Industrial College
Of Armed Forces

January 28, 2009

George Scalise
President
Semiconductor Industry Association
Profile of U.S. Semiconductor Industry

2007 Sales = $118 Billion

2007 World Market Share = 46% of $255.6 Billion Market

U.S. Jobs = 216,400

Percent of Sales Outside U.S. Market = 77%

R&D Investment = $20 Billion, 17% of Sales

Capital Equipment = $13 Billion, 11% of Sales

Historically about 25-30% of Revenues Invested in the Future

Source: SIA, U.S. DoL
Industry Revenue: SIA Forecast

Source: SIA Fall 2008 Forecast
Semiconductor Demand Drivers: 2009 Outlook

2009
Cell Phone Shipments
-6.4% (units)

2009
PC Shipments
-5% (Units)

2009
PMP/MP3
+8% (Units)

2009
Digital Still Camera
+7% (Units)

Sources: SIA Fall 2008 Forecast/iSuppli/ Deutsche Bank Securities Inc.
Note: Military is <1% and is included in Industrial.

$246.7B / -5.6%
2009
Semiconductors are America’s 2nd Largest Export 2007

Industry Defined By: NAIC Codes 336411 (Aircraft); 334413 (Semiconductors); 336111 (Automobiles)
Vacuum Tubes
ENIAC
IT producing industries spur growth.

IT Producing Industries are: Semiconductors, Computers, Communications, and Software.
Innovation Allows US to Do More With Less

*Increased functionality and a 66% price drop in Only 10 years!*

<table>
<thead>
<tr>
<th>Spec</th>
<th>1997</th>
<th>Q4 2007 (GT5622)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor</td>
<td>2nd Gen 32-bit</td>
<td>Intel E2160</td>
</tr>
<tr>
<td>Raw Power (Normalized)</td>
<td>1</td>
<td>80-120</td>
</tr>
<tr>
<td>Clock Rate (MHz)</td>
<td>75</td>
<td>1.8 GHz</td>
</tr>
<tr>
<td>Memory (MB)</td>
<td>9.2</td>
<td>3GB</td>
</tr>
<tr>
<td>Disk Storage (GB)</td>
<td>0.74</td>
<td>400GB</td>
</tr>
<tr>
<td>Modem</td>
<td>No</td>
<td>56K</td>
</tr>
<tr>
<td>Network Interface Card (NIC)</td>
<td>No</td>
<td>Ethernet</td>
</tr>
<tr>
<td>Graphics</td>
<td>Add-In</td>
<td>Integrated Chipset</td>
</tr>
<tr>
<td>CD ROM</td>
<td>1X</td>
<td>Multi-Format DVD Burner</td>
</tr>
<tr>
<td>CD-RW/DVD</td>
<td>No</td>
<td>None</td>
</tr>
<tr>
<td>Media Reader</td>
<td>None</td>
<td>15-in-1</td>
</tr>
<tr>
<td>Removable Storage</td>
<td>Floppy Disk (1.5MB)</td>
<td>Flash Drive</td>
</tr>
<tr>
<td>Price</td>
<td>$1,833</td>
<td>$630</td>
</tr>
</tbody>
</table>

Source: Gateway January 2008
Computing Price Declines Allow Government To Do More With Less Money

$128 Billion Cumulative in “Free” Computing Resulting From Technology Advancements Since 1998

Government Consumption Of Computers ($Billions)

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual Spending</th>
<th>at ’98 Prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>1999</td>
<td>9.5</td>
<td>14.7</td>
</tr>
<tr>
<td>2000</td>
<td>9.2</td>
<td>16</td>
</tr>
<tr>
<td>2001</td>
<td>7.7</td>
<td>13.9</td>
</tr>
<tr>
<td>2002</td>
<td>7.5</td>
<td>15.7</td>
</tr>
<tr>
<td>2003</td>
<td>7.2</td>
<td>16.8</td>
</tr>
<tr>
<td>2004</td>
<td>7.6</td>
<td>20.6</td>
</tr>
<tr>
<td>2005</td>
<td>7.6</td>
<td>24.2</td>
</tr>
<tr>
<td>2006</td>
<td>8.2</td>
<td>34</td>
</tr>
<tr>
<td>2007</td>
<td>8.8</td>
<td>45.8</td>
</tr>
</tbody>
</table>

Source: Bureau of Economic Affairs (www.bea.gov/national/xls/comp-gdp.xls)
Note: Includes Federal, State, and Local Governments.
Unprecedented actions in the mid-1980’s contributed to U.S. retaking lead, but...
… Europe, Korea and Taiwan have made impressive gains.

Note: Market share is based on headquarter region of seller, i.e. foundry output does not count in Taiwanese market share.

Source: SIA
U.S. Losing Share in New Semiconductor Manufacturing Capacity

Source: SIA/SEMI
Semiconductor Capital Equipment Spending

Source: VLSI Technology, SIA Forecast
Although 77% of U.S. chip industry sales are outside the U.S. market, U.S. chip companies currently have more than half of their facilities and employment in the U.S.

