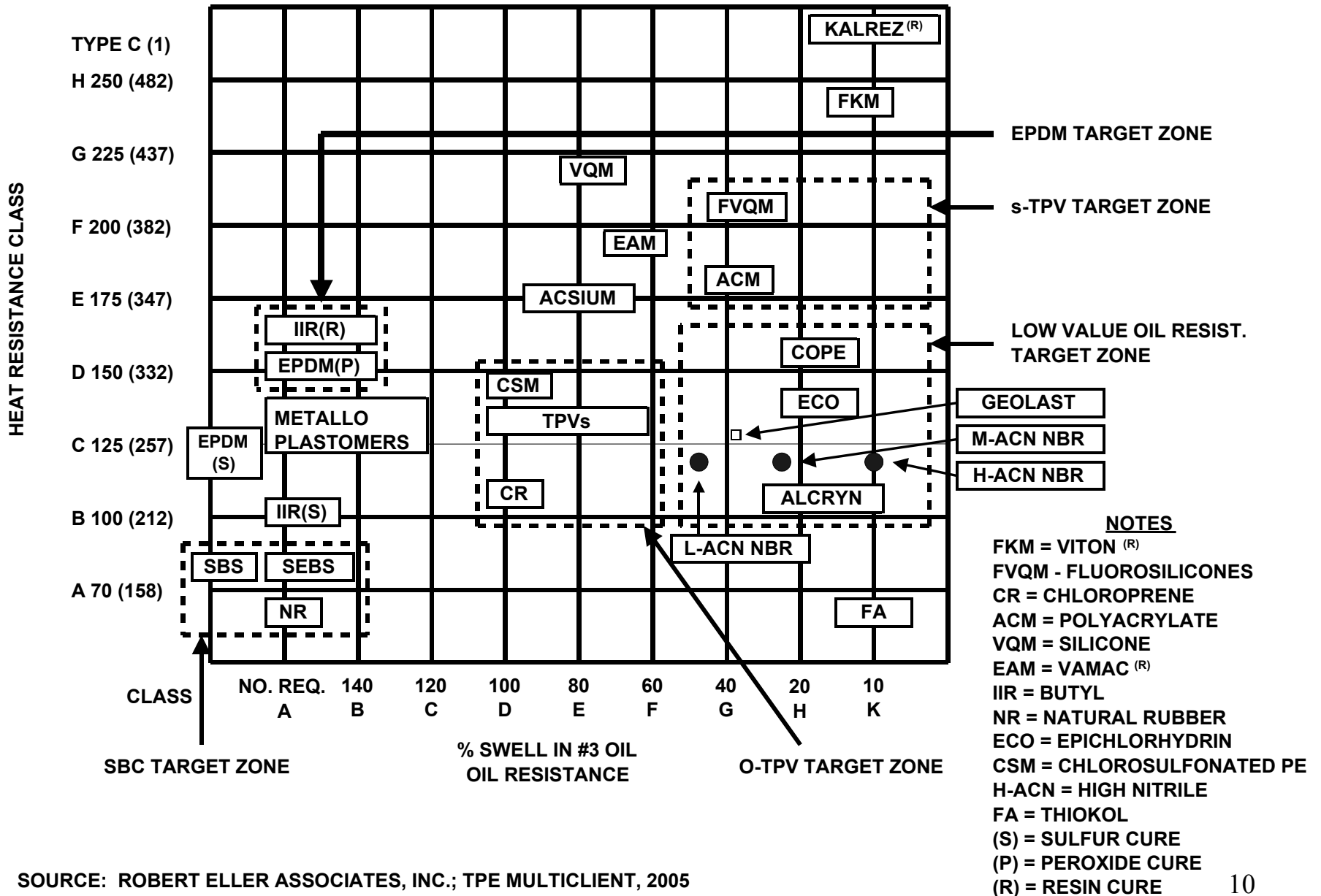


SUPER-TPVs COMPETING IN THE AUTOMOTIVE SECTOR

GRADE NAME	ELASTOMER TYPE	MATRIX RESIN(S)	SUPPLIER
TPSiV	SILICONE	PA, TPU, PP	DOW CORNING
GENIOMER	SILICONE	SEVERAL	WACKER
ZEOTHERM	POLYACRYLATE (ACM)	PP, PA, POLYESTER	ZEON
E-TPV	ETHYLENE ACRYLATE (AEM)	COPE	DUPONT
UNIPRENE XL	HYDROGENATED SBC (H-SBC)	PP	TEKNOR APEX
FLUOROPRENE	FLUOROELASTOMER	FLUOROPOLYMER	FREUDENBERG-NOK
PACREL	ACRYLIC RUBBER	PP, OTHERS	OPTATECH (NJOP)

