

The Semiconductor Supply Chain, a Moving Market

By

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- Strategic Planning and Business Development Consulting – Specialized in Electronic Materials Supply Chain Business & Technical Trends
- Techcet Critical Material Reports* :
 - Solar Cell Process Materials
 - Solar Cell Equipment Consumables
 - Polysilicon Market and Supply Chain
 - Ceramics
 - High K/ALD Precursors
 - Interconnect Materials Beyond 65nm
 - Ion Implant Sources
 - Liquid Dopants
 - Low Temperature Dielectric Precursors
 - Advanced Interconnect Dielectrics
 - Advanced Interconnect Metallization
 - CMP Consumables
 - Gases
 - Graphite
 - Masks and Reticles
 - Photoresists and Photoresist Ancillaries
 - Quartz
 - Silicon Carbide
 - Sputter Targets
 - Wet Chemicals

* Several Critical Materials Reports are commission by International Sematech.

Supply Chains We Follow

- ◎ Semiconductor Materials, both direct and indirect
- ◎ OEM suppliers
- ◎ Intellectual treasure
- ◎ Skilled Labor

OEM Semiconductor Supply Chain- Silicon Valley

- In 2008-2009 we were losing 3-4 machine shops and related supply chain providers per month
- In 2010, newer generation risk takers are buying equipment and older shops are running at full capacity
- Currently no shortage of most raw materials
- This supply chain is recovering, but still very vulnerable to the Asia shuffle

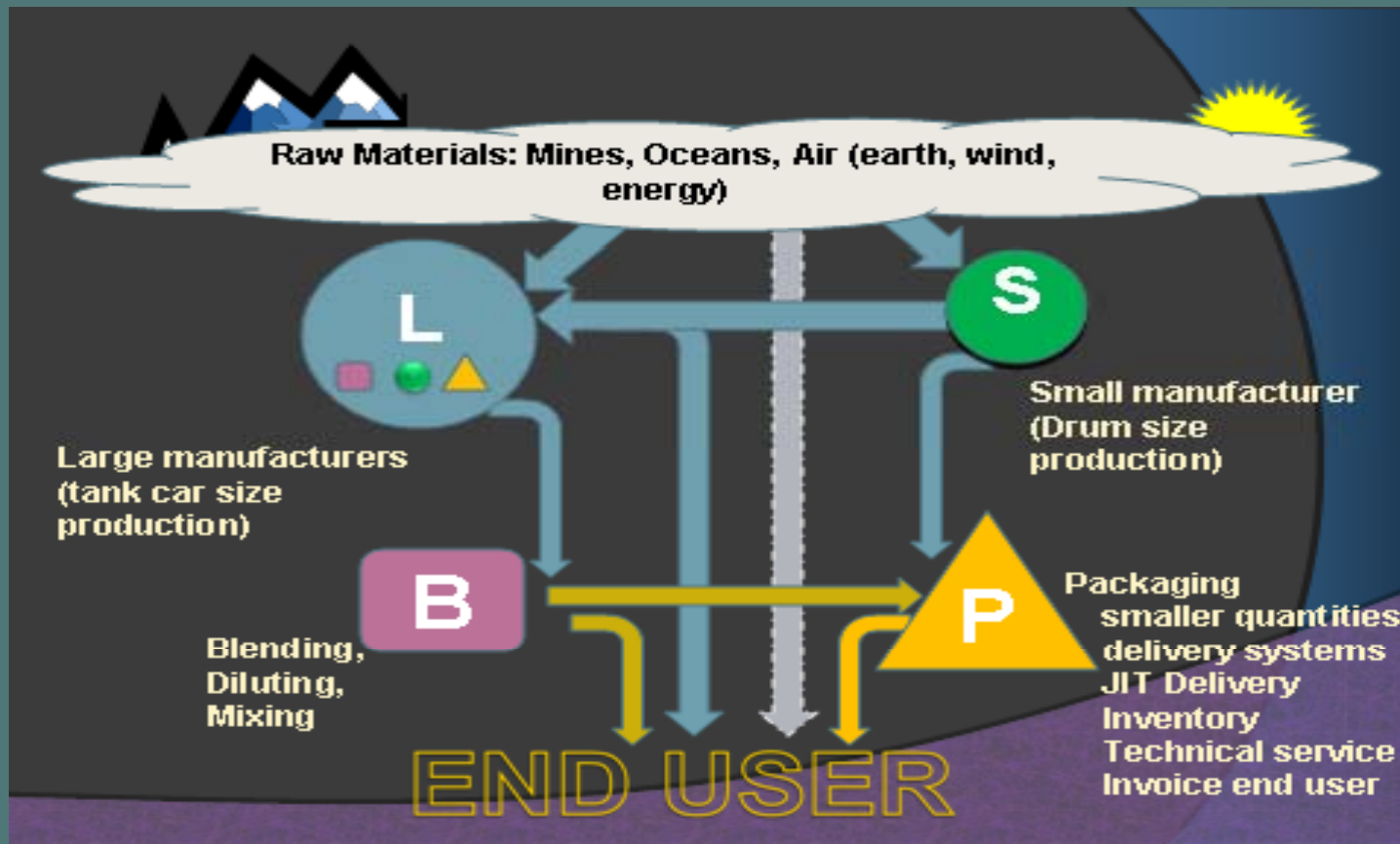
Intellectual Treasure Supply Chain

- Graduate and experienced Engineers working on daily contracts
- New Graduates, Engineers, physics and Chemistry majors working at Starbucks.
- New Engineers that are hired working for much lower salaries
- Will this discourage future generations of hard science majors?
- Can American graduates compete with Asian engineers on a cost basis?
- Is it worth it?

