SEMICONDUCTOR INDUSTRY ASSOCIATION

2005 ANNUAL REPORT

2020 IS CLOSER THAN YOU THINK

SIA 2005 ANNUAL REPORT CONTENTS

LAST YEAR, MORE TRANSISTORS WERE PRODUCED—AND AT A LOWER COST—THAN GRAINS OF RICE.

*** MOORE'S LAW:**

In 1965, Gordon Moore observed that the number of components on an integrated circuit was doubling roughly every 12 months with a commensurate reduction in cost per component. In 1970, he extended the amount of time to 24 months.

	Logic	Memory
1965		
1966		
1967		
1968		
1969		
1970		
1971		
1972	2,500	1,000
1973		
1974	3,200	4,000
1975		
1976		
1977		
1978	29,000	16,000
1979		
1980		
1981		
1982	120,000	64,000
1983		
1984		
1985		
1986	275,000	256,000
1987		
1988		
1989		
1990	1,180,000	1,000,000
1991		
1992		
1993		
1994	3,100,000	4,000,000
1995		
1996	7,500,000	16,000,000
1997		
1998	24,000,000	64,000,000
1999		
2000	42,000,000	128,000,000
2001		
2002	220,000,000	256,000,000
2003		
2004	410,000,000	256,000,000
2005	1,700,000,000	1,000,000,000

Transistors per integrated circuit: Logic / Memory

40 YEARS OF EXPONENTIAL PROGRESS

IT IS IMPOSSIBLE TO OVERSTATE THE IMPACT OF 40 YEARS OF CONTINUOUS PROGRESS IN SEMICONDUCTOR TECHNOLOGY. AS THE COMPLEXITY OF INTEGRATED CIRCUITS HAS CONTINUED TO DOUBLE EVERY COUPLE OF YEARS—THIS ABILITY TO CRAM AN EVER-INCREASING NUMBER OF COMPONENTS ONTO A CHIP AT CONSTANTLY DECLINING COST HAS REVOLUTIONIZED VIRTUALLY EVERY ASPECT OF HUMAN ENDEAVOR.

IN 1978, A COMMERCIAL FLIGHT BETWEEN NEW YORK AND PARIS COST $900 AND TOOK SEVEN HOURS. IF THE PRINCIPLES OF MOORE'S LAW WERE APPLIED TO THE AIRLINE INDUSTRY, THAT FLIGHT WOULD NOW COST ABOUT A PENNY AND TAKE LESS THAN ONE SECOND.

SCIENTISTS BELIEVE THAT ADVANCES IN SEMICONDUCTOR TECHNOLOGY CAN CONTINUE TO PROGRESS ACCORDING TO MOORE'S LAW FOR ANOTHER 10 TO 15 YEARS. THAT'S THE GOOD NEWS.

2020 REACHING THE LIMIT

THERE ARE LIMITS—physical, technological, and economic—to continued scaling of semiconductor components using the mainstream technology of today. Scientists generally agree that these limits will be reached around 2020. Without new breakthroughs, the pace of progress in semiconductor technology will slow considerably, as will progress in all of the related technologies—especially information technology—that depend on semiconductors. That's the bad news.

The limits of current technology do not necessarily mean an end to progress. With a sustained and coordinated commitment to basic research by the semiconductor industry, academia, and the federal government, the obstacles to continued advances in information technology can be overcome. The Nanotechnology Era will require new materials, new device structures, and new manufacturing methods.

THE CHALLENGES ARE ENORMOUS—BUT SO ARE THE REWARDS FOR SUCCESS.

LETTER FROM THE PRESIDENT

Forty years ago, a young engineer from Fairchild Semiconductor authored a magazine article in which he observed that progress in semiconductor technology had been advancing at an exponential rate, with the number of transistors on a chip doubling every year since the invention of the integrated circuit. He noted that the ability to cram more components onto each chip was also driving exponential reductions in the cost of each transistor. The author went on to predict that these advances would one day lead to "such wonders" as home computers, automatic controls for automobiles, and personal communications equipment.

Today, of course, we take these wonders—and many more—for granted, and the observation of Gordon Moore is universally known as "Moore's Law."

Elsewhere in this report are essays by G. Dan Hutcheson, chief executive officer of VLSI Research, and Professor Dale Jorgenson of Harvard University, detailing the contributions that continuous advances in semiconductor technology have made to the improvement of the human condition throughout the world.

Indeed, the pace of progress in our industry has been so continuous and so steady that we have almost come to assume that such progress is inevitable. In the real world, however, progress is not inevitable. Moore's Law, as its author has repeatedly insisted over the years, is really an observation, not a law of physics. The fact that Moore's Law, albeit through several iterations, has remained in effect for four decades is a testament to the dedication and creativity of scientists and engineers in industry, government, and university research programs throughout the country.

