The Semiconductor Materials and Supply Chain Update, August 2010

By
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and the
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Techcet Group, LLC

- **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 Wafer Fab 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 nicely, but still very vulnerable to the Asia shuffle

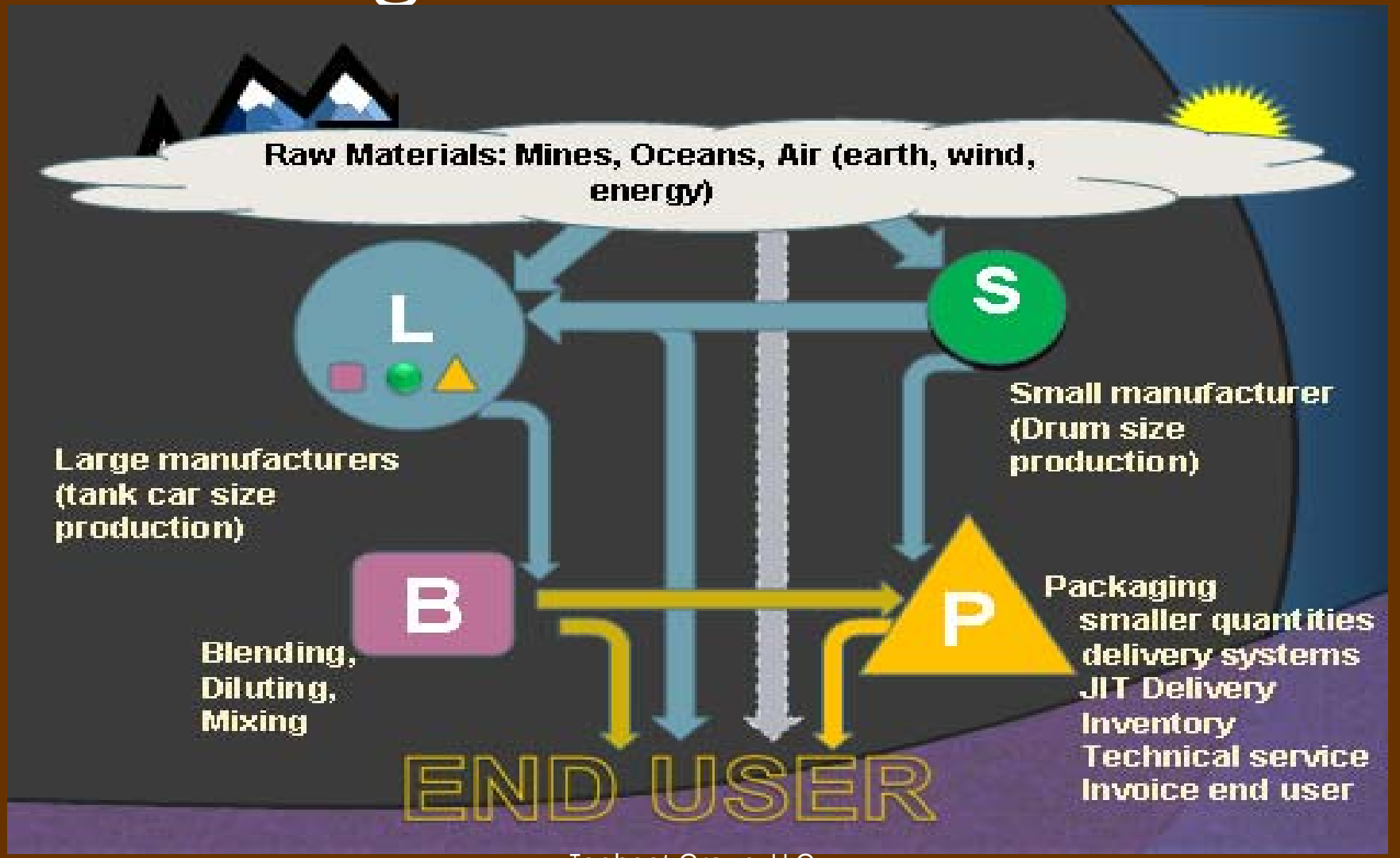
Intellectual Treasure Supply Chain

- 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?