Skilled labor supply chain

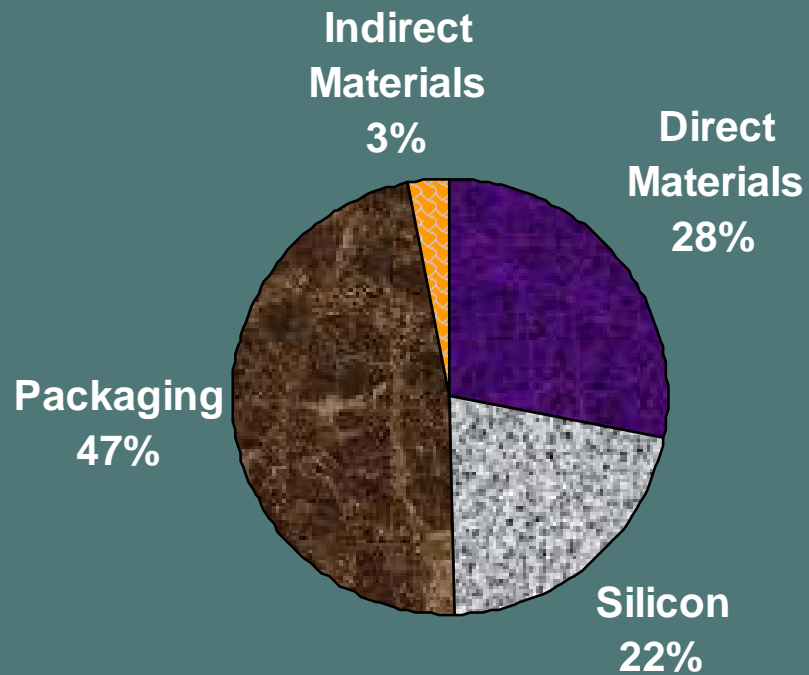
- ⦿ If fabs move out of Silicon Valley, the jobs for skilled labor moves or dies
- ⦿ Few opportunities for occupational training
- ⦿ With the repeated industry ups and downs, many skilled workers switch industries.
- ⦿ SEMI and other companies have had good luck with their High Tech U program.

Materials Supply Chain, Always Looking for the Lowest Link



Electronic Materials

Semiconductor
materials as
measured in
US\$



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Supply Constraints/ Drivers

**Other Markets
Demanding Same
Materials**

Market Drivers

- **Portable Applications
Driving Need for
Smaller Geometry
IC's**
- **Cloud Computing
Driving Demand for
Simpler
Technologies**

**Materials
Business
Growth/
Profitability**

**Raw Material
Production
Flexibility**

**Si/ polySi
Wafer Prices**

Crazy Supply Chains

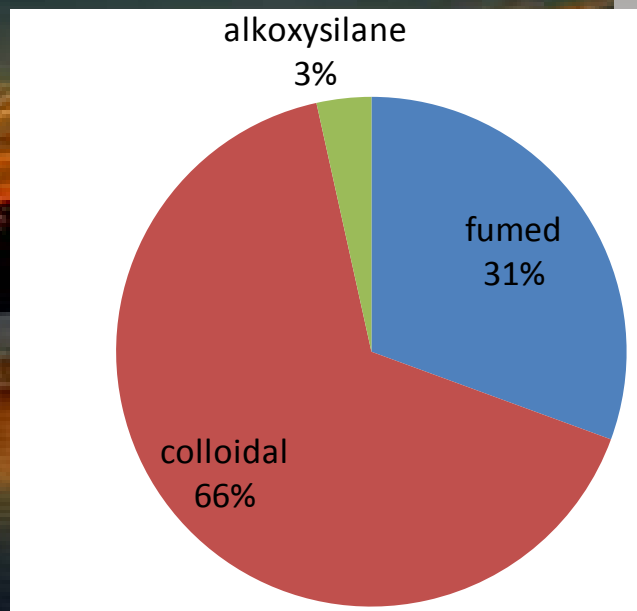
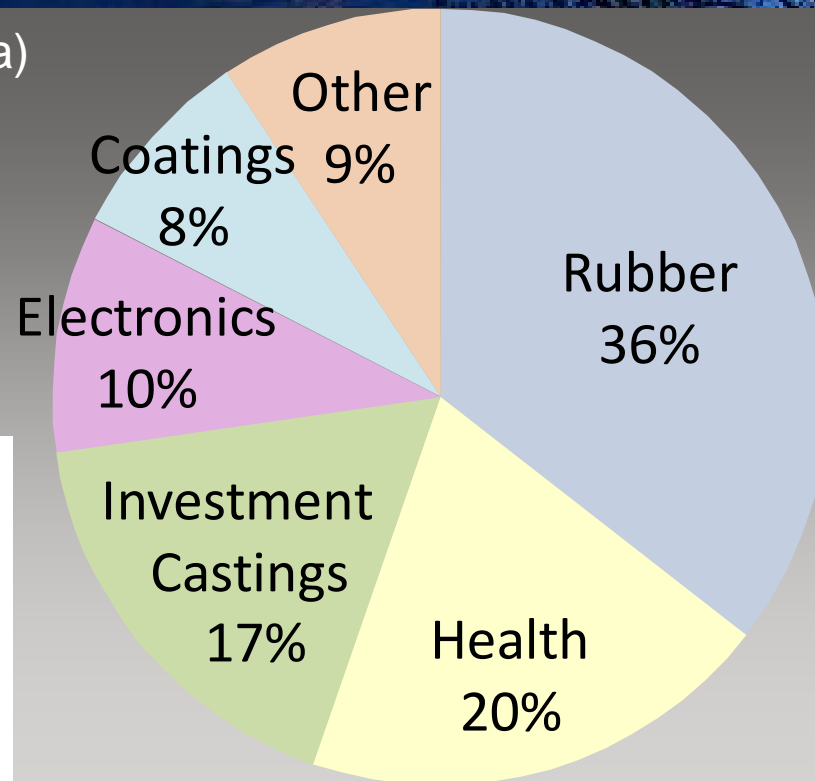
- ⦿ Makers selling to: Manufacturers, “Blenders”, Purifiers and Repackagers who sell to each other
- ⦿ OEMs competing with like parts/ materials suppliers (quartz, targets, post CMP cleaning)
- ⦿ Users always trying to buy deeper in the chain to save money and control POR