In the final analysis, Moore's Law really is all about competition. In a number of segments of the semiconductor industry, leading-edge—and sometimes even "bleeding-edge"—technology is absolutely essential to remaining competitive. Even in those product lines that do not require leading-edge process technology, continuous technological advances have yielded benefits for everyone, including chipmakers, their customers, and ultimately the end-users of semiconductor-based products.

Today we are in a global competition for leadership in the Nanotechnology Era. Within our industry there is general agreement that this new era begins when we reach the ultimate scaling capabilities of CMOS technology. At SIA, we are working to ensure that U.S. semiconductor manufacturers will lead the way into the Nanotechnology Era.

The experts who produce the International Technology Roadmap for Semiconductors (ITRS) project that we will reach the scaling limits of CMOS technology within 15 years, or sometime around 2020. History tells us that it typically takes around 15 years to move from basic research on a new technology to commercial implementation.

Our immediate challenge therefore is twofold:

First, we must continue aggressive research to solve the barriers along the road to ultimate CMOS technology.

Second, we must launch a major research program to identify new materials, create new device structures, and develop new manufacturing methods that will enable U.S.-based companies to continue to lead advances in information technology at the pace of Moore's Law in the Nanotechnology Era.

The Focus Center Research Program (FCRP) was established by SIA in 1999 to undertake coordinated research to keep pace with the ITRS. The FCRP involves more than 30 leading universities, the U.S. semiconductor industry, and the federal government to take CMOS technology to its ultimate limits.

This year SIA will launch the Nanoelectronics Research Initiative (NRI)—a collaborative research effort involving government, industry, and academia on the new materials, device structures, and assembly methods that will be essential in the Nanotechnology Era.

Meanwhile, we must and will continue to deal with the more immediate challenges confronting the U.S. semiconductor industry.

OUR PRIORITIES FOR 2005:

Continuing efforts to bring China into the mainstream of the world trading community, with special short-term emphasis on improving intellectual property protection.

Driving continuous improvement in all aspects of environmental protection and maintaining the safest possible working environment for those employed in semiconductor manufacturing throughout the world.

Successfully launching the NRI, including building a national consensus on the initial priorities, organizational structure, and funding of the NRI effort.

Working to assure that U.S. chipmakers continue to be the world leaders in semiconductor technology through coordinated research on "ultimate CMOS" technology.

As 40 years of progress under Moore's Law have demonstrated, the U.S. semiconductor industry thrives on challenge. Maintaining world leadership will not be easy. We face intense competition from nations and regions around the world that have recognized the value and importance of leadership in semiconductor technology. Our nation's economic progress, standard of living, and national security depend in large measure on maintaining leadership in semiconductor technology.

With the continued support and involvement of SIA members, I am confident that we are up to the challenge.

George M. Scalise

GEORGE M. SCALISE
President

THE MAN BEHIND THE LAW

While Gordon Moore is primarily known for the observation that is universally known as “Moore’s Law,” there is much more to the man behind the law. His career spans the entire history of solid-state electronics and his contributions to the growth of the microelectronics industry would fill volumes.

Born in San Francisco in 1929, Moore first became interested in science at an early age when a neighbor boy received a chemistry set for Christmas. Moore soon discovered that learning how chemicals interacted could be very exciting. As he told a reporter for the *San Jose Mercury News*, “With my chemistry set, I had to get a good explosion at the end or I wasn’t happy.”

Moore earned a B.S. in Chemistry from the University of California at Berkeley and a Ph.D. in Chemistry and Physics from the California Institute of Technology. After a brief stint as a researcher at Johns Hopkins University, he caught the eye of future Nobel laureate William Shockley. Moore was recruited as one of the original engineers at Shockley Semiconductor Company, a venture set up to manufacture transistors. Shockley Semiconductor proved to be a difficult working environment, and Moore and seven colleagues soon left to launch Fairchild Semiconductor Corporation, the progenitor of hundreds of future high-tech startups.

When his Fairchild colleague Robert N. Noyce invented the planar integrated circuit that made possible high-volume, cost-effective manufacture of integrated circuits, a new industry was born.

In the earliest days of the IC industry, engineers at Fairchild had to invent and build nearly every piece of equipment required to fabricate chips. For example, the first lenses used in the photolithographic process were actually 16mm movie camera lenses that Noyce purchased from a store in San Francisco. This early immersion in every aspect of the production process

Gordon Moore, 1975

left an indelible impression on Moore, especially concerning the day-to-day problems in producing semiconductors in volume. From the outset, he recognized the vital importance of close collaboration—and physical proximity—between research and development and manufacturing. This linkage is even more critical today as the industry approaches the physical limits of current technology.

In 1968, Gordon Moore, along with co-workers Noyce and Andrew S. Grove, left Fairchild to found Intel Corporation. Moore served as chief executive officer of Intel from 1975 until 1987.