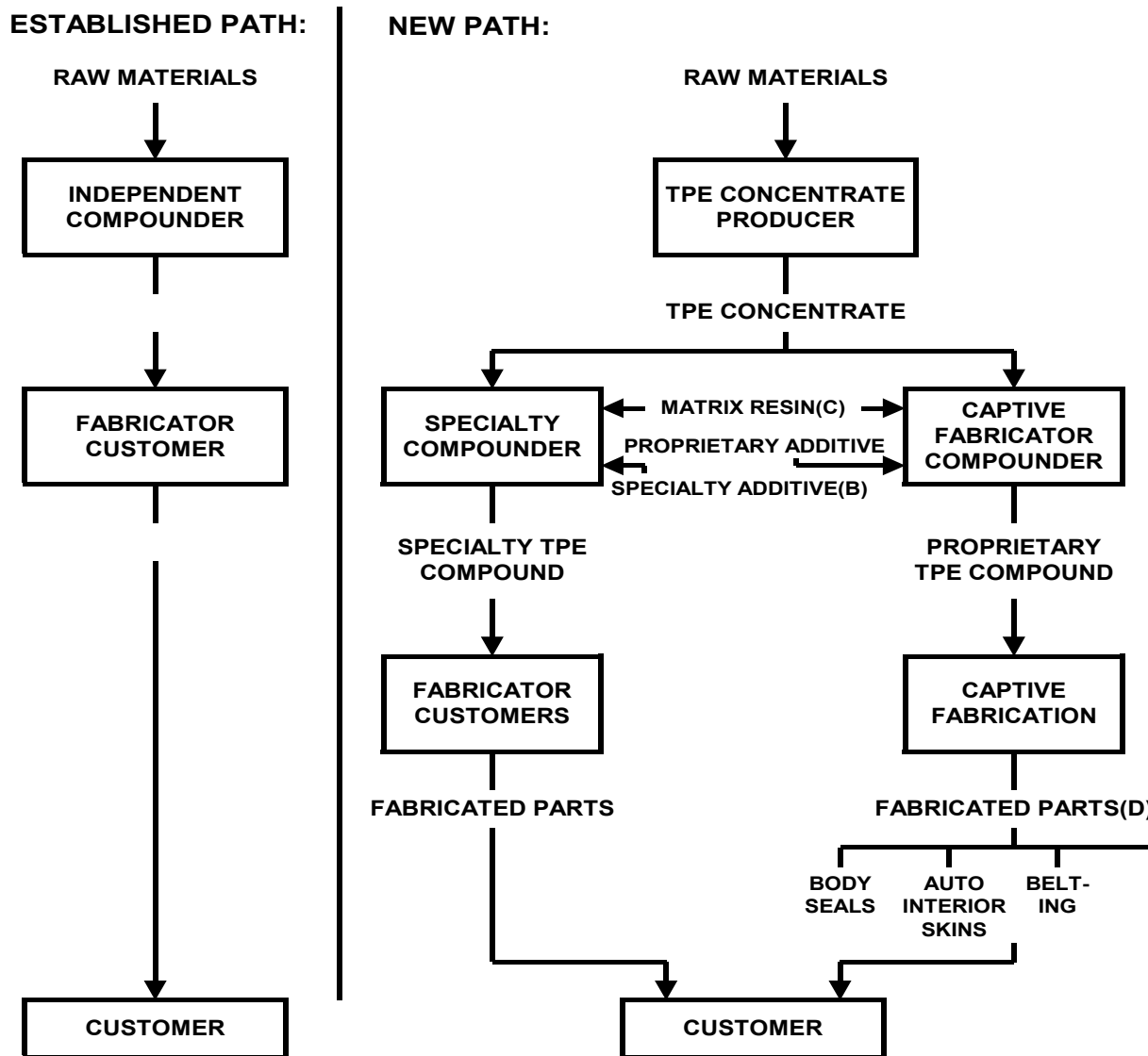


OIL RESISTANCE/HEAT RESISTANCE OF TPEs AND THERMOSET RUBBERS



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

PATH-TO-MARKET SHIFT FOR TPE COMPOUNDS^(A)



NOTES:

- (A) STARTING WITH TPVs, EXTENDING TO TPO, POSSIBLY SEBS-TYPE TPEs
- (B) E.G., FIRE RETARDANT, CONDUCTIVE FILLERS
- (C) E.G., POLYPROPYLENE, EXTENDING TO ENGINEERING PLASTICS
- (D) EXAMPLE FABRICATED PARTS SECTORS

POLYMER TECHNOLOGY, INFORMATION TECHNOLOGY MACROECONOMIC INFLUENCES ON TARGET TPEs

TPE TECHNOLOGIES:

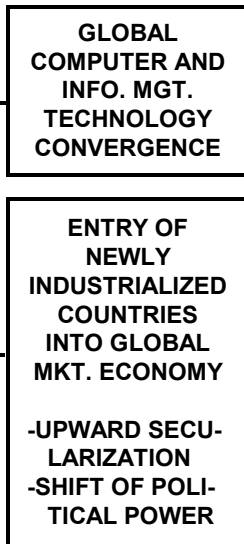
- RESIN
 - COMP'DG.
 - FABRICATION
 - TECHNOLOGY
 - TECHNOLOGY PROLIFERATION
-
- BROADENED PRODUCT ENVELOPE
 - LOWER SYSTEMS COSTS
 - INDUSTRY STRUCTURE SHIFT

END USER MARKET, MACROECONOMIC TRENDS:

- MFG. SHIFT TO LOWER COST COUNTRIES (ASIA, E.E., ETC.)
- ENTRY OF NEW COUNTRIES INTO GLOBAL MKT. ECONOMY
- ENLARGEMENT OF GLOBAL CONSUMER CLASS (3-->6BN)
- EMERGENCE OF NEW WORKER CLASS (+1.5BN)
- SLOWED POPULATION GROWTH IN WEST
- RELATIVELY STAGNANT/SLOWED GROWTH IN WESTERN ECONOMY
- SEVERE DOWNWARD OEM PRICE PRESSURES
- DEMAND SHIFT TO NEWLY INDUSTRIALIZED COUNTRIES
- DEMAND DRIVEN RAW MAT'L. PRICE INCREASES

RUBBER SECTOR:

- SLOW INNOVATION IN POLYMER TECHNOLOGY
- SLOW INNOVATION IN FABRICATION TECHNOLOGY
- VERY LIMITED INVESTMENT
- LOW R/D LEVELS



GLOBAL MARKET STRUCTURE/ MACROECONOMIC CHANGES:

- GLOBAL HORIZONTAL COLLABORATION REPLACING VERTICAL CHAIN OF COMMAND & MKT. STRUCTURE
- SUPPLY CHAIN RESTRUCTURE
- GLOBAL PERF. STANDARDS
- MFG. BASE SHIFT (EASTWARD)
- EMERGENCE OF NEW, LOCALLY CONTROLLED OEM MFG.
- SHIFT IN ROLE OF SALES/MKTG.
- CONT'D. OEM GLOBAL MKT. CONSOLIDATION?(b)
- OUTWARD FLOW OF PROFITS FROM NEWLY INDUSTRIALIZED COUNTRIES TOWARD WESTERN INVESTMENT
- INCREASED TERRORISM
- SUPPLY CHAIN MANIPULATION BY MAJOR GLOBAL OEMs

TPE EFFECTS:

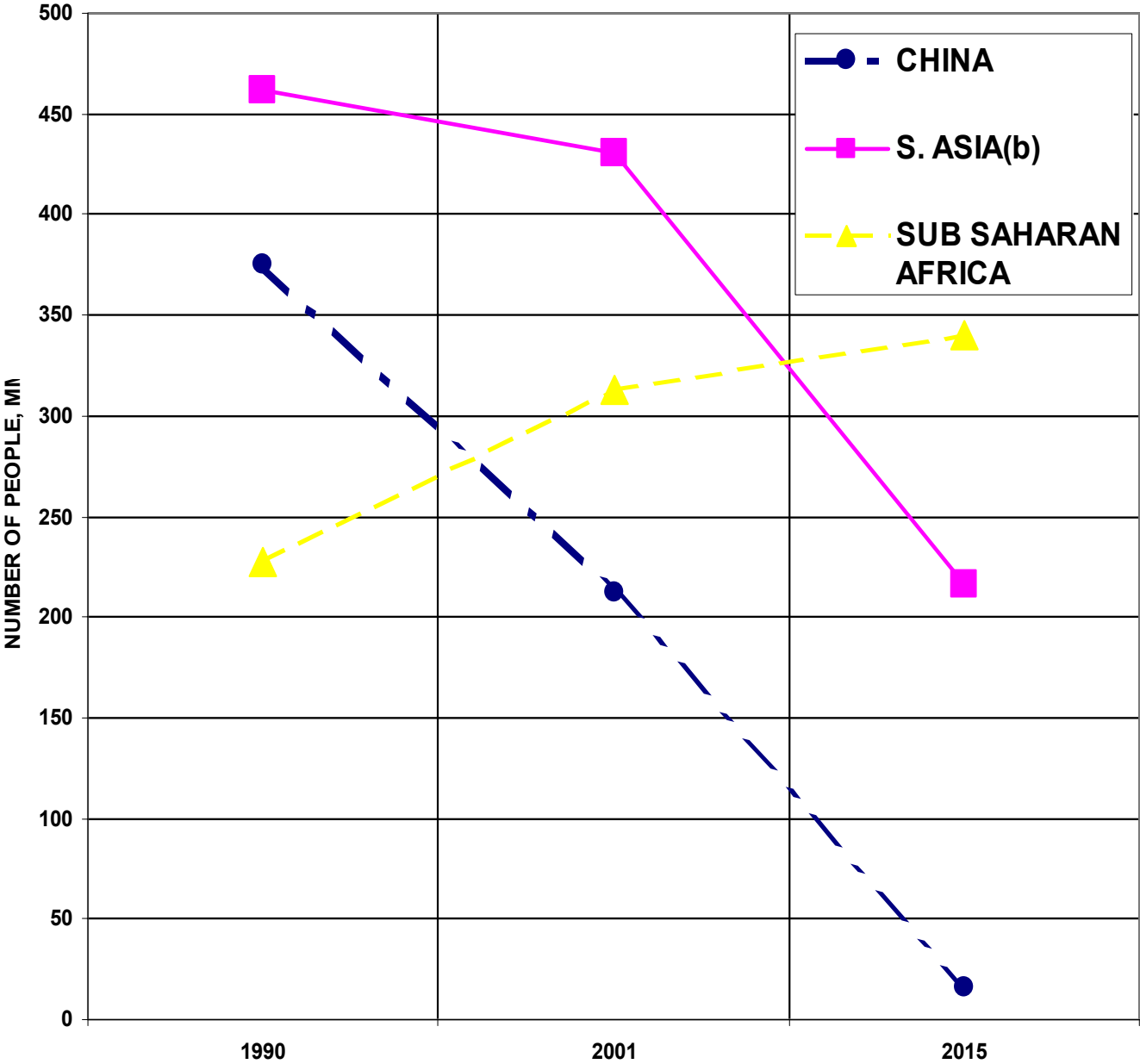
- SHARP INCREASE IN RUBBER MKT. PENETRATION BY TPEs
- TPE DEMAND SHIFT EASTWARD
- SLOW GROWTH OF WESTERN TPE MARKETS
- TREND TOWARD HIGHER VALUE TPEs IN WESTERN MARKETS
- TPE SUPPLY CHAIN CONSOLIDATION
- TPE INDUSTRY STRUCTURE SHIFT
- EMERGENCE OF NEW, LOCALLY CONTROLLED RESIN AND TPE COMPOUND PRODUCERS(a)
- NET GLOBAL TPE DEMAND INCREASE
- SHIFT TOWARD NEW TPE TECHNOLOGIES

NOTES: (a)A NEW PARALLEL SUPPLY CHAIN CHALLENGING THE POSITION OF ESTABLISHED WESTERN TPE SUPPLIERS
 (b)PARTIALLY OFFSET BY EMERGENCE OF NEW, LOCAL COMPETITION IN NEWLY INDUSTRIALIZED REGIONS