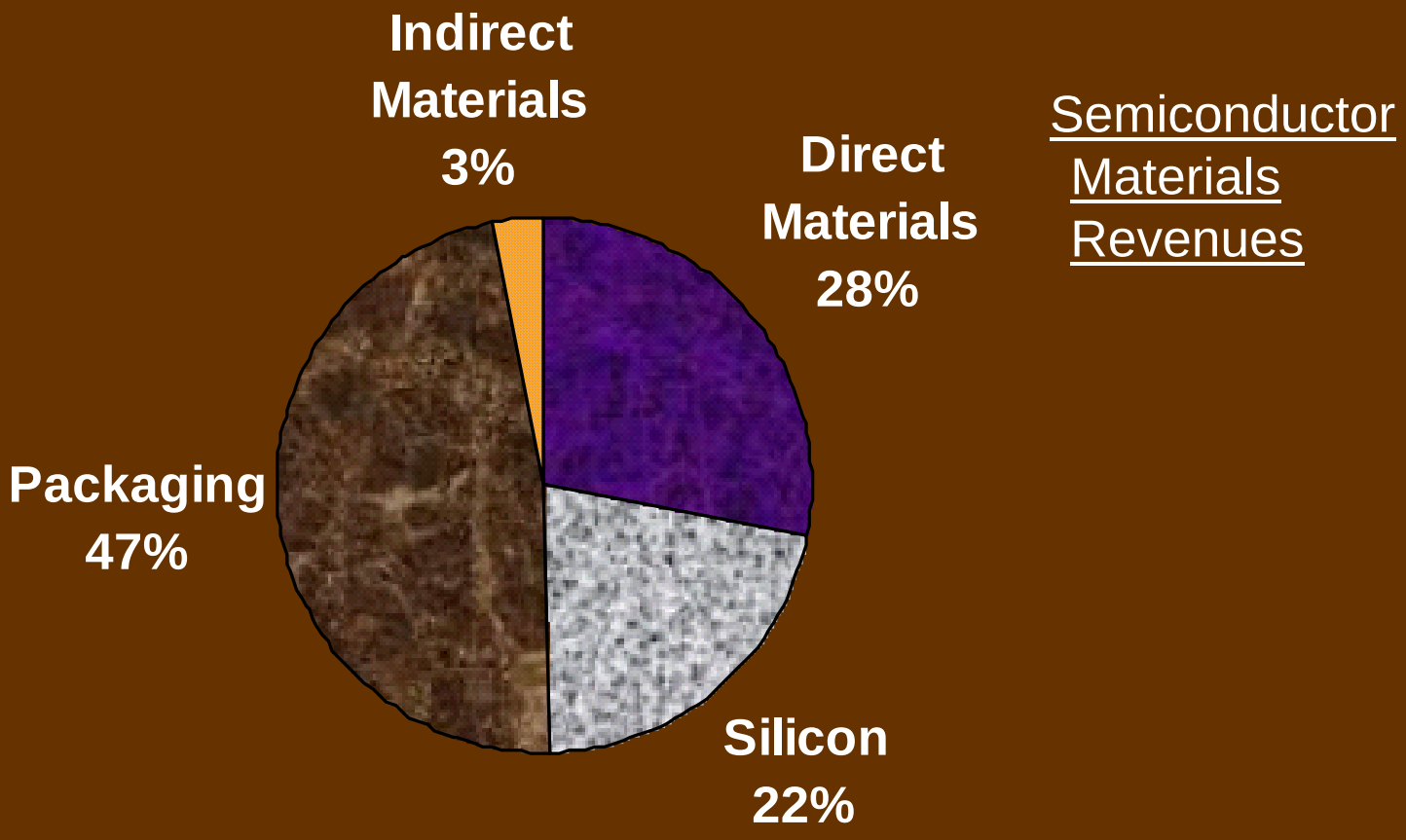
Skilled labor supply chain

- 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.

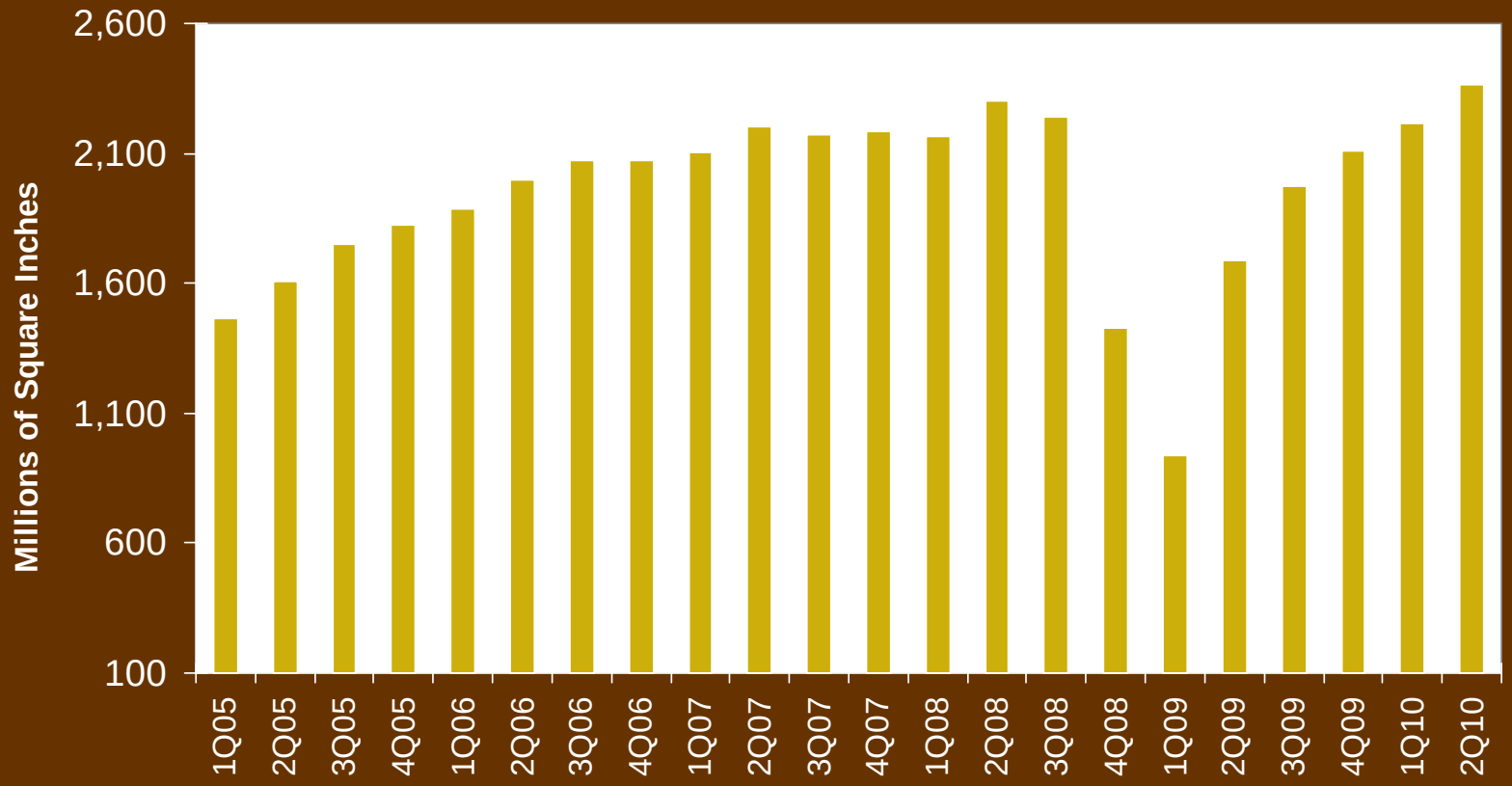
Materials Supply Chain, Always Looking for the Lowest Link