Throughout his long career, Moore remained first and foremost a scientist with a keen interest in finding solutions to challenges to continued progress in microchip technology. Even as a senior executive at Intel, Moore was often the "go-to guy" who could identify and solve the problems that inevitably occur when a new product moves from lab to fab.

In 1992, Moore spearheaded the creation of a consortium of technology experts to create and continuously update the International Technology Roadmap for Semiconductors—a rolling 15-year forecast of research requirements.

Gordon Moore has contributed much to the basic science of the industry, but his most widely acclaimed contribution will no doubt be the observation he made 40 years ago—an observation that became the semiconductor industry's most important competitive benchmark.

TODAY, A $1,200 PERSONAL COMPUTER HAS MORE PROCESSING POWER THAN THE MAINFRAME COMPUTERS USED BY NASA TO PUT MEN ON THE MOON IN 1969.

40 YEARS OF MOORE'S LAW

G. DAN HUTCHESON
CHIEF EXECUTIVE OFFICER, VLSI RESEARCH INC

It has been 40 years since Gordon Moore first posited what would one day come to be known as Moore's Law. Gordon's ideas were more than a forecast of an industry's ability to improve, they were a statement of the ability for semiconductor technology to contribute to economic growth and even the improvement of mankind in general. More importantly, Moore's Law set forth a vision of the future that harnessed the imaginations of scientists and engineers to make it all possible.

1970/1,000

The first DRAM chip, developed in 1970, had a capacity of 1,000 bits. Contemporary 4GB DRAM chips can hold 32 billion bits—enough to store the complete works of Shakespeare four times on a single chip.

Today, we take many of the benefits of Moore's Law for granted. Yet if you look behind the curtains of the new breakthrough sciences, as well as many of the mundane, you will find semiconductors working. Much would not be possible without the relentless progress of the semiconductor industry doubling performance for the same price every two years or so, and that is what Moore's Law is all about.

The miracles of nanobiology and genetic engineering would not be possible had Moore's Law not brought affordable computing power to the table. While our children play video games on black boxes filled with chips, professionals in the medical sciences use the same technology to visualize complex models of drug interaction and even to unlock genetic codes. The Lewis & Clarks of today don't use optics to map the landscape, they use computer visualization tools to map the human genome. Meanwhile, imagine traffic congestion without computer chips to turn the lights green when you drive up. It may seem mundane, but computer chips keep America moving efficiently. Without chips, cell phones would not be there to bring help to our loved ones in unexpected emergencies or simply to make that call to bring home a quart of milk. Communication is vital to the economy, and chips have greatly expanded our abilities here. Computers are the engines of America's productivity surge that has held inflation down since the '90s—and the engines of computers are semiconductors. Chips provide better automotive power-train control systems that make for fun cars that pollute less. Chips are replacing film in digital cameras, saving untold amounts of chemical pollution. Chips are being attached to animals in the wild, so we gain an even deeper understanding of the world around us. Chips make smart bombs smart…and Moore's Law makes them smarter. Chips are critical to our national defense, make unmanned aircraft possible, and save untold lives on the battlefield. These breakthroughs and many more are directly the result of advancements in chips as predicted by Moore's Law.

Moore's Law is an amazing story of how technological progress came to affect our everyday lives and will affect our children's lives for many generations to come. But its history is far richer than the development of semiconductors, which to some extent explains why Moore's Law was so readily accepted. This history also explains why there has been an insatiable demand for more powerful computers no matter what people have thought to the contrary.

The quest to store, retrieve, process, and communicate information is one task that makes humans different. No known animal uses tools to store, retrieve, and process information. Moreover the social and technological progress of the human race can be directly traced to this attribute.

Man's earliest attempts to store, retrieve, and process information date back to prehistoric times when humans first carved images in stone walls. Then in ancient times, Sumerian clay tokens developed as a way to track purchases and assets. By 3000 B.C. this early accounting tool had developed into the first

2005/
32 billion

complete system of writing on clay tablets. Ironically, these were the first silicon-based storage technologies and would be abandoned by 2000 B.C. when the Egyptians developed papyrus-based writing materials. It would take almost four millennia before silicon would stage a comeback as the base material, with the main addition being the ability to process stored information. In 105 A.D., a Chinese court official named Ts'ai Lun invented wood-based paper. It wasn't until around 1436 that Johann Gutenberg invented the movable type printing press so that books could be reproduced cost-effectively in volume. The first large book was the Gutenberg Bible, published in 1456. So something akin to Moore's Law occurred, as Gutenberg's innovation enabled progressing from printing single pages to entire books in 20 years. At the same time, resolution also improved, allowing finer type as well as image storage. Yet, this was primarily a storage mechanism. It would take at least another 400 years before retrieval would be an issue. In 1876, Melvil Dewey published his classification system that enabled libraries to store and retrieve all the books that were being made by that time. Alan Turing's "Turing Machine," first described in 1936, was the step that would make the transformation from books to computers. So Moore's Law can be seen to have a social significance that reaches back more than five millennia.