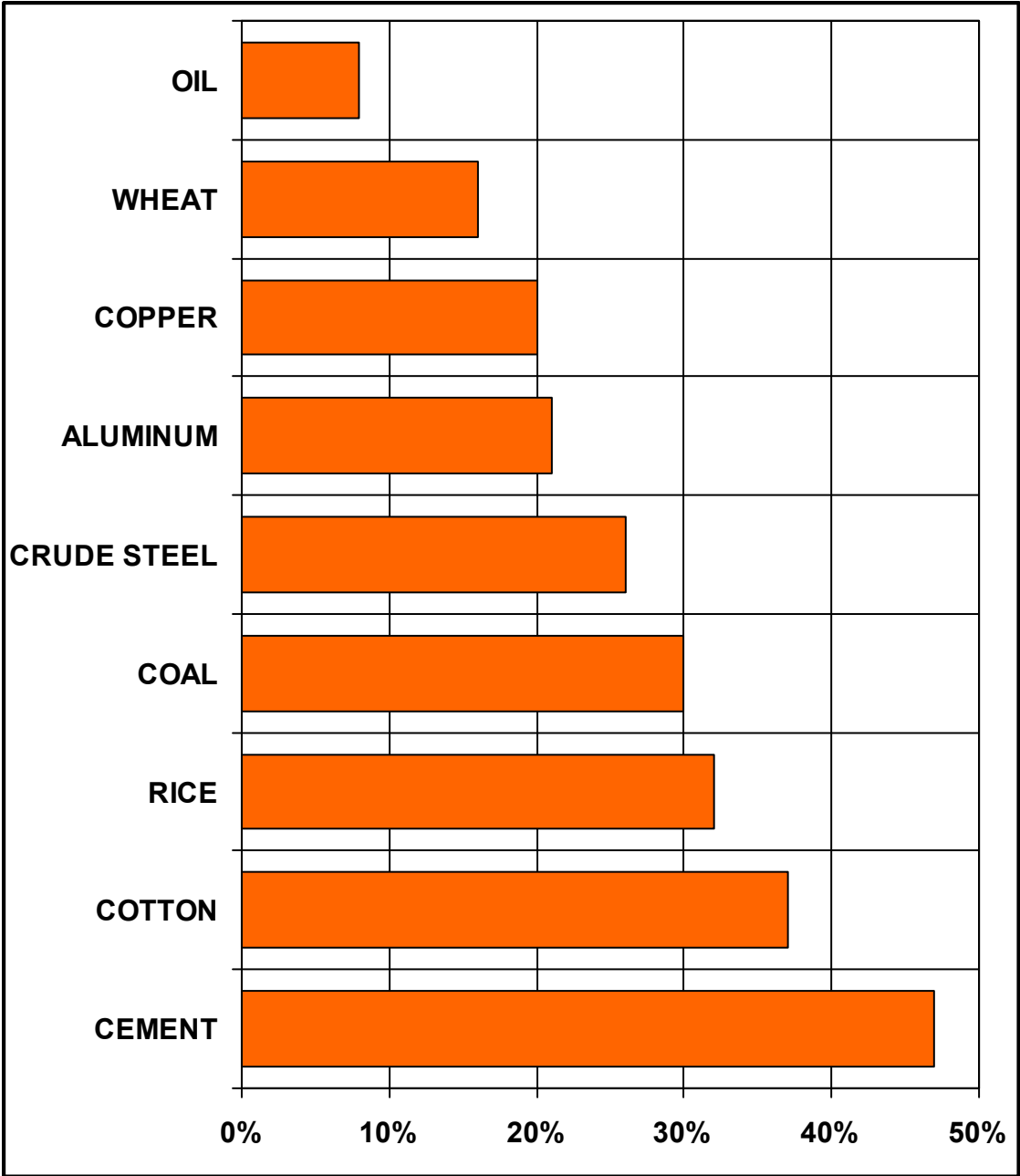
THE ECONOMIC WAR IS OVER?

- **MANUFACTURING FOR MANY TPE END PRODUCT SECTORS HAVE ALREADY SHIFTED FROM WEST TO EAST**
- **YUAN REVALUATION:**
 - TOKEN GESTURE?**
 - AGAINST A MARKET BASKET(U.S. DOLLAR EQUALLY WEIGHTED WITH OTHER CHINESE TRADING PARTNER CURRENCIES)**
 - U.S. DOLLAR POWER WEAKENED**
 - SUBSTANTIAL ASIAN COST ADVANTAGE WILL CONTINUE**
- **CHINESE U.S. BOND INVESTMENT SLOWS U.S. RETALIATION POT'L**
- **ASIAN TPE MARKET SIZES DWARF U.S. AND EUROPE MARKETS**
 - MARKET POWER OF 3 BN NEW CONSUMERS**
 - 1.5 BN NEW WORKERS**
- **ASIA PULLING AHEAD IN TECH. EDUCATION LEVEL AND NUMBERS**