Electronic Materials



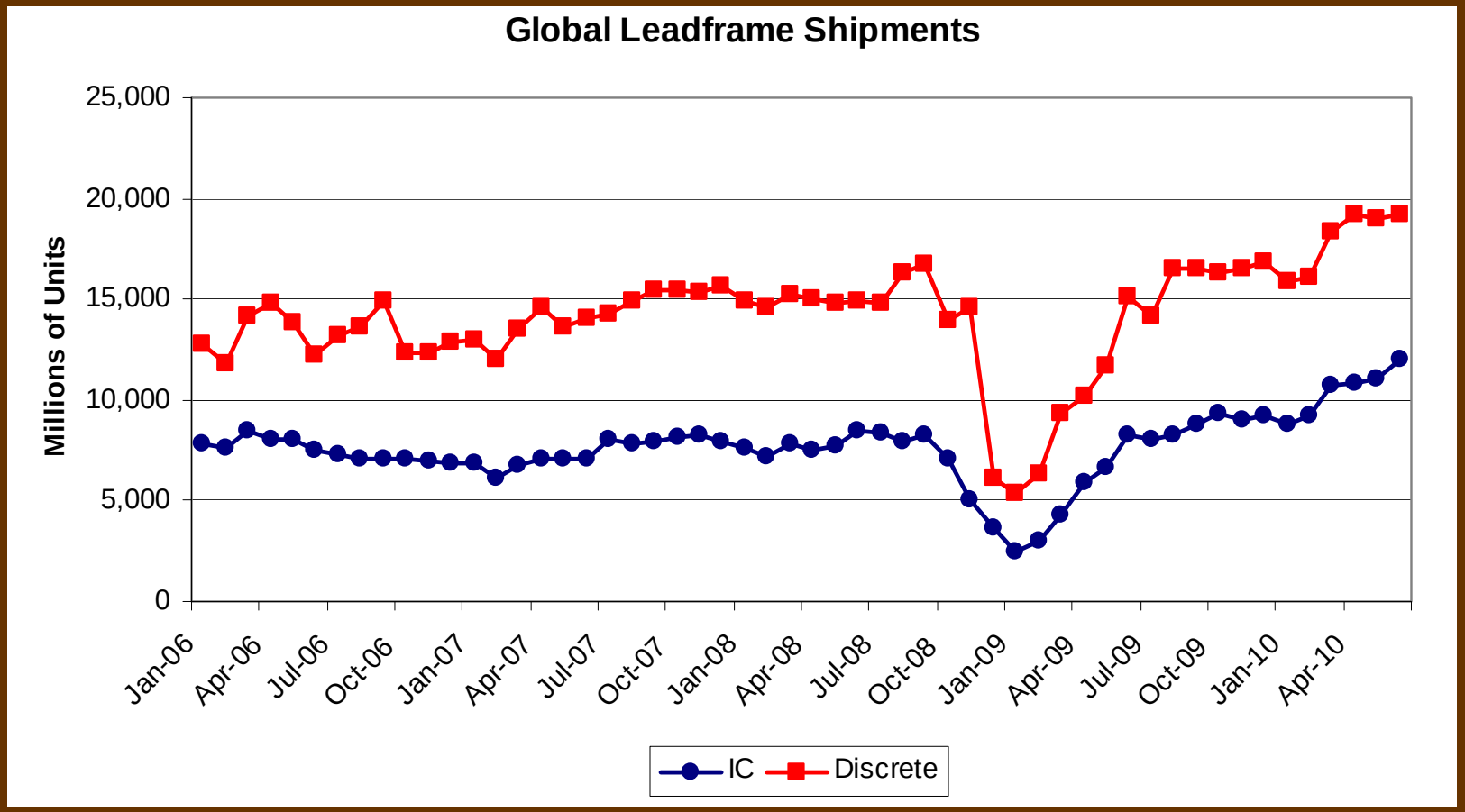
Silicon Wafer Shipments



Silicon shipments are for semiconductor applications only

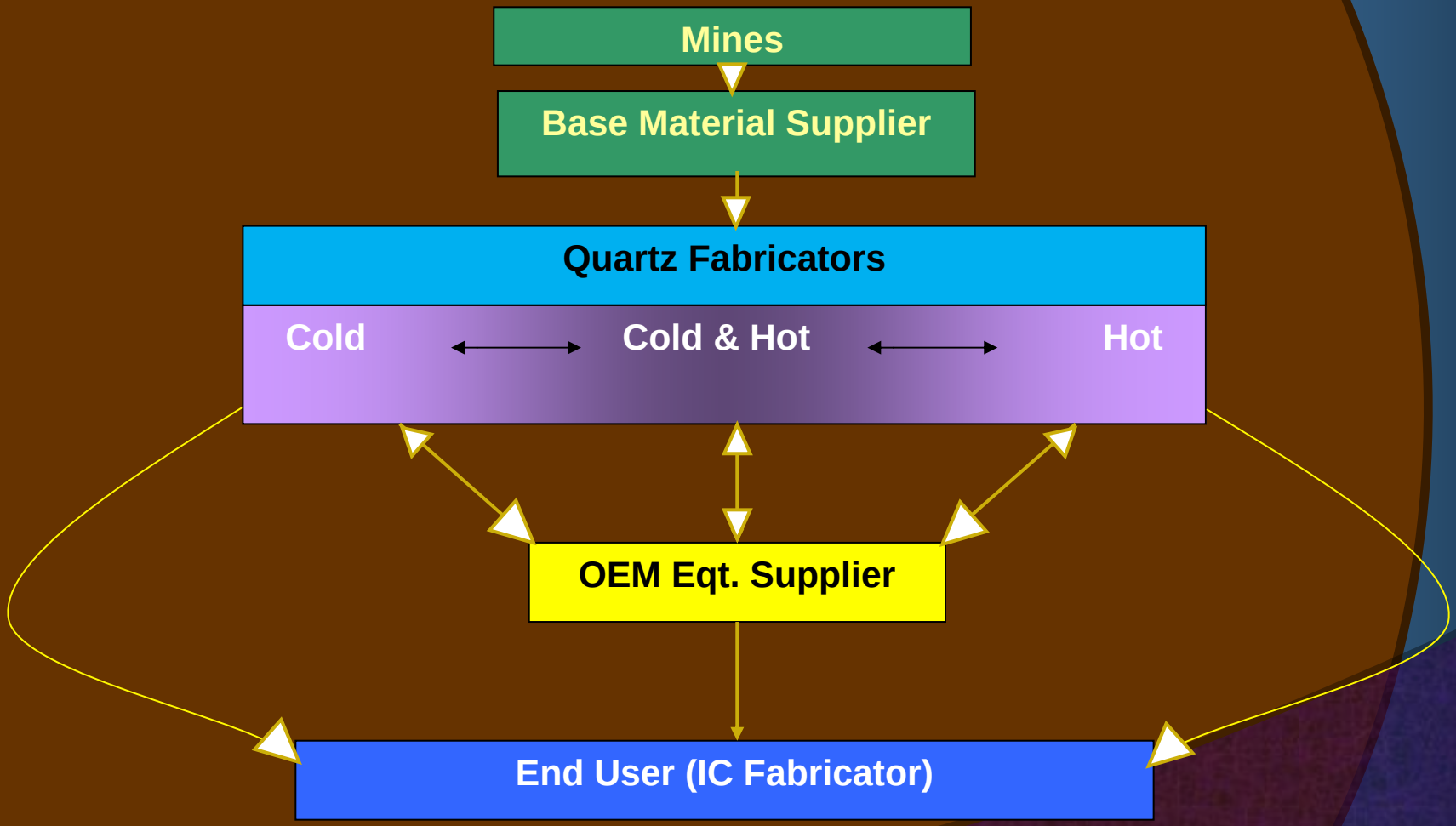
Source: SEMI Silicon Manufacturers Group July 2010