Silica Worldwide Use

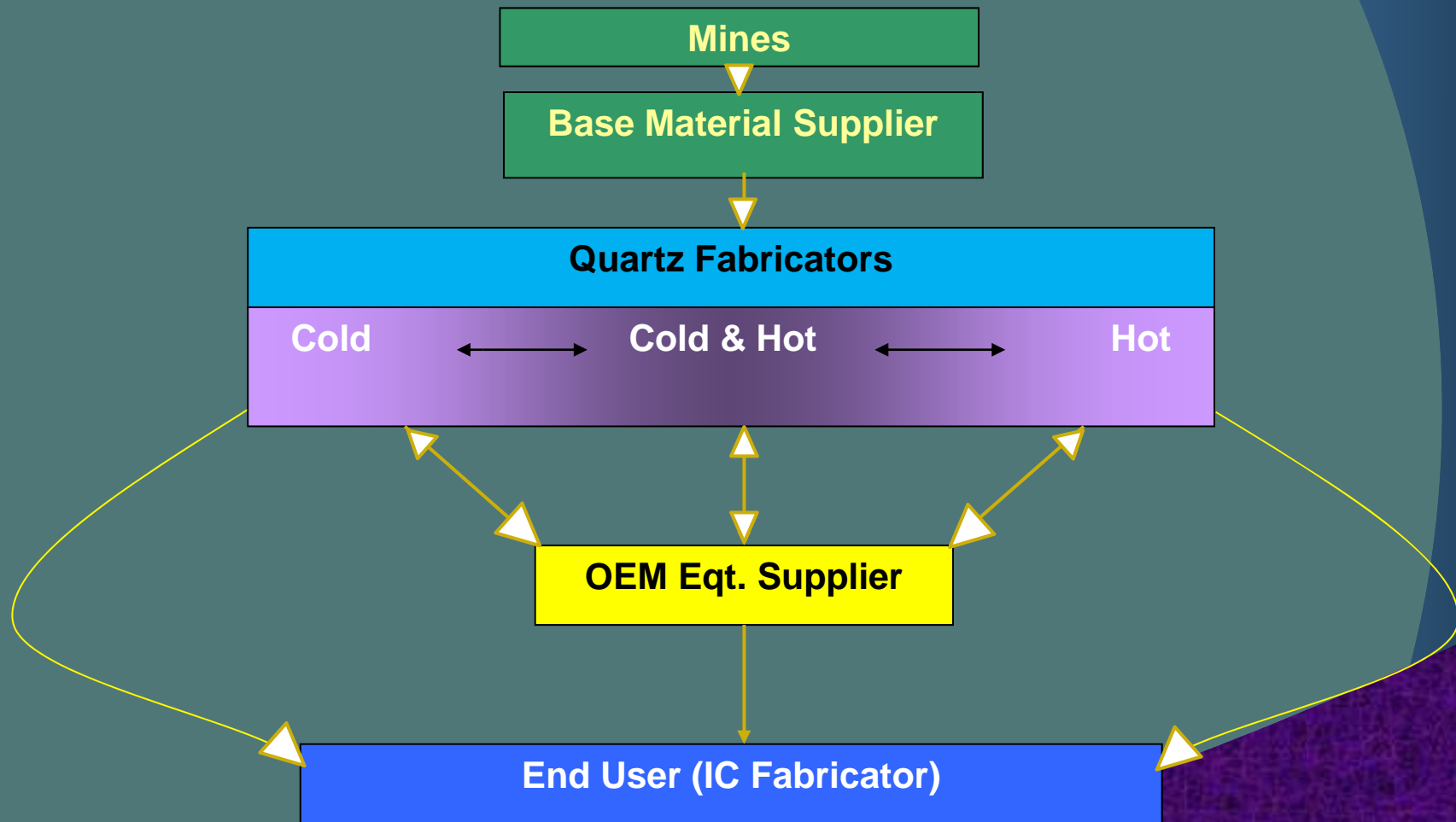
Hot growth areas:

- “green” tires (US & Europe)
- reinforced silicone-rubber in shoes (Asia)
- toothpaste (China) >5% CAGR
- electronics (CMP WW)
- cosmetics (WW)

“Rise in Chinese Economy Boosts Toothpaste Market”



Indirect Materials Supply Chain

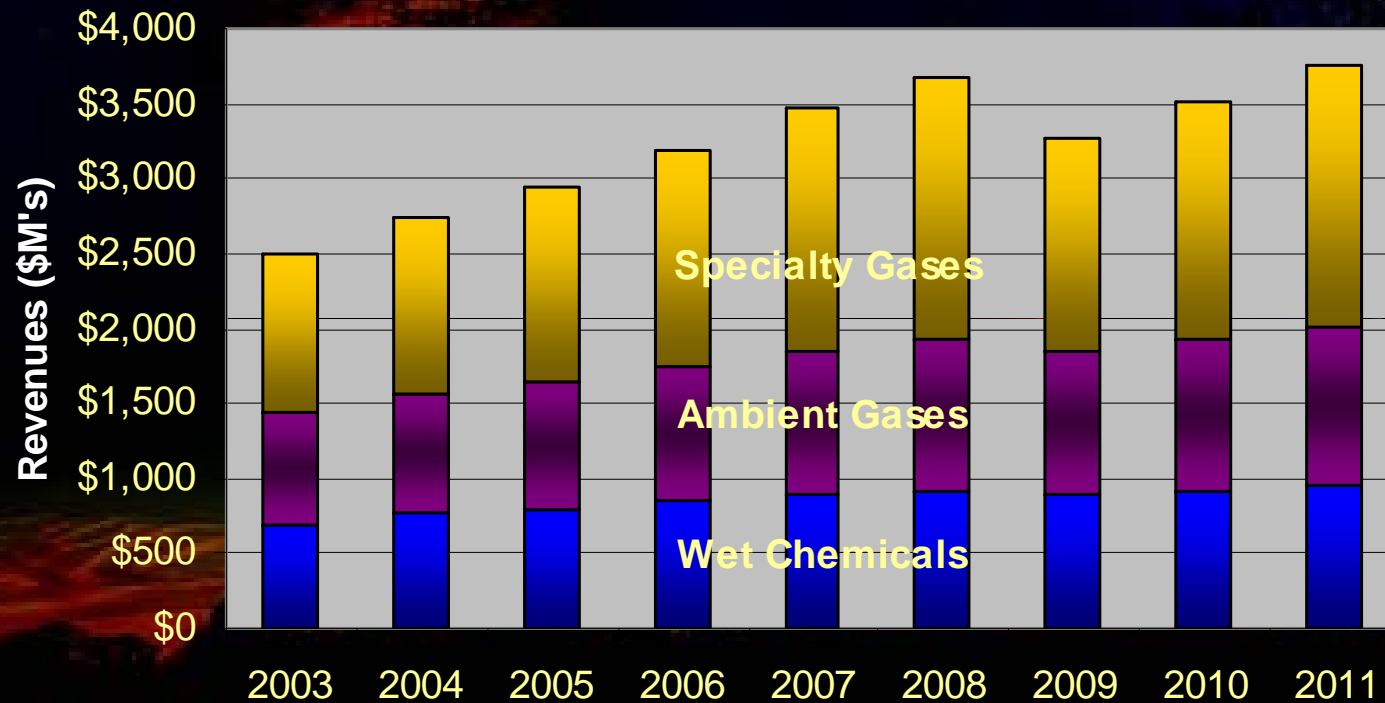


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Supply Chain Shift

- ⦿ Makers selling to end users
- ⦿ US Makers consolidating or getting out of the business
- ⦿ Solvents being minimized in IC Fabs
- ⦿ Asian material supplier market growing
- ⦿ For other chemicals such as acids, we are too picky and cheap