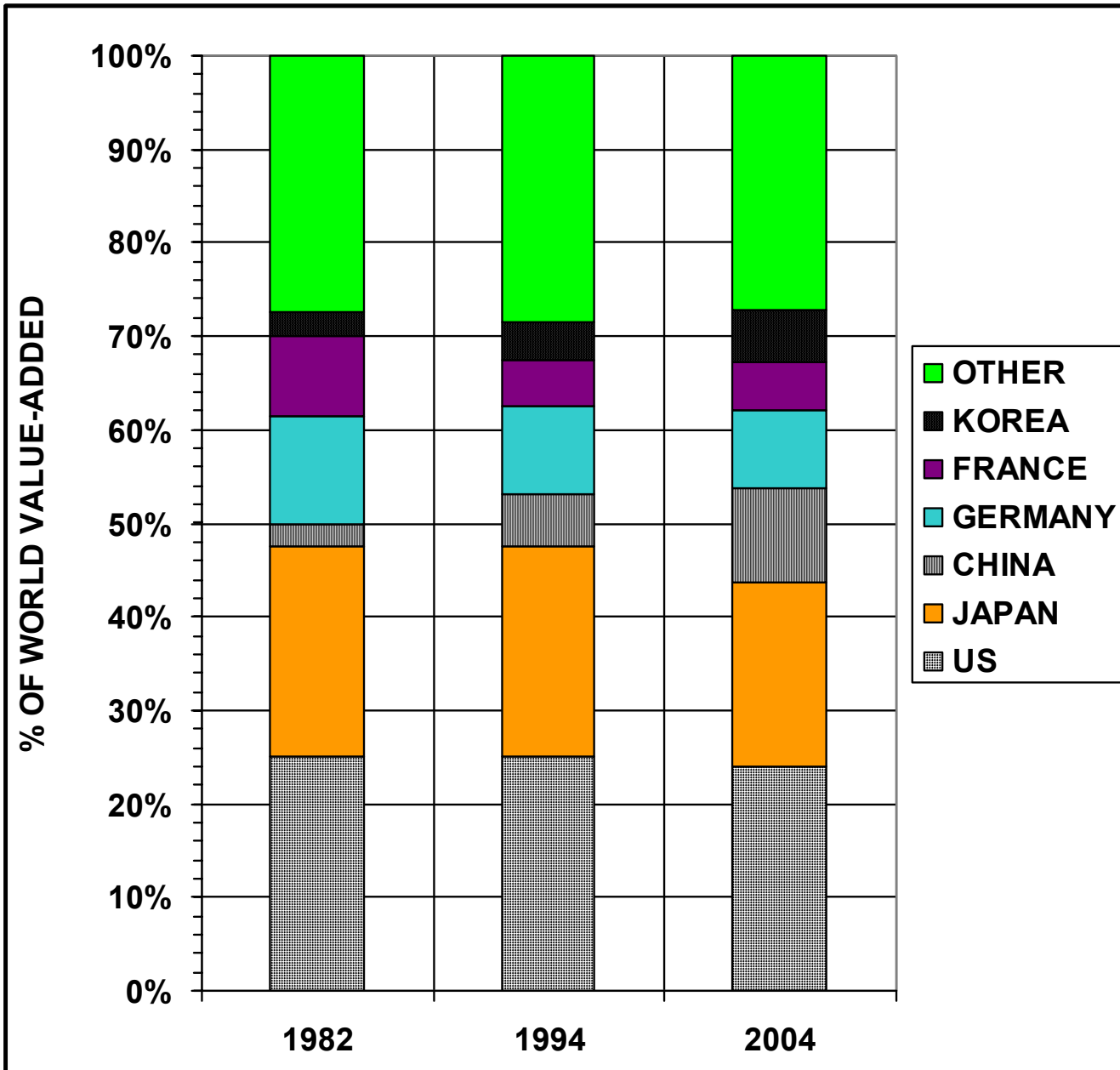
POPULATION LIVING IN EXTREME POVERTY



CHINA'S SHARE OF GLOBAL RAW MATERIALS CONSUMPTION



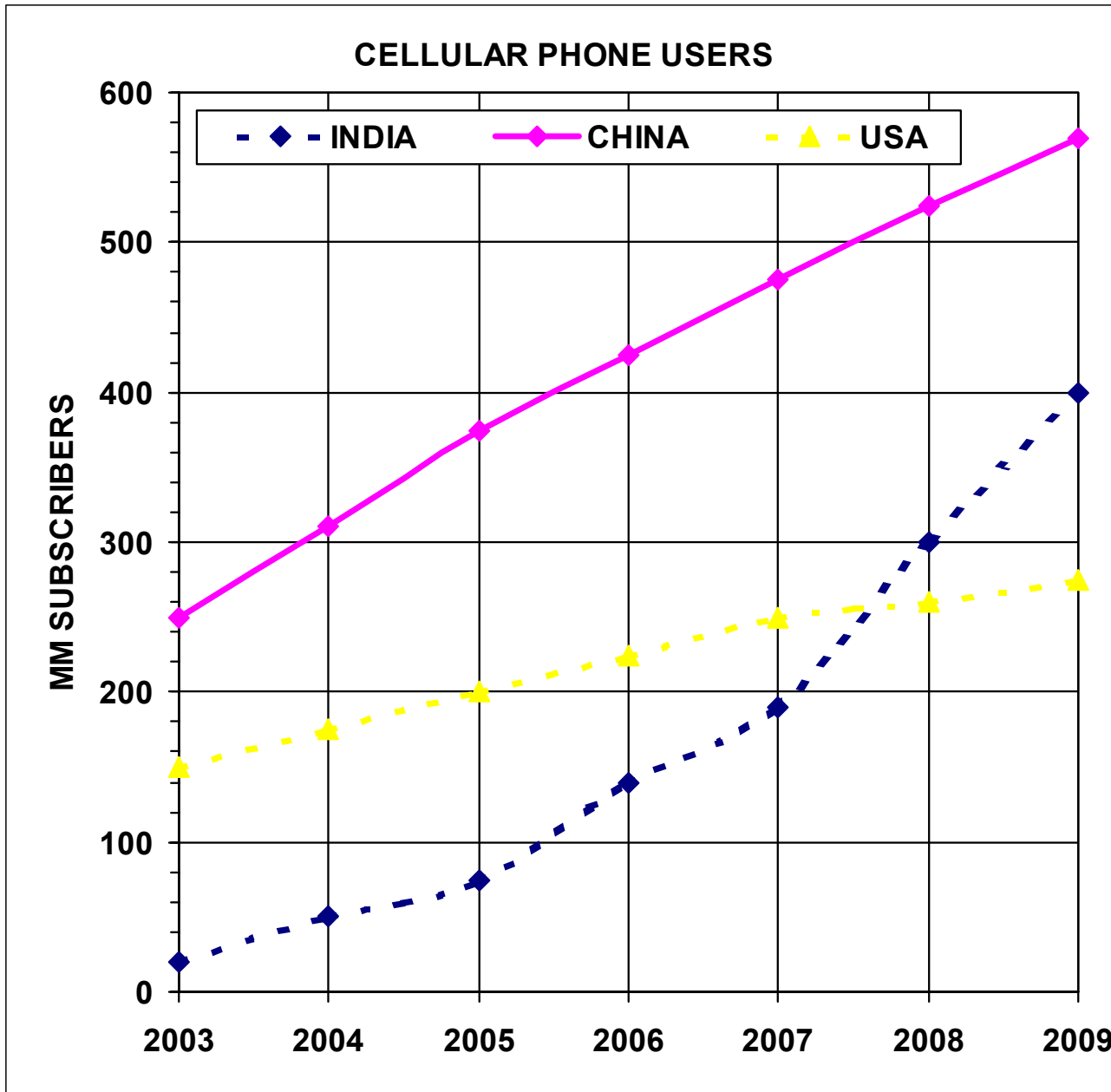
SHARE OF WORLDWIDE MANUFACTURER VALUE-ADDED