Leadframes unit shipments



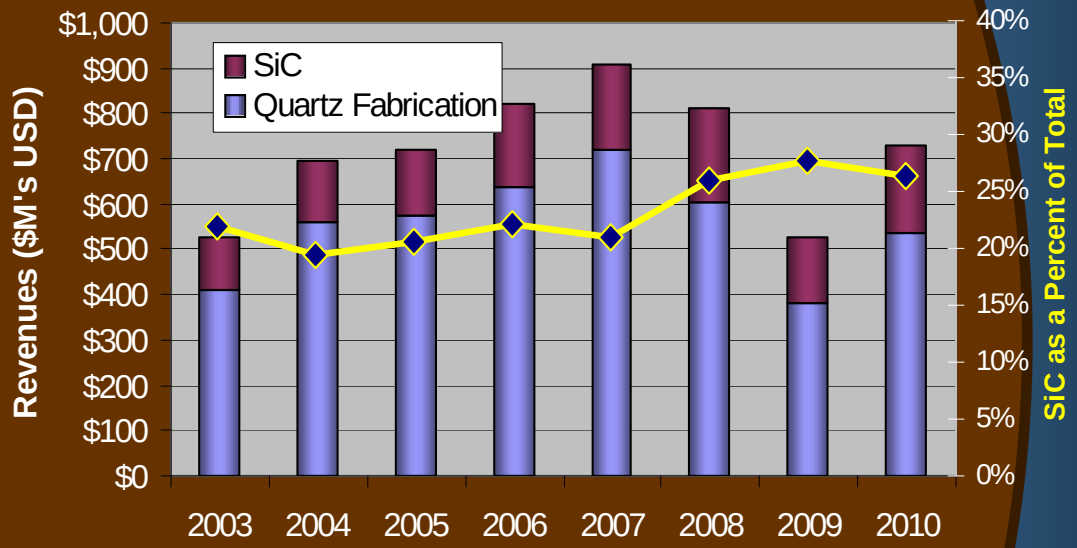
Source: SEMI Materials Market Data Subscription, July 2010

Indirect Materials Supply Chain



Indirect Materials Hit Hard – Quartz and SiC Markets

- SiC continues to gain relative market shares (performance and life time)
- Graphite losing ground based on "dirty" perception



- Silicon and SiC have such a better CTE, and cleaner reputation, they are hard to beat

Crazy Supply Chains

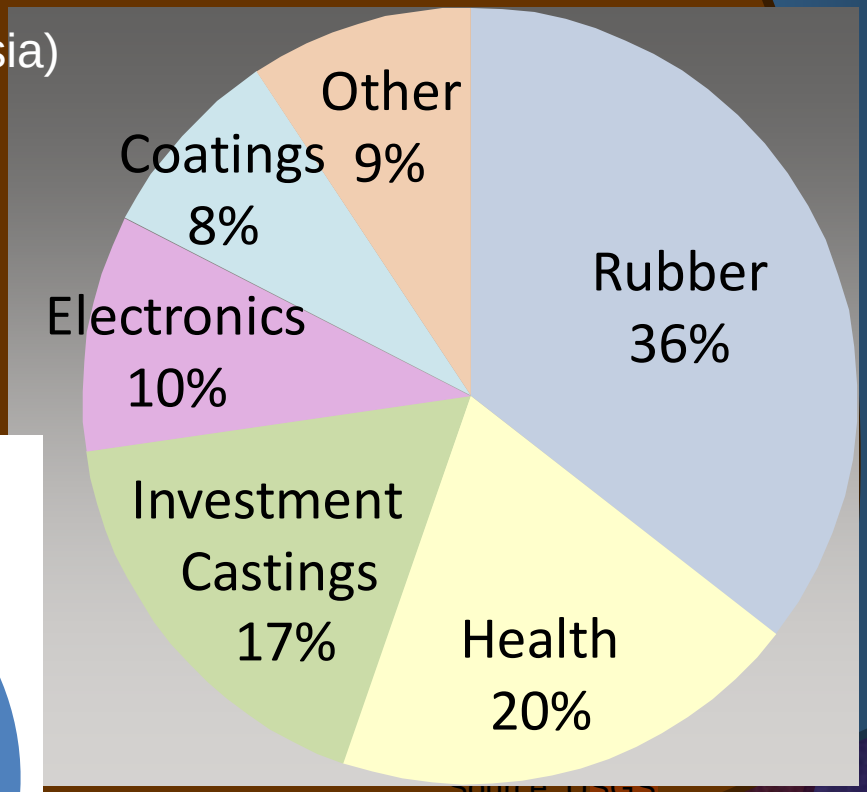
- Makers selling to: Manufacturers, “Blenders”, Purifiers and Repackagers who sell to each other
- OEMs competing with like parts/ materials suppliers (quartz, SiC, targets, Post CMP, metals, etc.)
- Users always trying to buy deeper in the chain to save money and control POR

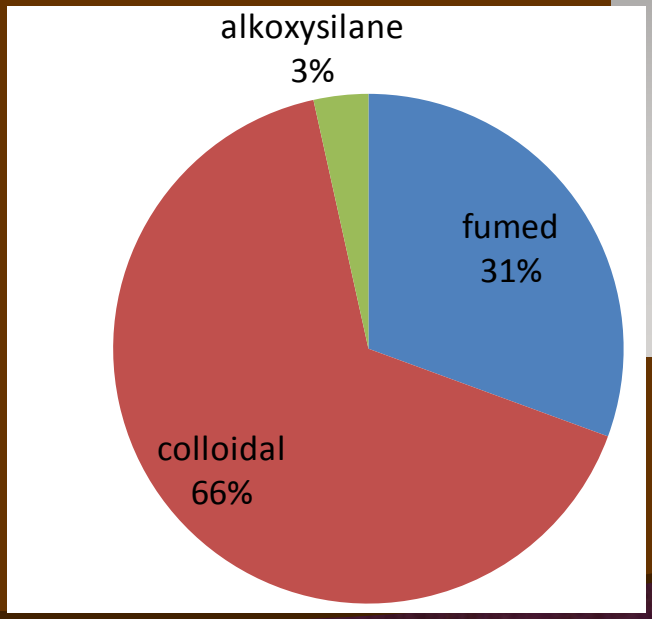
Silica Worldwide Use

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”