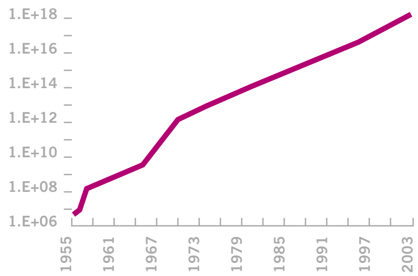
Moore's Law is also indelibly linked to the history of our industry and the economic benefits that it has provided over the years. Carver Mead, a pioneer in solid-state electronics, was the first to call the relationship "Moore's Law." Moore's observations about semiconductor technology are not without precedent. As early as 1887, Karl Marx, in predicting the coming importance of science and technology in the 20th century, noted that for every question science answered, it created two new ones—and that the answers were generated at minimal cost in proportion to the productivity gains made. More important was Marx's observation that investments in science and engineering led to technology, which paid off in a way that grew economies, not just military might.

It was this exponential growth of scientific "answers" that led to these developments, as well as to the invention of the transistor in 1947—and ultimately the integrated circuit in 1958. The integrated circuit (IC) developed rapidly, leading to Moore's observation that became known as a law—and in turn, launched the information revolution.

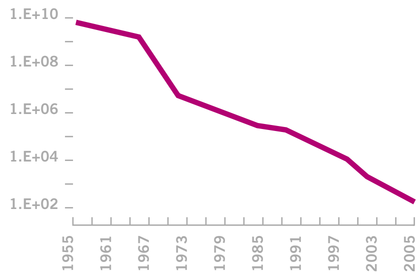
In 1964, *Electronics* magazine asked Moore, then at Fairchild Semiconductor, to write about what trends he thought would be important in the semiconductor industry over the next 10 years for its 35th anniversary issue. ICs were relatively new. Many designers didn't see a use for them and worse, some still argued over whether transistors would replace tubes. A few even saw integrated circuits as a threat: if the system could be integrated into an IC, who would need system designers?

The article, titled "Cramming more components into integrated circuits," was published by *Electronics* in its April 19, 1965, issue.

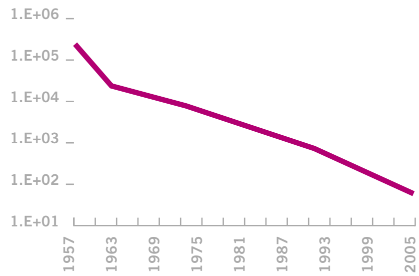
Worldwide Transistor Production



Average Price Per Transistor (nanodollars)



Semiconductor Feature Size (nanometers)



MOORE'S LAW: BY THE NUMBERS

Above are three metrics that graphically demonstrate the effects of Moore's Law. Constantly improving semiconductor technology has driven exponential increases in the number of transistors that can be placed on a chip while simultaneously driving reductions in cost and increases in performance. The result: chips that get faster, better, and cheaper every year.

This issue's contents exemplify how so few really understood the importance of the integrated circuit. Ahead of it was the cover article by RCA's legendary David Sarnoff who, facing retirement, reminisced about "*Electronics*' first 35 years" with a look ahead. After this were several more articles—with Moore's paper buried on page 114. *Electronics* was the most respected publication covering its field. Today, the magazine is defunct, not surviving Moore's Law.

Moore's paper proved so long-lasting because it was more than just a prediction. The paper provided the basis for understanding how and why integrated circuits would transform the industry. Moore considered user benefits, technology trends, and the economics of manufacturing in his assessment. Thus he had described the basic business model for the semiconductor industry—a business model that lasted through the end of the millennium.

From a user perspective, his major points in favor of ICs were that they had proven to be reliable, they lowered system costs, and they often improved performance. He concluded, "Thus a foundation has been constructed for integrated electronics to pervade all of electronics." From a manufacturing perspective, Moore's major points in favor of ICs were that integration levels could be systematically increased based on continuous improvements in largely existing manufacturing technology. He saw improvements in lithography as the key driver.

From an economics perspective, Moore recognized the business import of these manufacturing trends and wrote, "Reduced cost is one of the big attractions of integrated electronics, and the cost advantage continues to increase as the technology evolves toward the production of larger and larger circuit functions on a single semiconductor substrate. For simple circuits, the cost per component is nearly inversely proportional to the number of components, the result of the equivalent package containing more components."

The essential economic statement of Moore's Law is that the evolution of technology brings more components and thus greater functionality for the same cost. Computing power improves essentially for free, driving productivity in the economy, and thus fueling demand for more semiconductors. This is why the growth in transistor production has been so explosive. Lower cost of production has led to an amazing ability to not only produce transistors on a massive scale, but to consume them as well.