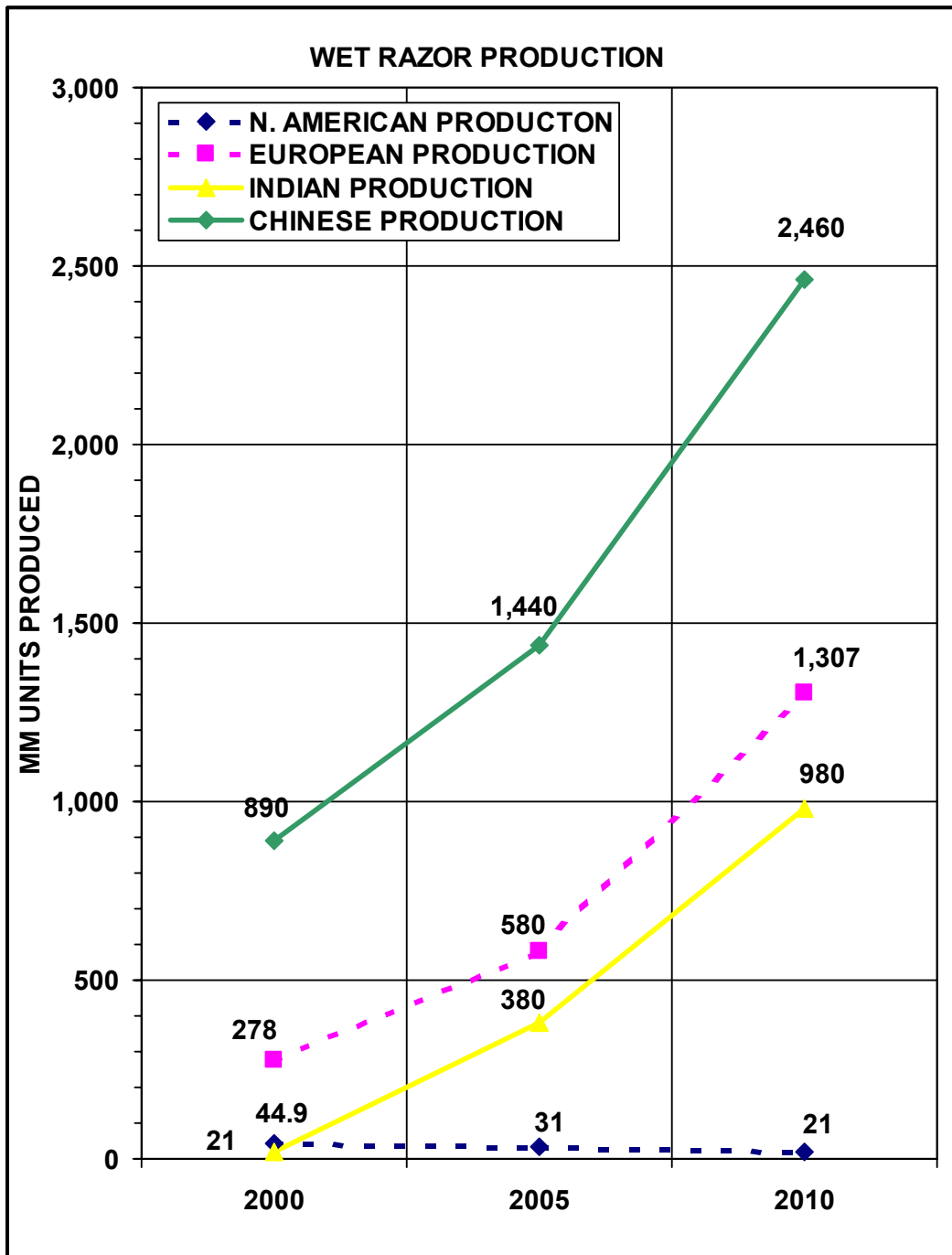


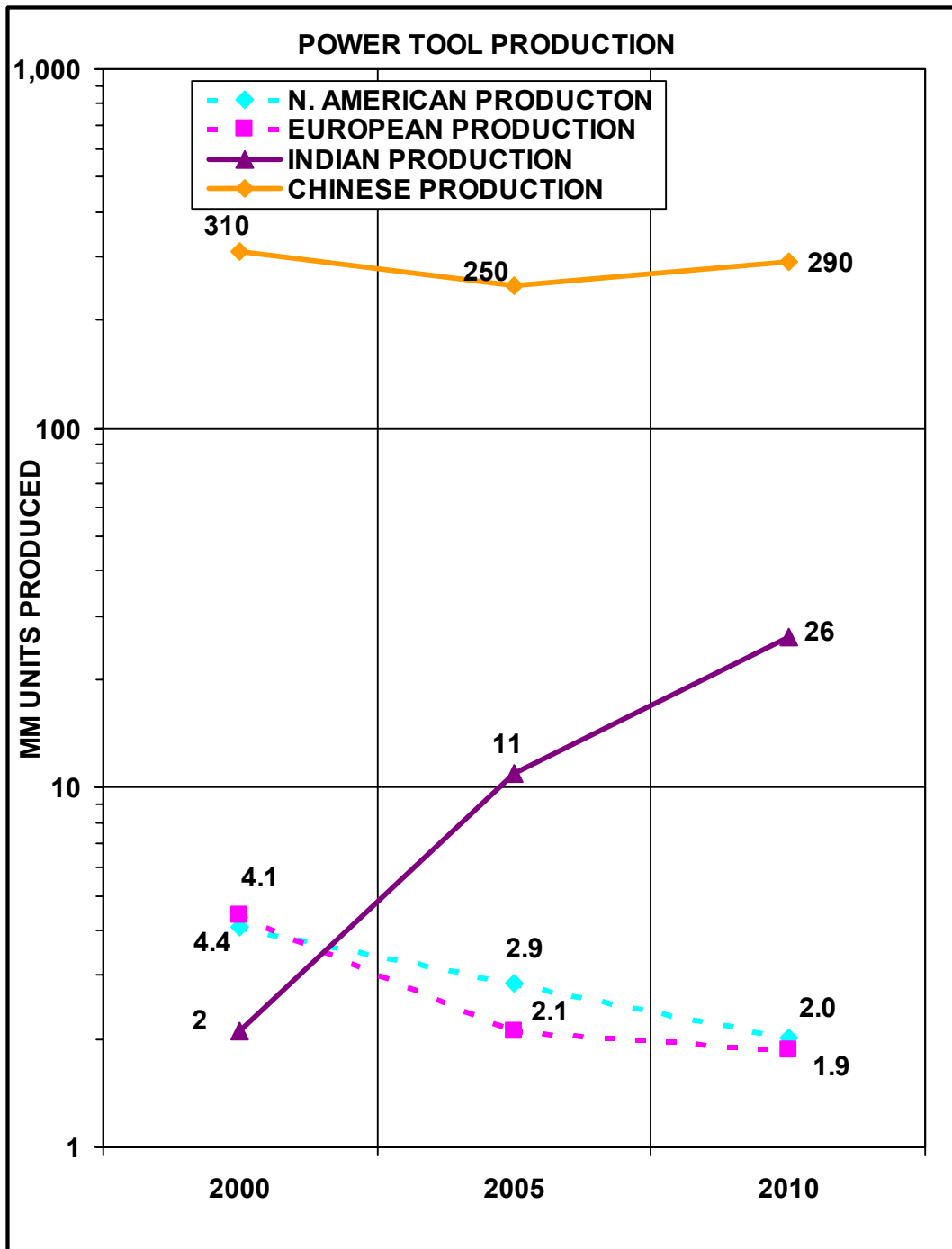
CHINA SHARES OF GLOBAL PRODUCTION

MARKET SECTOR	GLOBAL MARKET SHARE %	NOTE/TPE IMPORTANCE
CAMERAS	50	GRIPS/SOFT TOUCH/BUTTONS
FANS	50	MINOR
DVD READERS	54	GRIPS/SOFT TOUCH/BUTTONS
TELEPHONES	50	
TV SETS	30	
MOBILE PHONES	28	GRIPS/SOFT TOUCH/BUTTONS
LAPTOP COMPUTERS	12	PADS/BUTTONS/SOFT TOUCH
AUTOMOBILE	5	

INDIA, CHINA, AND USA CELL PHONE USE (MILLIONS OF PEOPLE)







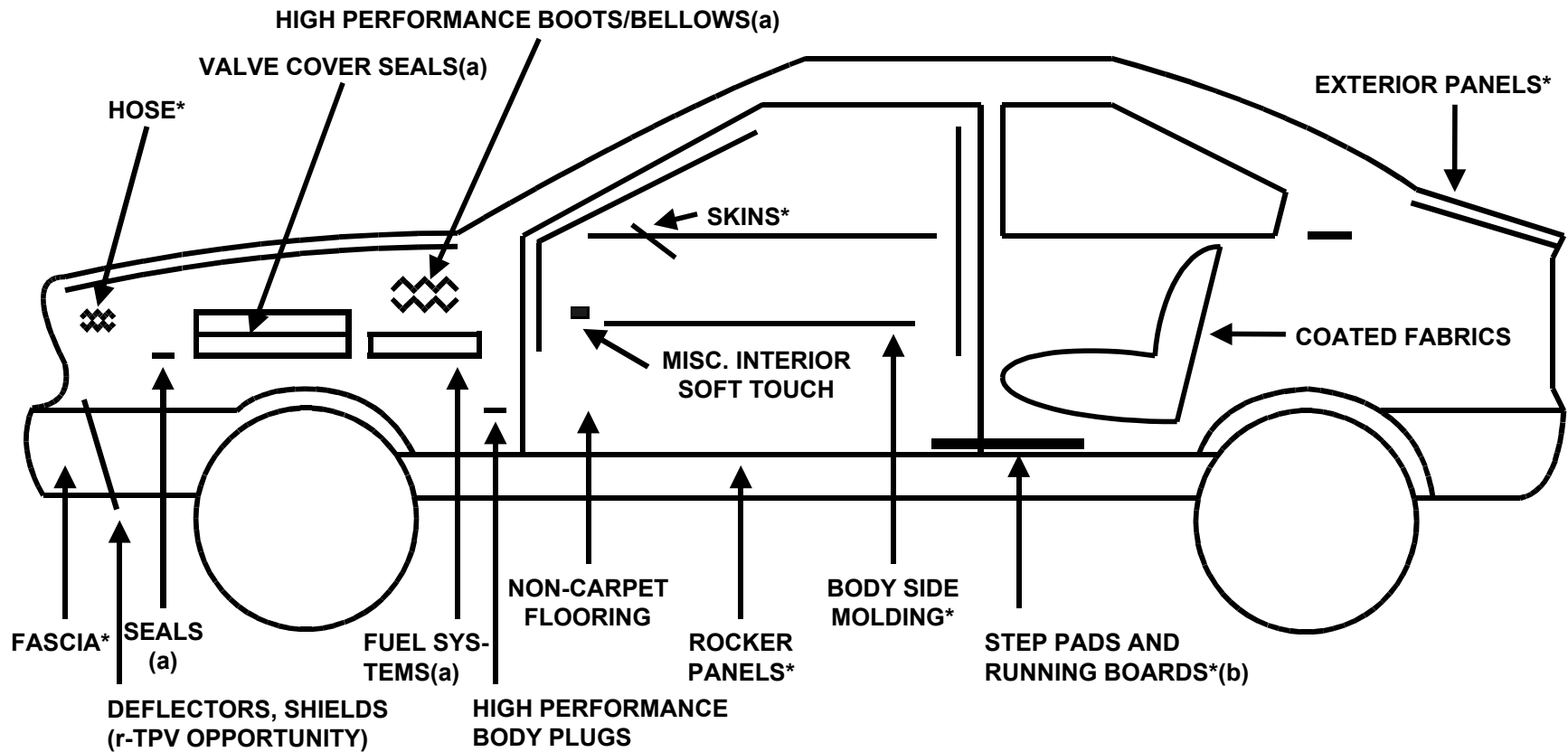
PARALLEL SUPPLY CHAIN

- **WESTERN TPE COMPOUNDERS:**
 - ONLY NOW RESPONDING TO CHINA/INDIA TPE POT'L
 - WOFEs VS. JV'S (IP PROTECTION)
 - TARGETING TRANSPLANTS
 - LIMITED ACCESS TO DOMESTIC MARKETS
 - CULTURAL BARRIERS
 - FORCED TO USE LOCAL CHANNEL PARTNERS
 - BONDED WAREHOUSES WILL MAKE IMPORTING EASIER
- **ASIAN DOMESTIC COMPOUNDERS:**
 - TECHNOLOGY TRANSFER BARRIERS NOT SIGNIFICANT
 - GOVERNMENT SUPPORT
 - BETTER(FAMILY/CULTURAL) CONNECTIONS
 - LIMITED ACCESS TO TRANSPLANT CUSTOMERS THUS FAR
 - PRICES LOWER BUT GAP CLOSING