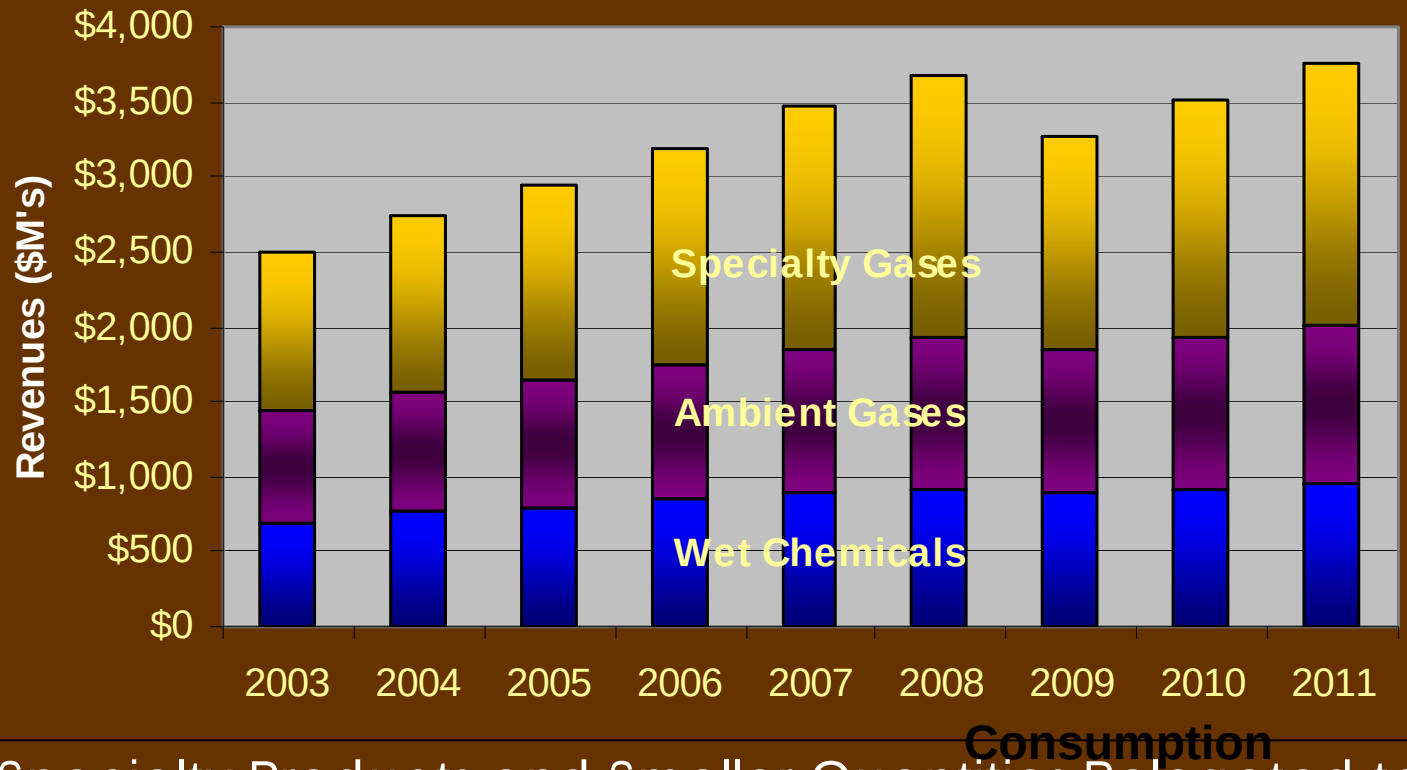


Supply Chain Shift

- Makers selling to end users
- US Makers consolidating or getting out of the business
- Solvents being minimized in IC Fabs- in older fabs, 30% solvents-newer fabs, 15%
- Asian material supplier market growing
- For other chemicals such as acids, we are too picky and cheap

Puppy Picture

Gases & Wet Chemicals



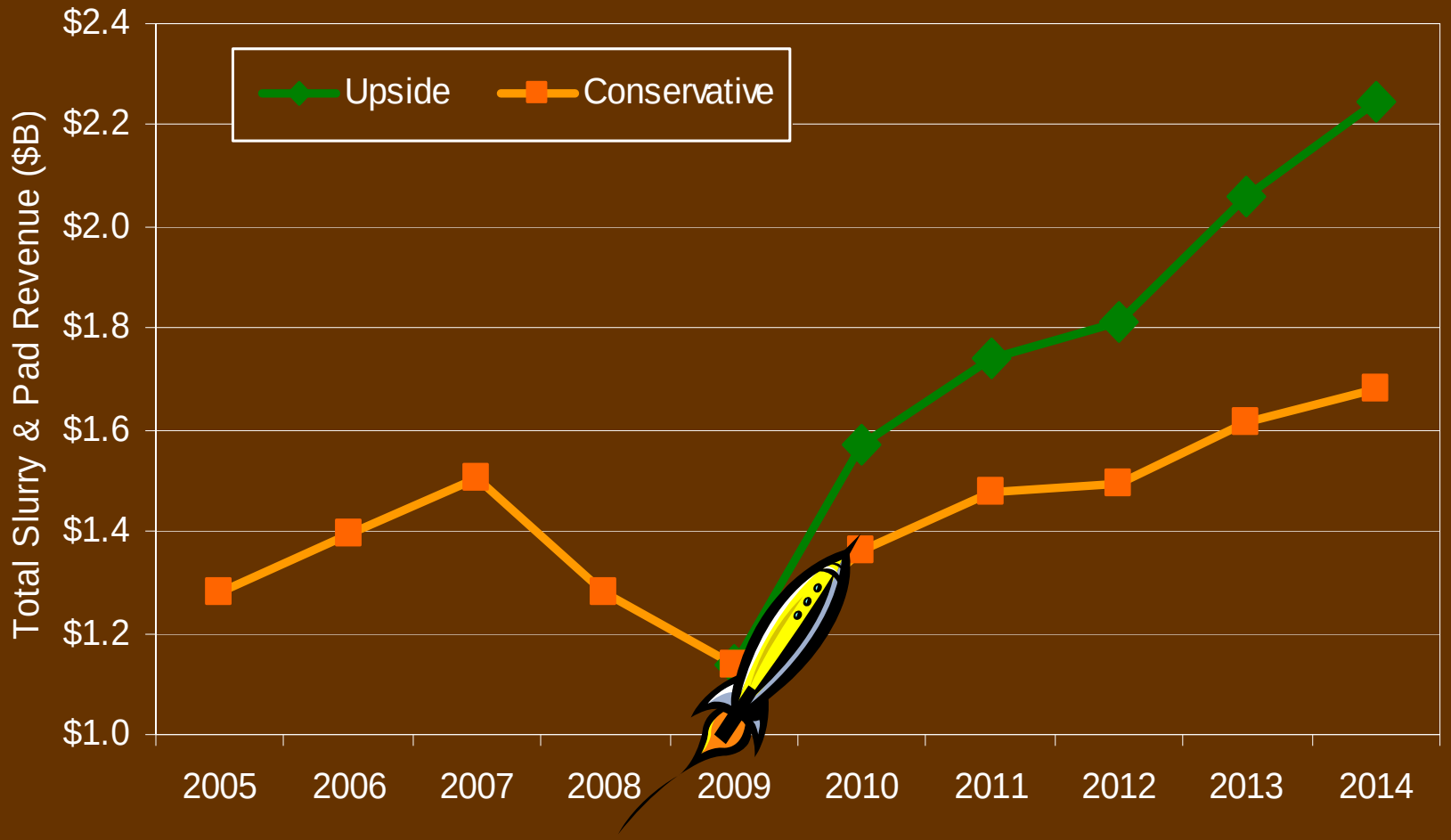
Source: USGS

- 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

Cost Reduction Focus 2008-09

- All IC Materials Are Affected
- Cheaper Materials
  - Sputter Target Purity versus Price
  - CVD/ALD Precursors (Hf-organo versus $HfCl_4$)
- Do More with Less
  - Previously Undiluted Slurries Diluted
  - Self-Mix of Post-CMP versus Specialty Chemical
- Cost Pressure Throughout the Supply Chain
- New Entrants Focus on Cost of Ownership
- The Possible Exception: New Technology (Hf, Zr, Ta, Co, Cu, etc. CVD or ALD Precursors)