The economic value of Moore's Law is that it has been a powerful deflationary force in the world's macro-economy. Inflation is a measure of price changes without any qualitative change—so if price per function is declining, it is deflationary. This effect has never been fully accounted for in government statistics. The decline in price per bit has been stunning.

In 1954, five years before the IC was invented, the average selling price of a transistor was $5.52. Fifty years later, in 2004,

$0.000,000,001

Today, the cost per bit of DRAM memory is an astounding 1 nanodollar (one billionth of a dollar).

this had dropped to 191 nanodollars (a billionth of a dollar). If the semiconductor were fully adjusted for inflation, its size in 2004 would have been 6 million-trillion dollars. That is many orders of magnitude greater than Gross World Product! So it is hard to understate the long-term economic impact of the semiconductor industry. Much of this impact has come directly to America, because it has been the world's leader in semiconductors.

So what makes Moore's Law work? There are three primary technical factors: reductions in feature size, increased yield, and increased packing density. The first two are largely driven by improvements in manufacturing and the latter largely by improvements in design methodology.

Reductions in feature sizes have made the largest contributions by far, accounting for roughly half of the gains since 1976. Feature sizes are reduced by improvements in lithography. Transistors can be made smaller and hence more can be packed into a given area.

These gains have come from new lithography tools, resist processing tools and materials, and etch tools. Lithography tools were not always the most costly tool in the factory. The camel's hair brush, first used in 1957 to paint on hot wax for the mesa transistors, cost little more than a dime. But since that time prices have escalated rapidly, increasing roughly an order of magnitude every decade and a half. The industry passed the $10M mark in 2003 and some tools now cost as much as $20M.

Over the decades, these cost increases have been consistently pointed to as a threat to the continuance of Moore's Law. It is testimony to the power of this law that these costs can be absorbed with little effect.

At some point the effect of these technologies translating into high costs will cause Moore's Law to cease. This is why the spotlight is always on costs and how to defray them.

The idea of Moore's Law meeting Moore's Wall and the show stopping, or the contrary belief that there will be unending prosperity in the 21st century buoyed by Moore's Law, have been recurring themes in the media and technical community since the mid-'70s. I have built my career, in part, by predicting that the end of Moore's Law was not coming anytime soon. Many others have lost theirs over the past 30 years by predicting its demise due to physical limits. I have always had faith in the ability of the brightest minds in science and technology to come up with the ideas needed to overcome these limits. But I am growing concerned.

The costs of the research to keep Moore's clock ticking are rising with each node. I fear the day that it becomes too expensive for the private sector, and the clock stops. In part because of the many conveniences, but mostly because of the dramatic effect it has had in driving America's productivity and thus its leadership in the global economy, when Moore's clock stops the consequences to the economy should be obvious.

What will America do as a nation when Moore's Law has beat its last heartbeat, when it no longer delivers its productivity gains and anti-inflationary effects? How will we pay for ever-rising healthcare costs? What will happen if America's economy falls behind and the U.S. is no longer the global leader? Other nations recognize the importance of semiconductors at the public level and are investing heavily. These are important questions for legislators to consider.

As Gordon commented on his law a few years back, "No exponential lasts forever. But forever can be postponed." Let's invest to postpone it.

To learn more, see "The Economic Implications Of Moore's Law" in *High Dielectric Constant Materials, Springer Series in Advanced Microelectronics*, Volume 16, Springer-Verlag, New York, 2004.

FASTER, BETTER, CHEAPER.
THROUGHOUT THE ECONOMY AND IN NEARLY EVERY INDUSTRY, INNOVATIONS IN SEMICONDUCTOR TECHNOLOGY HAVE DRIVEN GAINS IN PRODUCTIVITY UNPRECEDENTED SINCE THE INDUSTRIAL REVOLUTION.

MOORE'S LAW AND THE EMERGENCE OF THE NEW ECONOMY

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The resurgence of the American economy since 1995 has now survived the dot-com crash, the short recession of 2001, and the tragedy of 9/11[1]. The unusual combination of more rapid growth and slower inflation has touched off a strenuous debate about whether improvements in America's economic performance can be sustained. A consensus has emerged that the development and deployment of information technology (IT) is the foundation of the American growth resurgence[2]. The mantra of the "new economy"—faster, better, cheaper—characterizes the speed of technological change and product improvement in semiconductors, the key enabling technology.

THE ECONOMICS OF INFORMATION TECHNOLOGY BEGINS WITH THE PRECIPITOUS AND CONTINUING FALL IN SEMICONDUCTOR PRICES.

In 1965 Gordon Moore, then research director at Fairchild Semiconductor, made a prescient observation, later known as Moore's Law[3]. Plotting data on integrated circuits, he observed that each new device contained roughly twice as many transistors as the previous one and was released within 12–24 months of its predecessor. This implied exponential growth of chip capacity at 25–50 percent per year! Moore's Law, formulated in the infancy of the semiconductor industry, has tracked chip capacity for 40 years. Moore recently extrapolated this trend for at least another decade[4].