ENTRANCE OF WESTERN TPE SUPPLIERS

	TPE TYPE								
Company	SEBS	TPO	TPV	TPU	Metallo	Eng-TPE	Super TPV	Mfr/ Import	Notes
Compounders:									
Alpha Gary	x							Import	No local AG office/only sales agents (Paeco)
Arkema						x		Import	Nylon based thermoplastic elastomer
Basell		x			x			Import	
BASF				x				Import	
Dow		x			x			Import	
Dow Corning	x		x				x	Import	
DSM	x		x			x		Import	
Dupont						x		Import	ETP-TPV
Exxon/Mobil			x		x			Import	Includes AES
GE						x		Import	Flexible Noryl
GLS	x							Import	Suzhou Plant opening 2006
Merquinsa				x				Import	
Milton Plastics (Kraiburg)	x		x	x				Import	
Mitsui			x					Import	
Optatech	x		x					Mfr	JV with NJOP
Noveon				x				Mfr	Opened plant in 2005
Poly One	x		x	x				Mfr	Mixed capacity multi product plant
RTP	x	x	x	x				Mfr	Shared capacity multi product plant
Schulman	x	x	x	x				Mfr	
SK	x		x	x				Mfr/ Import	Chinese plant only SEBS compounds/shared capacity plant with PP compounds
Solvay Eng Polymers		x	x					Import	Recently introduced to the Chinese market
SPC (Teknor Apex)	x		x					Import	Plant in Singapore
Zylog	x							Import	Indian plant location

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**

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

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

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

CONCLUSIONS

MANUFACTURING/SUPPLY

- **WESTERN TPE COMPOUNDERS START TO RESPOND WITH LOCAL MANUFACTURING**
- **PARALLEL TO SUPPLY CHAINS COMPETING**
- **ASIAN DOMESTIC COMPOUNDER ADVANTAGES**

GROWTH

- **STRONG CHINA TPU GROWTH-DRIVEN BY FOOTWEAR, AUTOMOTIVE AND CONSUMER PRODUCTS**
- **INTRA TPE COMPETITION WILL SHIFT TOWARD SBCs**
- **RUBBER MARKET PENETRATION ACCELERATING:**
 - **BODY/GLAZING SEALS**
 - **HOSE AND BELT**
- **GROWTH WILL BE 12%**



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



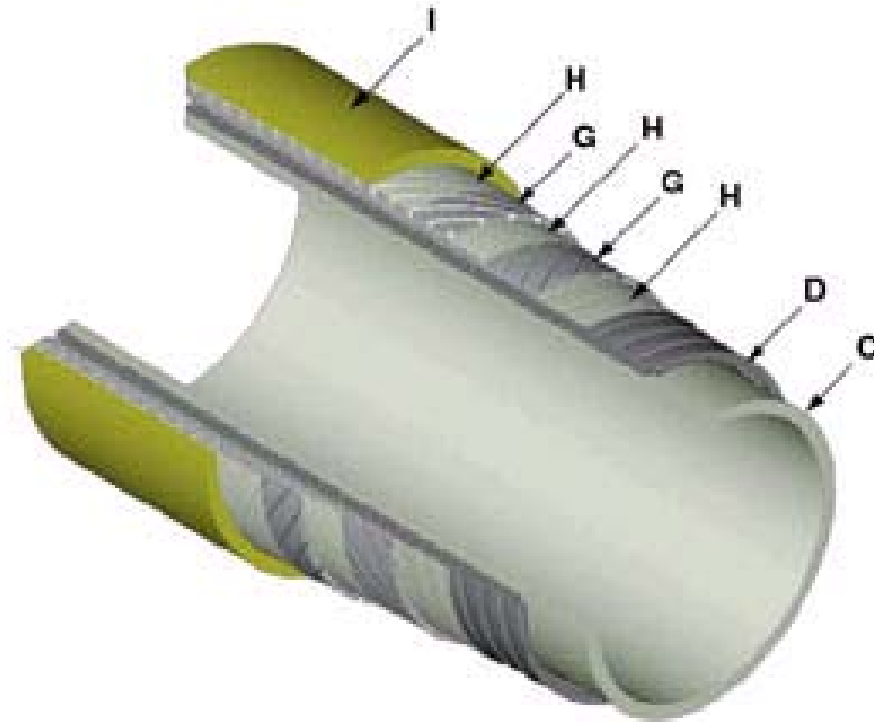
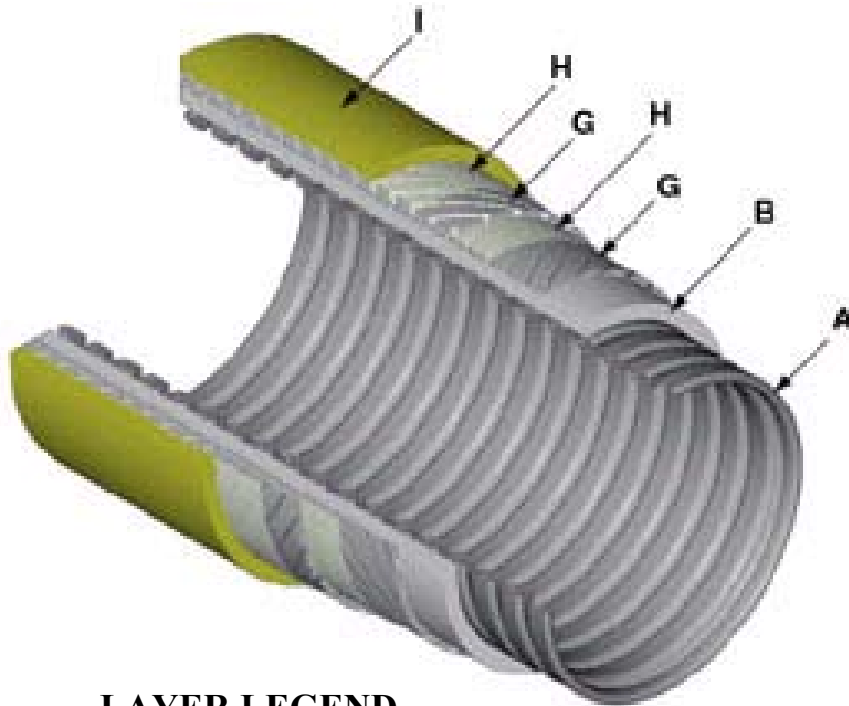
Manufacturer: Valeo

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.



Product type:Rear tailgate seal

Note: Sponge/dense EPDM



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