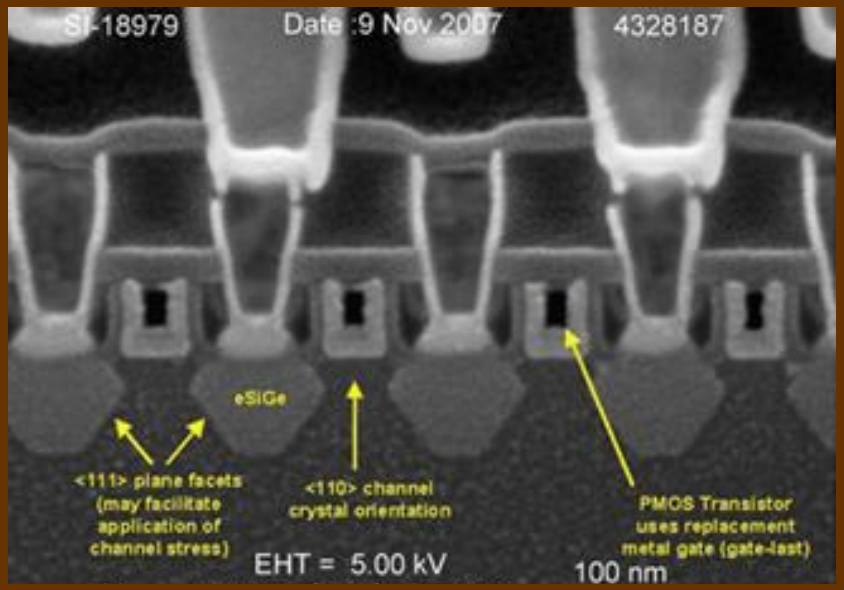
The Business of CMP - 2010



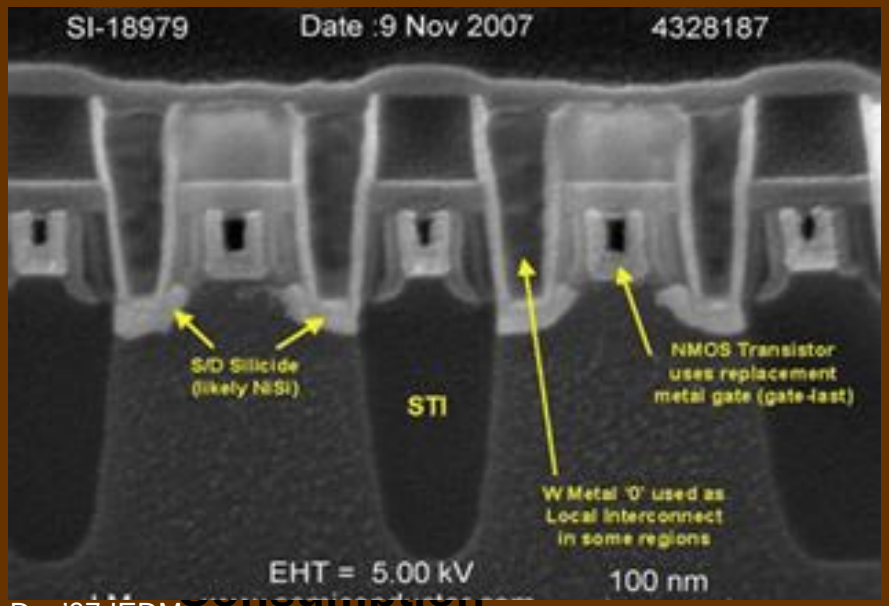
New High K – Metal Gate

Replacement Metal Gate Process

PMOS



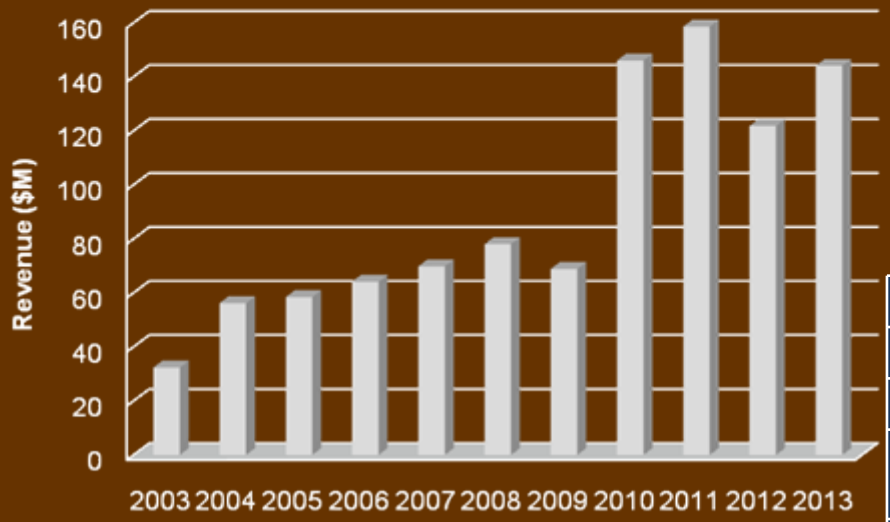
NMOS



Pictures from Dec'07 IEDM

- Significant growth expected for Precursors, for 2015 Market Size in Expected to be <$100M
- Slurry and pad folks say "Oh boy, more CMP" (Al)