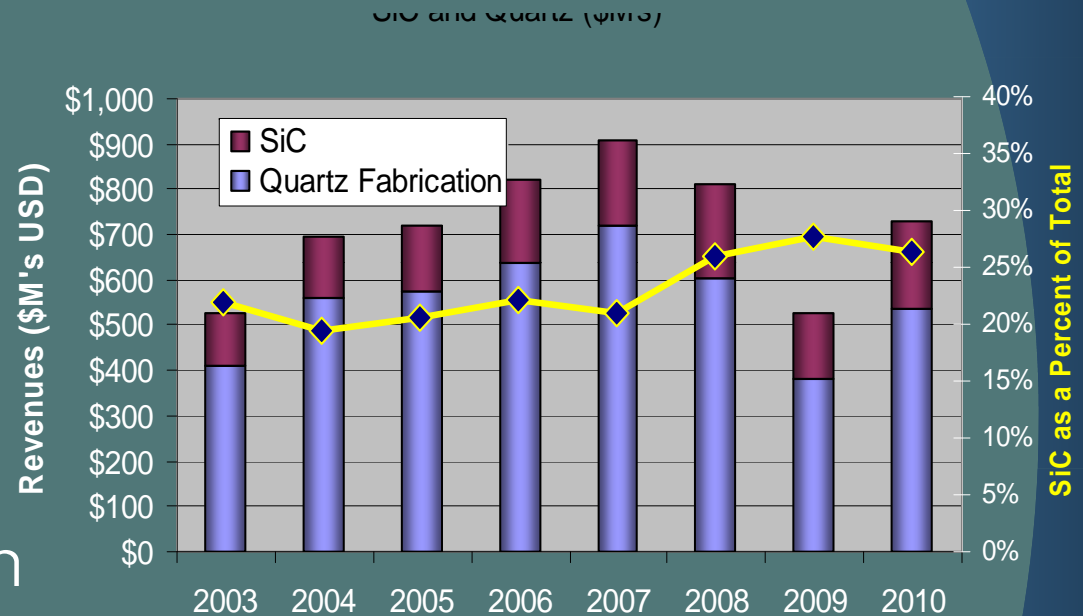
Gases & Wet Chemicals



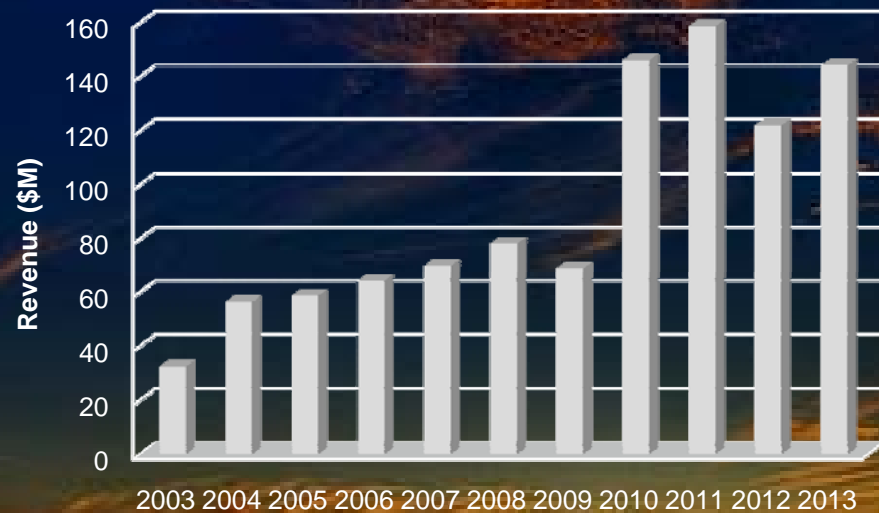
- Specialty Products and Smaller Quantities Relegated to Smaller Companies and Local Suppliers
- Larger Companies Primarily Want to Deal in Bulk Volumes and Cater to Asia

Indirect Materials Hit Hard – Quartz and SiC Markets

- Both SiC and Si continue to gain relative market shares
- Graphite losing ground based on “dirty” perception
- Silicon and SiC have such a better CTE, and cleaner reputation, they are hard to beat