The economics of information technology begins with the precipitous and continuing fall in semiconductor prices. Moore emphasized this price decline in his original formulation of Moore's Law and dramatically plunging prices are used almost interchangeably with faster and better devices in describing the evolution of semiconductor technology. The rapid price decline has been transmitted to the prices of a range of products that rely heavily on this technology, like computers and telecommunications equipment. The technology has also helped to reduce the costs of aircraft, automobiles, scientific instruments, and a host of other products.

Swiftly falling IT prices provide powerful economic incentives for the rapid diffusion of information technology. A substantial acceleration in the IT price decline occurred in 1995, triggered by a much sharper acceleration in the price decline for semiconductors. This can be traced to a shift in the product cycle from three years to two years as a consequence of intensifying competition in semiconductor markets. Continuation of this shorter product cycle for the next decade is consistent with the technological developments projected in the most recent International Technology Roadmap for Semiconductors[5].

The accelerated IT price decline since 1995 signals faster productivity growth in IT-producing industries—semiconductors, computers, communications equipment, and software. These industries have accounted for a substantial share of the surge in U.S. economic growth. It is important, however, to emphasize that accelerating growth is not limited to these industries. To analyze the impact of the accelerated price decline in greater detail, it is useful to divide the remaining industries between IT-using industries, those particularly intensive in the utilization of IT equipment and software, and non-IT industries.

Although three-quarters of U.S. industries have contributed to the acceleration in economic growth, the four IT-producing industries are responsible for a quarter of the growth resurgence, but only 3 percent of the GDP. IT-using industries account for another quarter of the growth resurgence and about the same proportion of the GDP, while non-IT industries with 70 percent of value-added are responsible for only half the resurgence. Obviously, the impact of the IT-producing industries is far out of proportion to their relatively small size.

In view of the critical importance of productivity, it is essential to define this concept more precisely. Productivity is defined as output per unit of input, where input includes capital and labor inputs as well as purchased inputs[6]. This definition has the crucial advantage of clearly identifying the role of purchased goods and services, such as semiconductors used by other IT-producing industries. The purchased goods and services are the components of the industry's inputs that are "outsourced" in order to make the most of the advantages of specialization.

Industry inputs consist of capital, labor, and purchased inputs. It is remarkable that four IT-producing sectors taken together have the most rapid growth of all three. The surging growth of the four IT-producing industries has its sources in both inputs and productivity; however, the relative importance of these sources differs considerably. All the IT-producing industries have large contributions of purchased goods and services, including inputs from other IT-producing sectors. The software industry has the most rapidly growing labor input, but almost no productivity growth.

Two industries responsible for much of IT hardware—computers and semiconductors—exhibit truly extraordinary rates of productivity growth, as well as a substantial acceleration in the growth of productivity after 1995. As a group, the four IT-producing industries contribute more to economy-wide productivity growth than all the other industries combined. In fact, the contributions of the IT-using and non-IT industries

25%

SINCE 1995, INFORMATION TECHNOLOGY INDUSTRIES HAVE ACCOUNTED FOR 25% OF OVERALL ECONOMIC GROWTH, WHILE MAKING UP ONLY 3% OF THE GDP. AS A GROUP, THESE INDUSTRIES CONTRIBUTE MORE TO ECONOMY-WIDE PRODUCTIVITY GROWTH THAN ALL OTHER INDUSTRIES COMBINED.

to the economy's productivity growth have been slightly negative, partly offsetting the positive contribution of the IT-producing industries.

However, investment rather than productivity has been the predominant source of U.S. economic growth throughout the postwar period. The rising contribution of investment since 1995 has been the key contributor to the U.S. growth resurgence and has boosted growth by close to a full percentage point. The contribution of IT investment accounts for more than half of this increase. Investment in computers has been the predominant impetus to faster growth, but communications equipment and software investments have also made important contributions.

Accelerated capital growth reflects the surge of investment in IT equipment and software after 1995 in the large IT-using sectors like finance and trade. However, virtually all industries have responded to more rapid declines in IT prices by substituting IT for non-IT capital. Capital from IT products has grown at double-digit rates during most of the last three decades. By contrast non-IT capital has grown at about the same rate as the economy as a whole, an order of magnitude more slowly. Half of U.S. industries actually show a declining contribution of non-IT capital.

While the IT-producing industries demonstrate accelerating growth in every dimension, the impact is limited by their relatively small size. IT-using sectors are especially prominent in the accelerated deployment of IT equipment and software, while the non-IT industries contribute impressively to faster productivity growth. After 1995, IT-producing industries show sharply accelerating growth in productivity, while IT-using industries diverge from this trend by exhibiting a more rapid decline. Productivity growth in non-IT industries has jumped very substantially, accounting for much of the acceleration in economy-wide productivity.

