



Funding The Future

in the Semiconductor Equipment & Materials Industry

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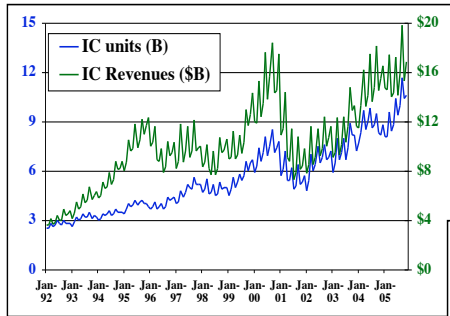
At A Crossroads

- Market drivers shift to Consumer
- Equipment & Materials experience slower growth
- Moore's Law technically remains intact for another 3+ generations
- Escalating cost of R&D required to maintain progress is creating an annual "gap" estimated at US\$9.3 billion by 2010



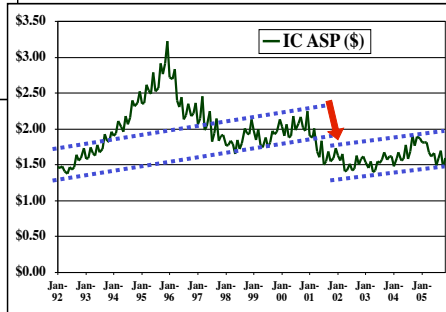


Consumer Pricing Impact



(source: SIA/WSTS)

- Long-term chip ASP increases at 4% CAGR
- But the 25% pricing dislocation in 2001 remains



- Units recovered post-2000 and continued to grow at 10% CAGR
- Dollars barely returned to prior peak

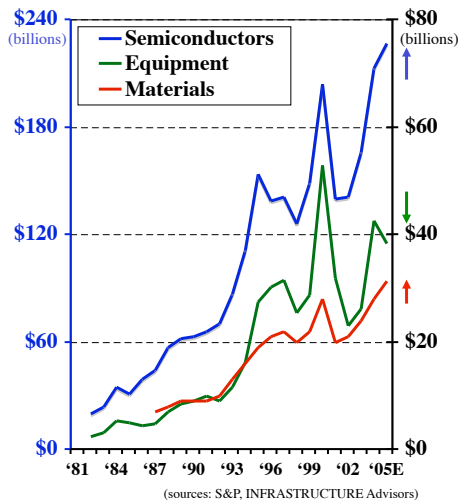
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Industry Revenue Slowdown



(sources: S&P, INFRASTRUCTURE Advisors)

- Volatility remains
- Semiconductor growth slowed from ~17% to 7%
- Equipment slowed from ~20% to 5% growth
- Materials growth down from ~13% to 4%
- The business has changed!

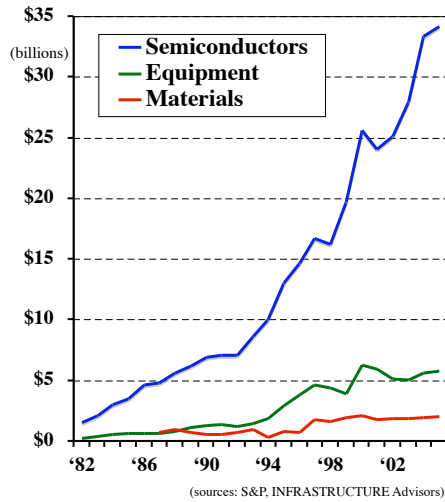
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R&D Spending



- In real currency terms, only the semiconductor device industry has been able to substantially increase R&D spending
 - Includes product & process
- Over the last 5 years, Equipment & Materials industry held R&D flat (\$)

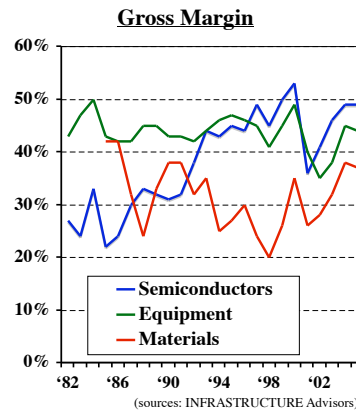
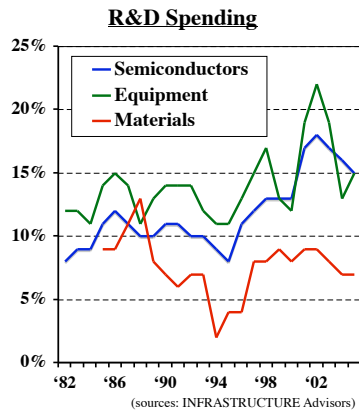
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Business Models



- R&D percentages increased for most sectors in last decade

- Only semiconductor industry's Gross Margin has improved

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Supply Chain R&D Spending

- **6% Research**
 - Most is “applied” vs “pure”
- **66% Development**
 - Growing 20% to 30% per generation
 - Process integration complexity is escalating
- **28% Support**
 - Ongoing integration
 - Continuous improvement
 - Global customer base