Targets - Tantalum Supply and Demand

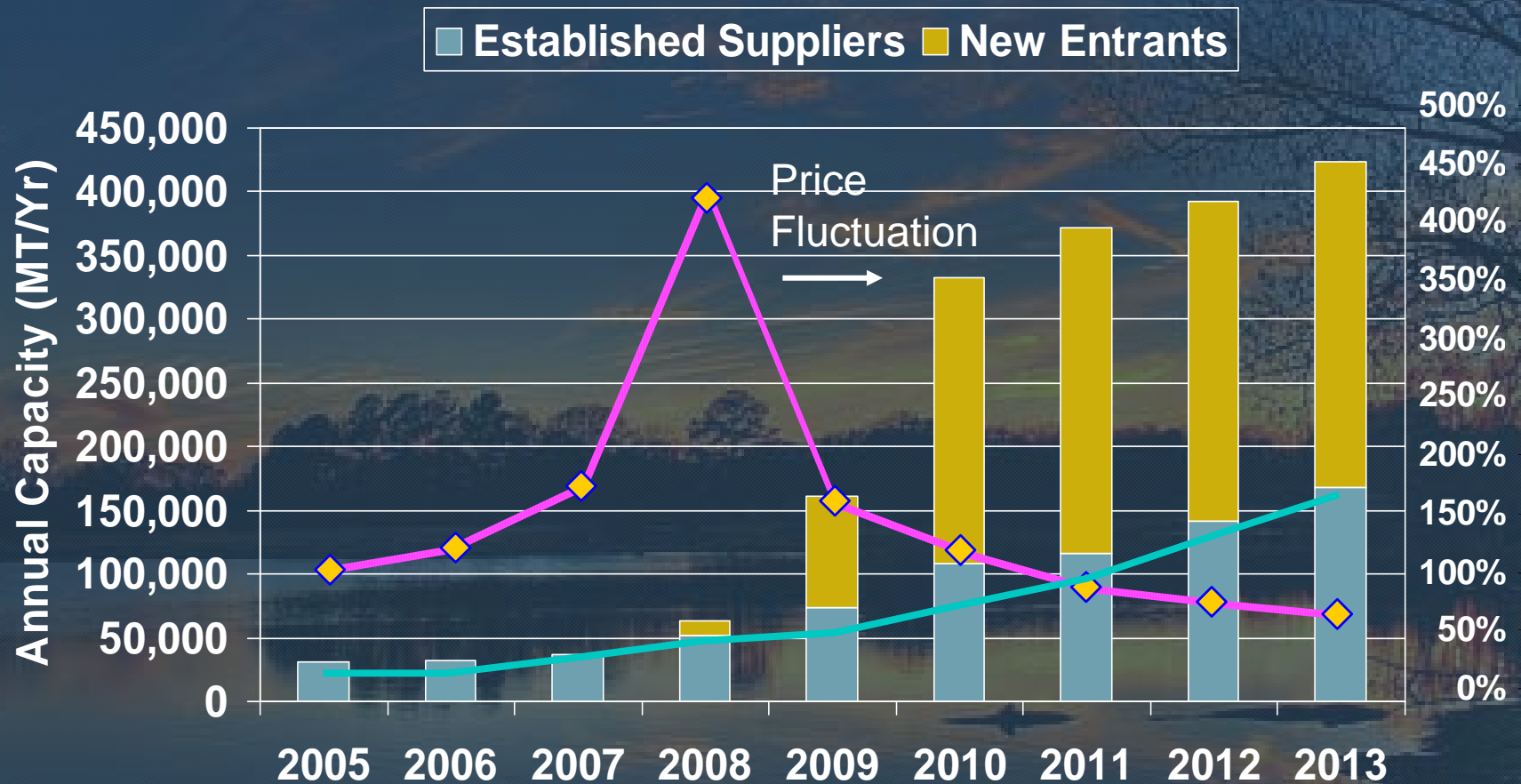


- Poor demand impacting Ta market
- Main Ta Mine Moth-balled

• **2009 Ta Target Revenues ~ \$70M will soar to >\$140M in 2010 due to price escalation**

Ta	2000	2010 est	comments
Supply			
Australia	1.3	0.0	Mines shutdown
Africa	0.79	1.025	<u>Humanitarian</u> issues
Brazil	0.42	0.85	
China	0.37	0.33	
SE Asia	0.25	0.27	
Canada	0.17	0.15	
Others	0.05	0.19	
Recycled	0.75	0.5	
Stockpiles	0.65	0.42	
Total Supply	5.25	3.735	
Demand	5.2	4.2	
Shortfall	0.05	0.465	