The very modest acceleration in employment growth after 1995 has been concentrated in IT-using industries. Since the number of workers available for employment is determined largely by demographic trends, the acceleration in IT investment is reflected in rates of labor compensation and changes in the industry distribution of employment. The rapidly growing IT-using industries have absorbed large numbers of college-educated workers, while non-IT industries have shed substantial numbers of non-college workers.

The surge of IT investment in the United States after 1995 has counterparts in all other industrialized economies. Using "internationally harmonized" IT prices that rely primarily on U.S. trends, the burst of IT investment in all industrialized economies that accompanied the acceleration in the IT price decline in 1995 is revealed unmistakably. These economies have also experienced a rise in productivity growth in the IT-producing industries. However, differences in the relative importance of these industries have generated wide disparities in the impact of IT on economic growth. Among the G7 countries—Canada, France, Germany, Italy, Japan, the U.K., and the U.S.—the role of the IT-producing industries is greatest in the U.S.

To conclude: The mechanism underlying the resurgence of U.S. economic growth has now come into clear focus[7]. The surge was generated by the accelerating decline of IT prices, propelled by a shift in the semiconductor product cycle from three years to two in 1995. The price decline set off an investment boom that achieved its peak during the last half of the 1990s and has now recovered much of the momentum lost during the 2001 recession. Achievement of the ambitious goals of the International Technology Roadmap for Semiconductors (2004) will greatly help to assure that America's improved economic performance can be sustained.

1 Jorgenson, Ho, and Stiroh (2004) http://www.newyorkfed.org/research/current_issues/ci10-13.html present projections of U.S. economic growth.

2 The role of information technology in the American growth resurgence is discussed in detail by Jorgenson, Ho, and Stiroh (2005).

3 Moore (1965) ftp://download.intel.com/research/silicon/moorespaper.pdf.

4 Moore (2003) ftp://download.intel.com/research/silicon/Gordon_Moore_ISSCC_021003.pdf.

5 On International Technology Roadmap for Semiconductors (2004), see: http://public.itrs.net/.

6 In economic jargon this definition is often referred to as "total factor productivity." This must be carefully distinguished from the more common "labor productivity," output per hour worked.

To avoid confusion I will use the term "productivity" only in the sense of total factor productivity or output per unit of all inputs.

7 More detail on this mechanism is provided by Jorgenson (2001).

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ABOUT SIA

THE SEMICONDUCTOR INDUSTRY ASSOCIATION (SIA) IS THE PREMIER TRADE ORGANIZATION REPRESENTING THE U.S. SEMICONDUCTOR INDUSTRY. FOUNDED IN 1977 BY FIVE MICROELECTRONICS INNOVATORS, SIA UNITES 95 COMPANIES RESPONSIBLE FOR MORE THAN 85% OF SEMICONDUCTOR PRODUCTION IN THIS COUNTRY.

Our coalition provides domestic semiconductor companies a forum to advance the global competitiveness of the $80 billion U.S. chip industry. Through a network of corporate CEOs and working committees, SIA shapes public policy on issues critical to the industry and provides a spectrum of services to aid members in growing their own businesses.

DRIVING PROGRESS AND RESULTS

Among major domestic industries, the semiconductor industry is unique. Every year, chipmakers boost performance dramatically while cutting prices, continually making high-technology goods more productive and affordable for consumers. The benefits to the U.S. economy of this "more for less" manufacturing dynamic are dramatic. In the past five years, information technology, fueled by faster and cheaper chips, has reduced the U.S. inflation rate significantly and has doubled the nation's productivity growth rate.

With the SIA, U.S. semiconductor companies are addressing significant challenges:

- **Educating and recruiting a highly skilled workforce.**
- **Maintaining the nation's world leadership in semiconductor technology.**
- **Promoting fair and open trade.**
- **Providing safe working conditions in production facilities.**
- **Protecting the environment.**
- **Tracking and distributing statistical information on market trends.**