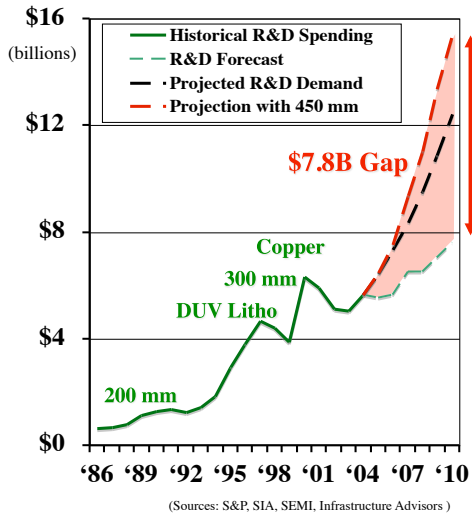


Factors Driving R&D

- **Continued CMOS scaling / new structures**
 - New materials
 - Tighter process control & metrology
 - More complex process integration
 - Next generation Lithography beyond immersion
- **Advanced packaging / new test methods**
- **Next wafer substrate - 450 mm silicon?**



Equipment R&D Funding Gap



- Historical R&D has been flat since 2000 peak
- Supply based on an assumed 14% of industry revenues
- R&D demand expected to grow at +20% to +30% per node
- Cumulative shortfall over 5 years will be \$15B
- Next substrate (450 mm ?) will drive up demand further
 - Adds another \$8B cumulative R&D demand

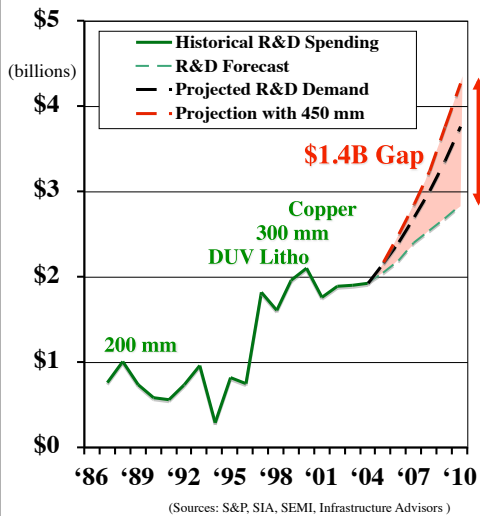
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Materials R&D Funding Gap



- Historical R&D has been flat since 2000 peak
- Supply based on assumed 6.8% of industry revenues
- R&D demand expected to grow at +20% to +25% per node
- Cumulative shortfall over 5 years will be \$2.6B
- Next substrate (450 mm ?) will drive up demand further
 - Adds another \$1.5B cumulative R&D demand

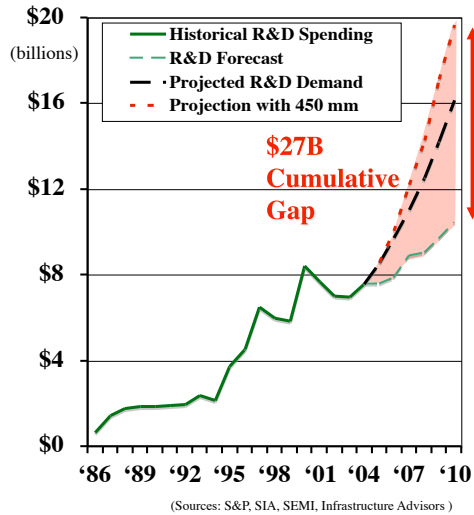
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R&D Funding Gap (Equip/Materials)



- Potential \$9B Gap between supply and demand in 2010
- Cumulative shortfall for “scaling” over 5 years will be \$18B
- Next substrate (450 mm ?) will drive up demand by further \$9B
- Where is the funding?
- Where is the ROI?

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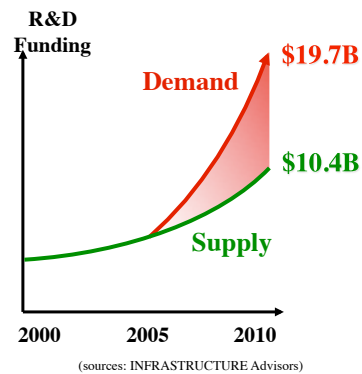
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Closing The Gap - Alternatives

- Strengthen business models
 - to maintain R&D spending in cyclic downturns
- Reduction of R&D costs
- Partnering & collaboration
- External funding
 - e.g. Customers
- Government funding/subsidies
 - Fundamental research
 - Integration labs
- Slow the Pace ?



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Industry Validation

- Research for White Paper supported by 48 organizations (60+ executives) including:

Advanced Energy Industries, Inc.	Cymer, Inc.	Mattson Technology, Inc.
Advantest Corporation	Dai Nippon Screen Mfg Co., Ltd	Micro Component Technology, Inc.
Agilent Technologies	DISCO Corporation	Micronic Laser Systems
Air Products and Chemicals, Inc.	The Dow Chemical Company	Nikon Corporation
Aixtron AG	EKC Technology, Inc.	Novellus Systems, Inc.
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Summary & Conclusions

- As the industry growth rates slow, so does the affordable level of R&D funding
- The demand for R&D spending is escalating with each node
- The resulting Gap will be substantial and will increase with incremental major programs
- There is a clear need for increased industry collaboration and more effective ROI analysis to reduce the R&D funding gap
- Need to avoid “blind alleys” and stimulate more creativity

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