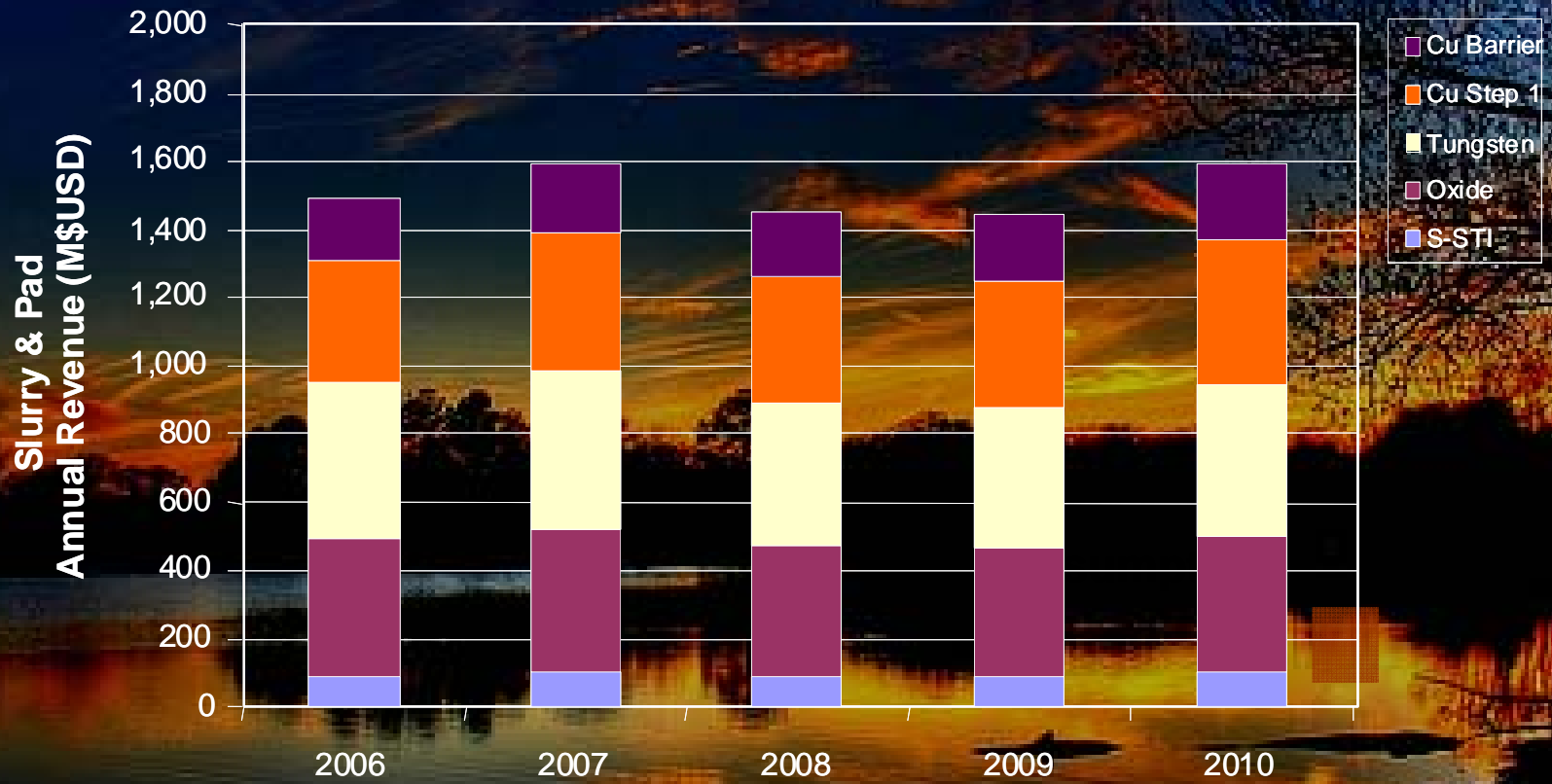
Polysilicon



Source: SEMI and Techcet



CMP Slurry & Pad Materials Market

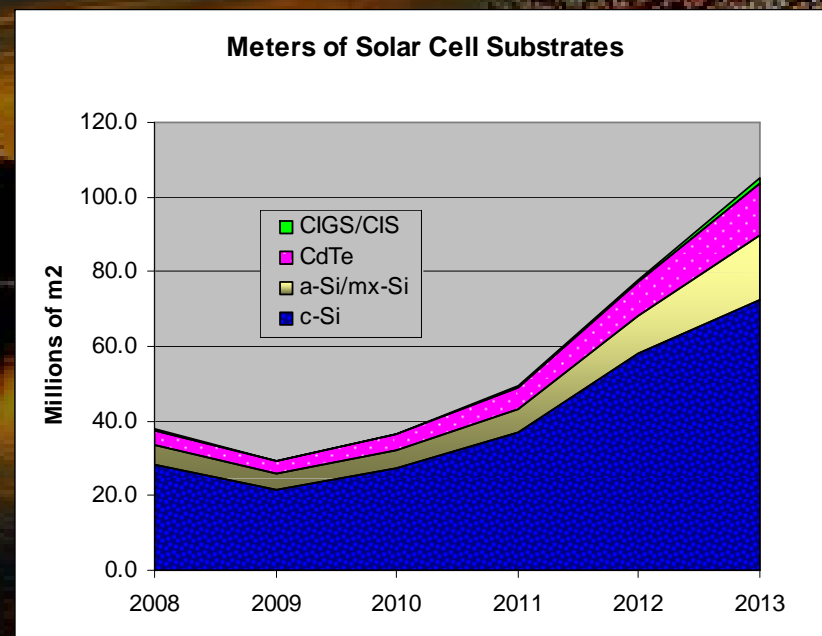


Supply Chain Cross-Links

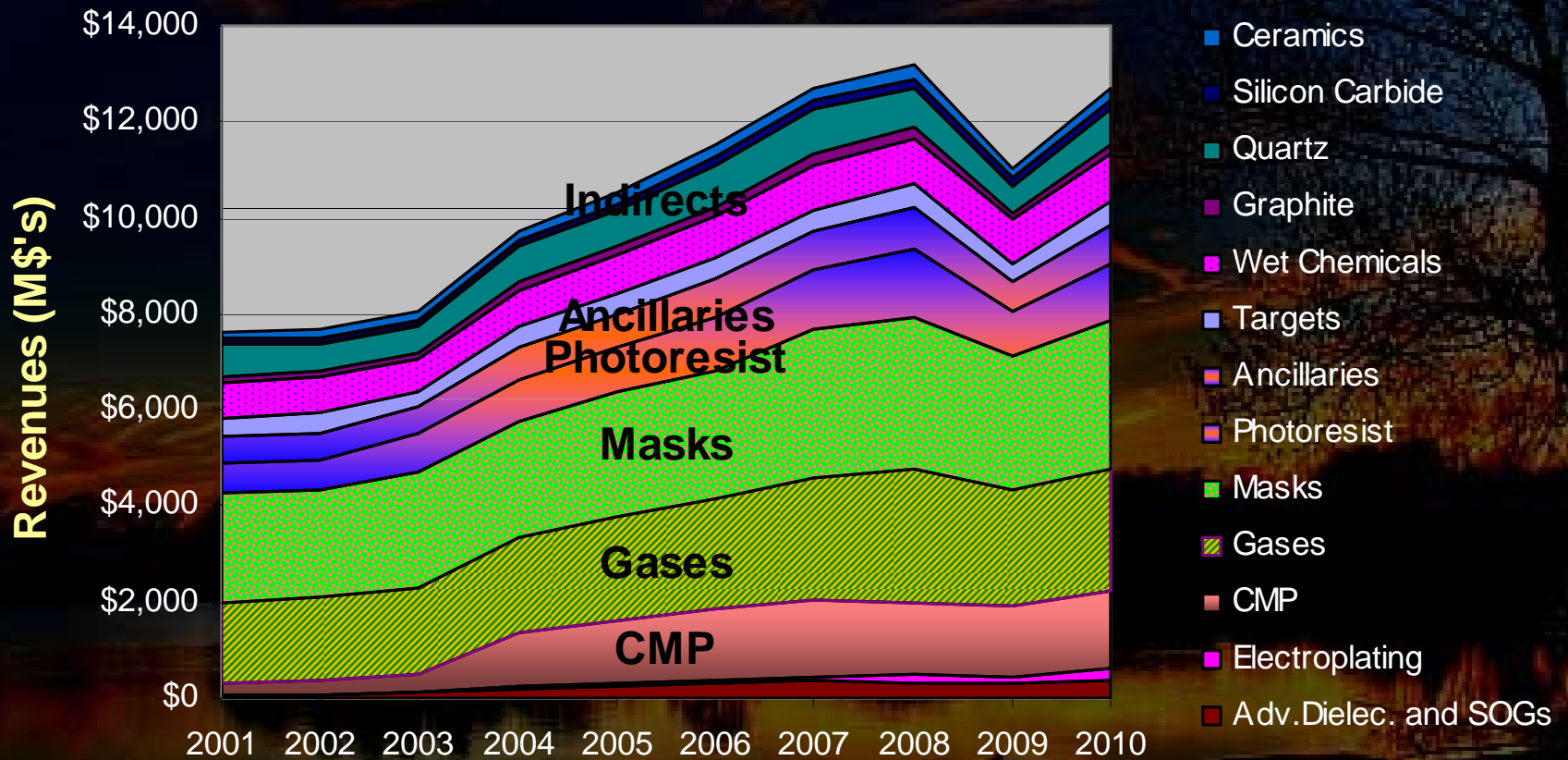
- PV Materials Markets drive for lower cost will impact ASPs of Like SC Materials
 - Already happening in TFT area - Gases

