



# Funding The Future

in the Semiconductor Equipment & Materials Industry

Ron Leckie

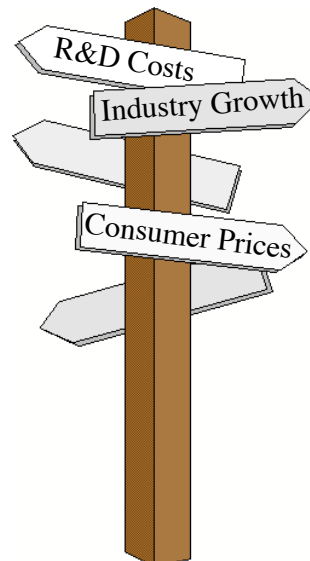
Silicon Valley Lunch Forum

11 May, 2006



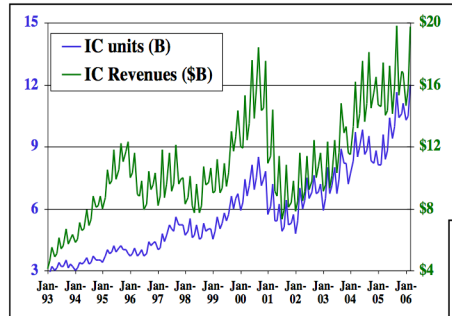
## At A Crossroads

- 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



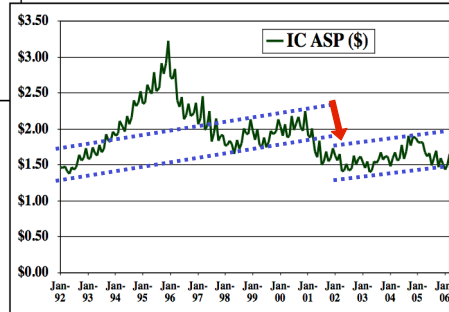


## Consumer Pricing Impact



(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

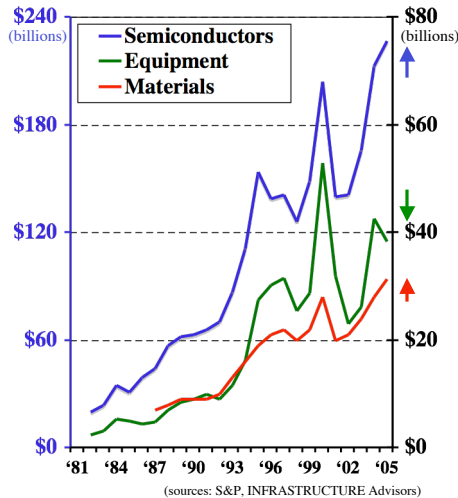
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## Industry Revenue Slowdown



(sources: S&P, INFRASTRUCTURE Advisors)

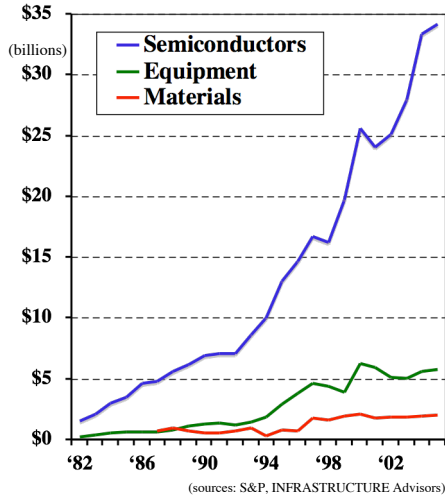
- Volatility remains
- Semiconductor growth slowed from ~17% to 7%
- Equipment slowed from ~20% to 5% growth
- Materials growth down from ~13% to 4%
- The business has changed!

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## R&D Spending



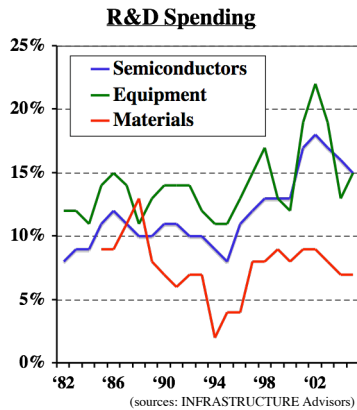
- In real currency terms, only the semiconductor device industry has been able to substantially increase R&D spending
  - Includes product & process
- Over the last 5 years, Equipment & Materials industry held R&D flat (\$)