- **23% of Sales in U.S. Market**
- **67% of U.S.-Owned Capacity in the U.S.**
- **51% of U.S. Industry’s Worldwide Employment in North America**
- **74% of U.S. Industry’s Labor Compensation in North America**

Source: SIA Annual Economic Survey/WSTS
US LEADERSHIP IN SEMICONDUCTORS

**UNIVERSITY RESEARCH**
- Increase Basic Research at America’s Universities to Maintain Leadership in Nanotech Era
- $20M Appropriation for Focus Center Program to Match Industry’s $20M
- Double NSF, NIST, & DOE Office of Science in 10 Years

**TALENT**
- Double Number of Science, Technology, and Engineering and Mathematics Graduate by 2015
- Improve K12 Math Science Education
- Keep Overseas Talent in the US by removing H-1B and Greencard Caps for Highly Skilled Workers

**LEVEL PLAYING FIELD**
- Permanent & Expanded R&D Tax Credit
- Encourage Repatriation of Earnings
- Allow Expensing of High Tech Equipment
- Reduce Tax Rates
- Encourage State Incentives

**PREREQUISITES**
- Open Markets, Antidumping, IP Protection, Export Control Reform, China WTO Implementation, Environmental Protection, Safe Workplace
Limits of Current CMOS Technology

- **Physical Limits:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>ITRS 22nm node (2016)</th>
<th>Physical Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum dimension</td>
<td>9 nanometers</td>
<td>1.5 nanometers</td>
</tr>
<tr>
<td>Fastest switching time</td>
<td>150 femto-seconds</td>
<td>40 femto-seconds</td>
</tr>
</tbody>
</table>

- **Power dissipation limits:** “Device-at-the-physical-limit” will dissipate several thousand Watts/square-cm

- **Technological Limits:** Pushing CMOS to its ultimate limits requires revolutionary materials and device innovations that have significant scientific and engineering barriers

- **Economic Limits:** Implementing all the technology innovations may raise manufacturing and development costs to being beyond the reach of all but a few global entities.
The Focus Center Research Program: fostering innovation for the most intractable problems

Roadmap
Hitting Physical Limits in Silicon--ITRS ‘Red Brick Wall’

National University Research Program Entirely for IC Technology
- Engages the best and the brightest
- Partnership with US Gov.
- Covers entire Semiconductor ‘food chain’
- Focuses on the most intractable problems
- Supplies next generation technology leaders

US Semiconductor Industry Growth

Increasing Product Complexity & Shrinking Design Cycles

Dwindling Supply of Qualified Engineers

Shrinking Long-range Research Budgets & Drying Pipeline
The Focus Center Academic Talent Pool

Top universities and faculty talent are engaged with the FCRP
(41 Universities, over 200 Research Faculty, ~ 500 Students)
NRI Funded Universities

35 Universities in 20 States
Foreign Nationals Represent the Majority of Masters and Ph.D. EE Graduate Degrees at U.S. Universities

Source: Report from the Engineering Workforce Commission of the American Association of Engineering Societies: 2006 Engineering and Technology Degrees
The Obama-Biden Technology Agenda

- Deploy next-generation broadband
- Double funding for basic research
- Invest in university-based research
- Make the R&D tax credit permanent
- Ensure competitive markets
- Protect American intellectual property
- Make math and science education a priority
The Obama-Biden Technology Agenda Continued

- Encourage careers in science and engineering
- Employ science and technology to solve America’s most pressing problems
  - Health care
  - Climate-friendly energy development
  - Modernize public safety networks
  - Advance biomedical research
World Semiconductor Council Overview

- World Semiconductor Council (WSC) represents world’s major semiconductor producing countries/regions
  - US, Japan, Europe, Korea, Chinese Taipei, China
  - CEO’s meet in May

- Officials representing WSC members participate in Governments/Authorities Meeting on Semiconductors (GAMS)
  - Receive and discuss WSC recommendations.

- WSC and GAMS address policy objectives that benefit worldwide industry
  - Opening markets for semiconductor and downstream products
  - Promoting best practices in environment, safety and health
  - Protection of IP

http://www.semiconductorcouncil.org/
WSC: Key Achievements

- MCP Zero Tariff Agreement – eliminated US, Korean, EU tariffs
- Agreements to two reduce use of chemicals, PFC and PFOS, that have environmental impacts.
- Policy proposals regarding layout design IP
- Position on antidumping – consensus reached among all members
- Position on levies – position taken against policies that tax growth of key semiconductor demand drivers
- Support for Doha/tariff elimination – supporting growth of key demand drivers
Advisory Councils Help Shape Technology Policies

- President’s Council of Advisors on Science and Technology (PCAST)
- President’s Information Technology Advisory Committee (PITAC)
Semiconductors - Driving Innovation, Shaping The Future

EDUCATION
- Classroom computers
- Online learning
- Accessing information

ECONOMIC GROWTH
- Improving productivity
- Enabling innovation
- Reducing costs
- Slowing inflation

ENERGY SOLUTIONS
- Enabling alternate energy sources
- Reducing transmission losses
- Energy-efficient homes and vehicles
- Fuel-efficient transportation

HEALTH CARE
- Technology drives advances in medical science
- New tools improve health care:
  - Diagnostic tools
  - Robotic surgery
  - Tools for minimally-invasive surgery
- IT lowers cost of delivery of health care

AGING POPULATIONS
- U.S. and China have aging populations
- Fewer workers to support retired people
- Improved productivity is the solution