● Thin Film CAGR of 20%+ expected over 5 yrs

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Front End Process Materials*

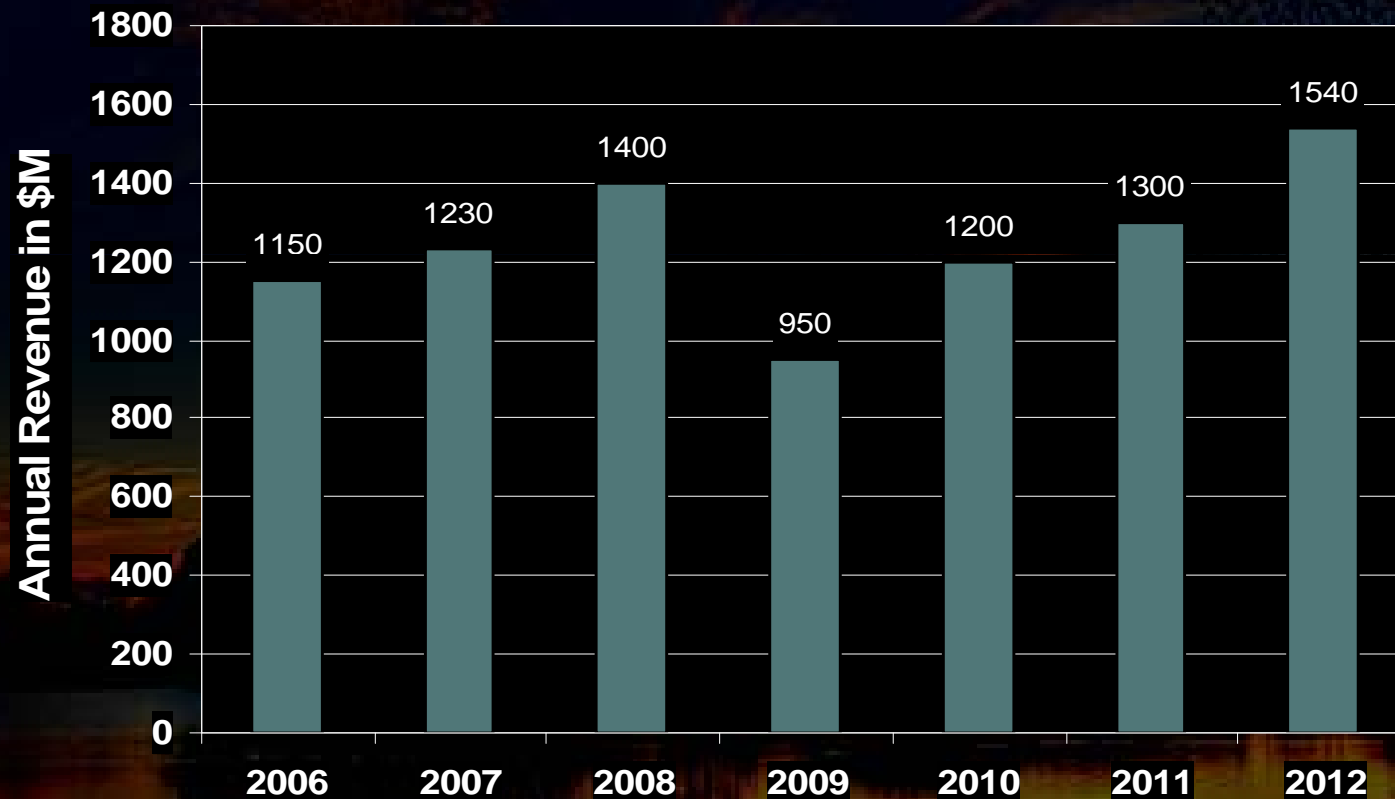


* Without Silicon

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Worldwide Estimated Photoresist Market Size (in US\$)



Cost Per Puddle



Puddle size



Puddles Per Wafer

Conclusions?

- These four supply chains are at major risk
- Growth in Asia continues, causing much of this risk
- Some jobs can switch to software or bio-engineering, but where is the re-training for the over 45 group?
- For materials, US laws and regulations affect an aging and disappearing manufacturing base
- Growth areas in SC Materials
 - Litho – 193 nm ArF resists
 - Interconnect Materials (CMP, dielectrics, metals) > \$2B
 - Front End Materials (dielectrics, metals) <\$200M by 2015



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