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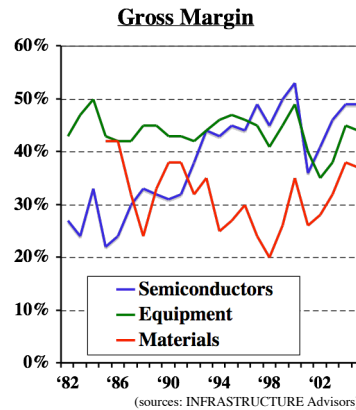
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## Business Models



- 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

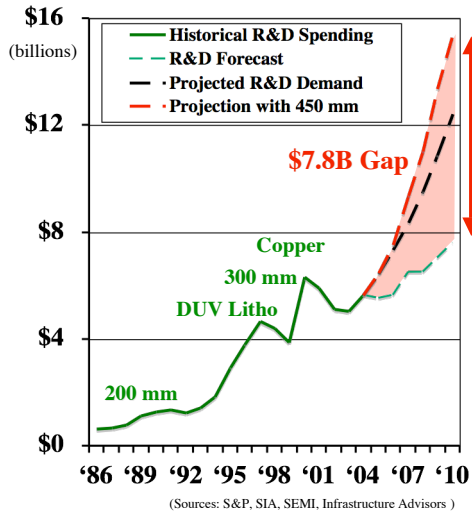


## Factors Driving R&D

- **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

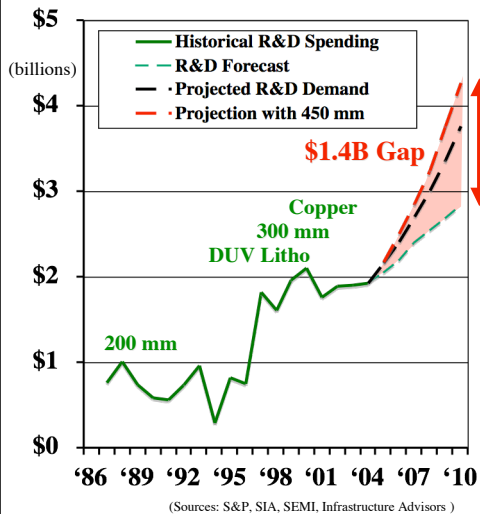
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## Materials R&D Funding Gap



- 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

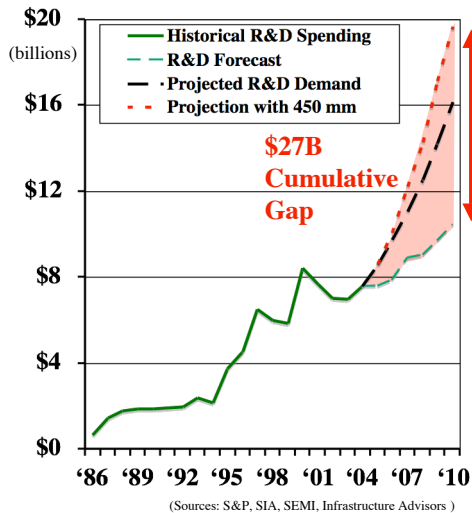
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## R&D Funding Gap (Equip/Materials)



- 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 cumulative demand by a further \$9B
- Where is the funding?
- Where is the ROI?

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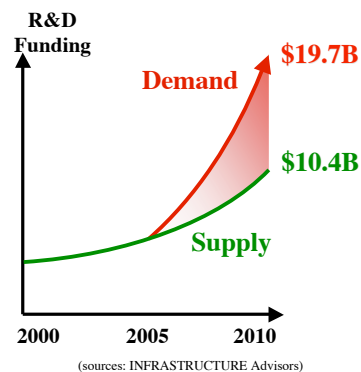
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## Closing The Gap - Alternatives

- 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.             |
| Applied Materials, Inc.          | Electro Scientific Industries, Inc. | Photonics Inc.                     |
| ASET                             | EV Group                            | Sumco USA                          |
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| Asyst Technologies, Inc.         | Hitachi High-Technologies Corp.     | Teradyne, Inc.                     |
| ATMI, Inc.                       | IMEC                                | Tokyo Electron, Ltd.               |
| Axcelis Technologies, Inc.       | KLA Tencor Corporation              | Toshiba Ceramics Co., Ltd.         |
| Brooks Automation, Inc.          | Kulicke and Soffa Industries, Inc.  | Unaxis Management, AG              |
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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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