Targets - Tantalum Supply and Demand

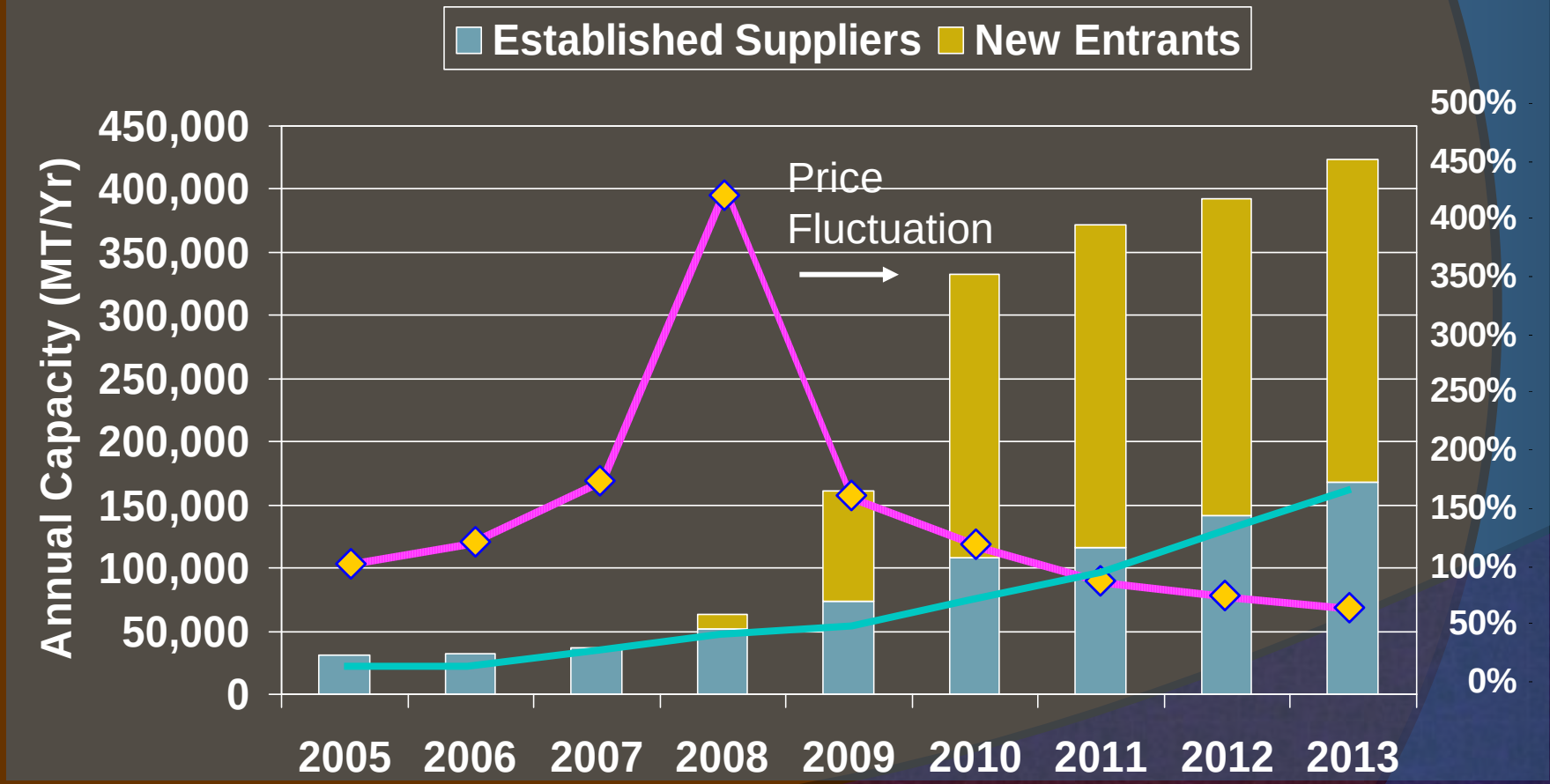


- **Poor demand impacting Ta market**
- **Main Ta Mine Moth-balled**

Ta	2000	2010 est	comments
Supply			
Australia	1.3	0.0	Mines shutdown
Africa	0.79	1.025	Humanitarian 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**	

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

Polysilicon

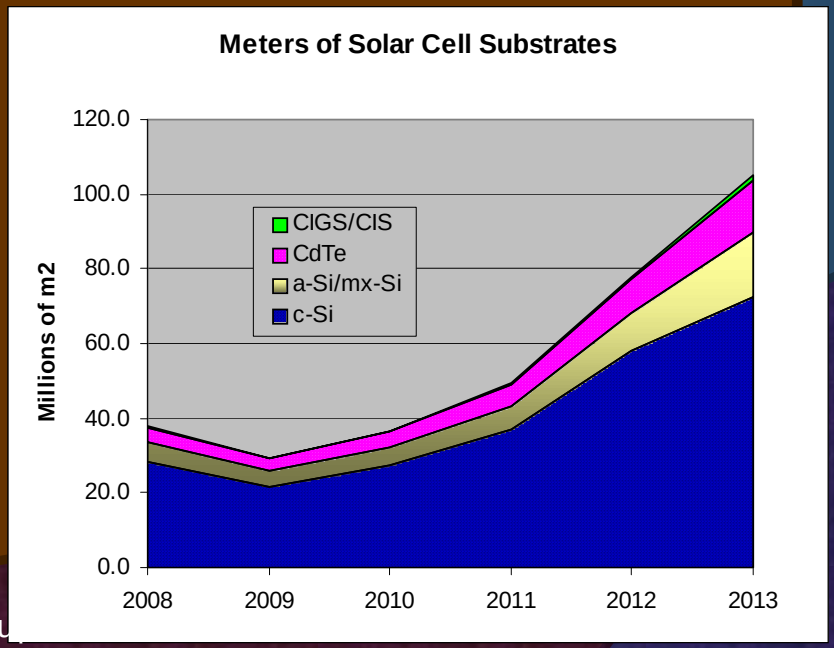


Source: SEMI and Techcet

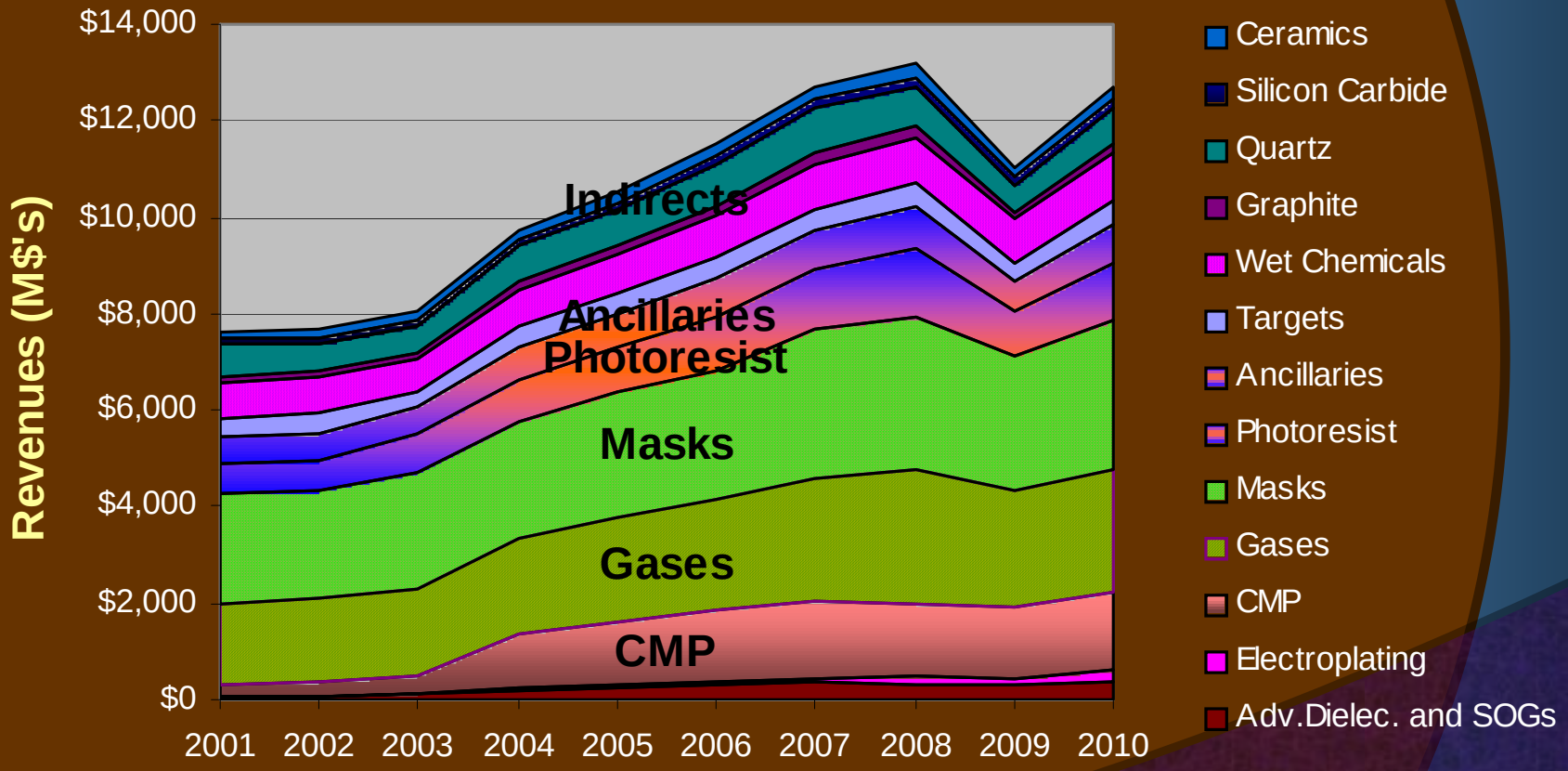
Supply Chain Cross-Links

- 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

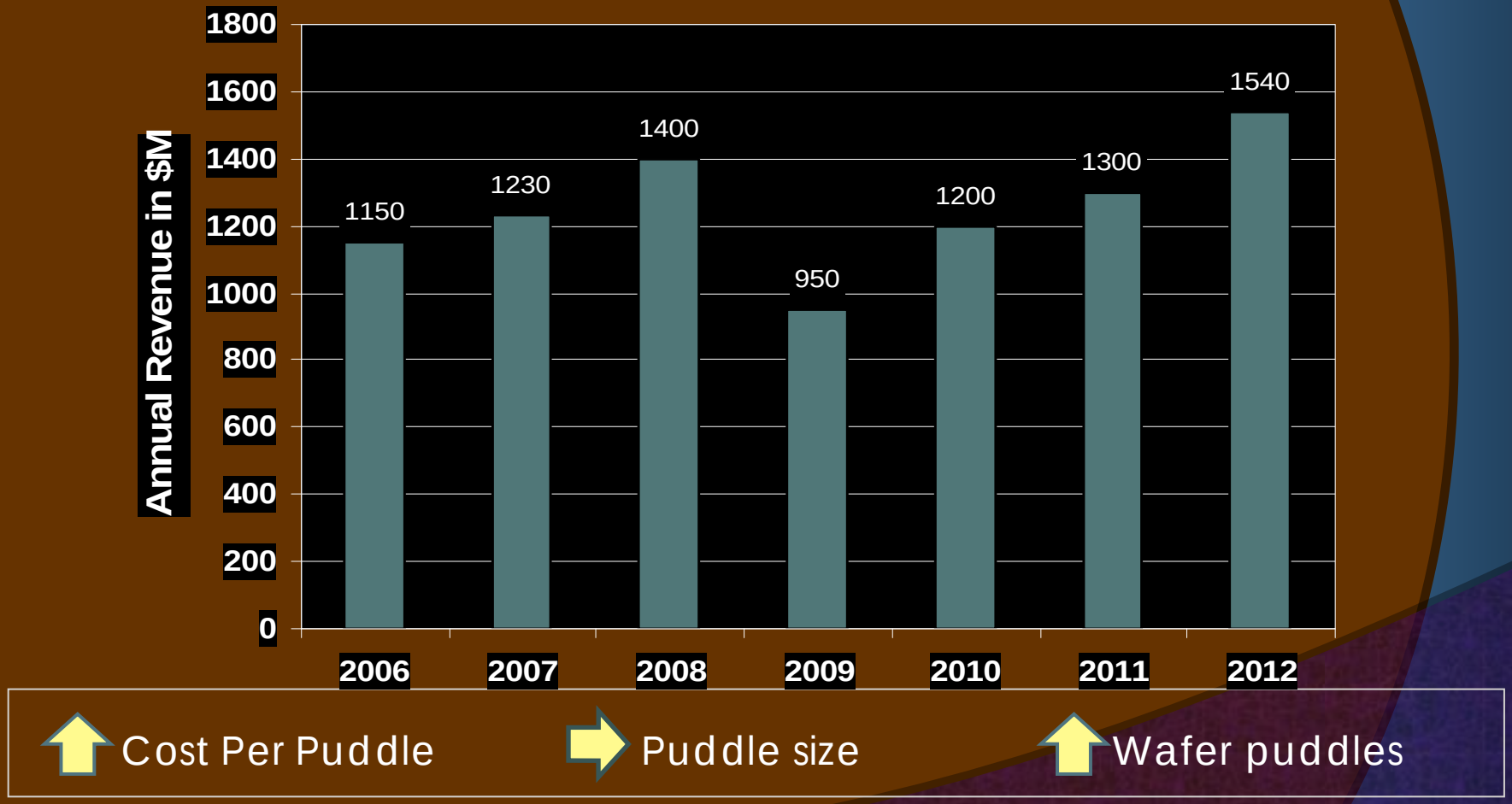


Front End Process Materials*



* Without Silicon

Worldwide Estimated Photoresist Market Size (in US$)



Conclusions?

- These four supply chains are at some level of 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, what about EUV?
  - Interconnect Materials (CMP, dielectrics, metals) > $2B
  - Front End Materials (dielectrics, metals) <$200M by 2015

Acknowledgments

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