UNITING AN INDUSTRY OF INNOVATORS

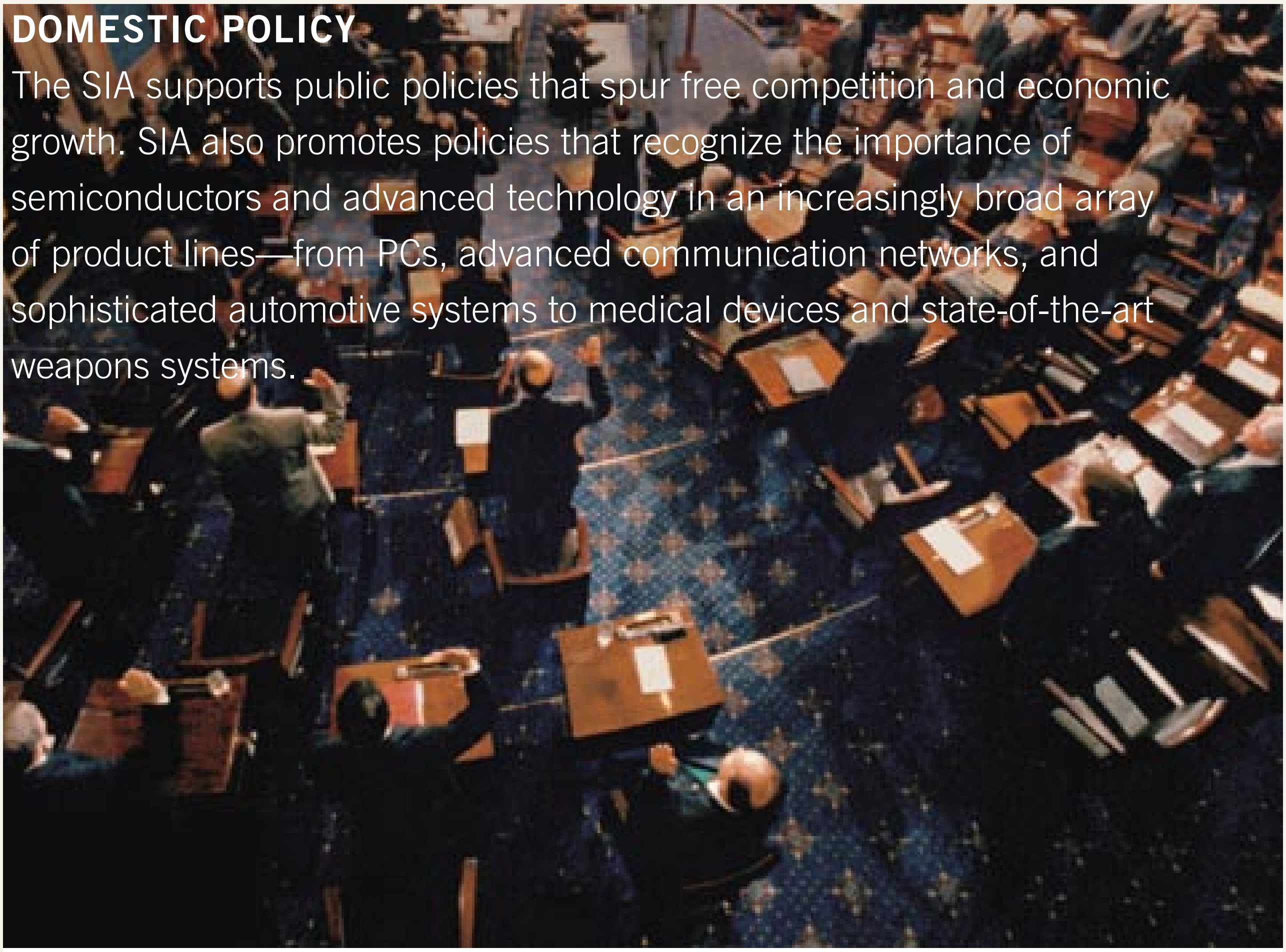
The Semiconductor Industry Association provides every chip company—large, small, integrated, or fabless—with a powerful voice. Collectively, we continue to make tremendous progress in trade, technology, public policy, occupational safety and health, environmental concerns, industry statistics, and government procurement.

Each step forward is a tribute to the willingness of our members to commit time, people, and money to such projects. In turn, SIA member companies influence the industry agenda through their participation on committees—thereby ensuring positive outcomes on critical issues and reaping the concrete rewards of the association's many successes.

SIA AGENDA

DOMESTIC POLICY

The SIA supports public policies that spur free competition and economic growth. SIA also promotes policies that recognize the importance of semiconductors and advanced technology in an increasingly broad array of product lines—from PCs, advanced communication networks, and sophisticated automotive systems to medical devices and state-of-the-art weapons systems.



ACCELERATING ADOPTION OF BROADBAND

SIA has strongly supported the acceleration of broadband deployment, pressing forward with initiatives with the High Tech Broadband Coalition as well as President Bush's Council of Advisors on Science and Technology, a high-level advisory body on which SIA President George Scalise actively serves.

In April 2004, President Bush proposed the goal of extending "broadband technology to every corner of our country by the year 2007 with competition shortly thereafter." The president proposed a number of specific actions which include refraining from taxing broadband access, increasing access to federal land for fiber-optic cables and transmission towers, opening up more federally controlled wireless spectrum to auction in free public use, and supporting FCC efforts to eliminate burdensome regulations.

In October 2004, the FCC made an important decision to clarify its unbundling decision with respect to fiber-to-the-curb. This decision was built on the FCC's February 2003 vote to largely deregulate deployment of new last-mile broadband facilities. As one indication of the importance of this action, SBC Communications shortly thereafter announced that it planned to "dramatically accelerate its plan to build a new fiber-optics network into neighborhoods, providing 18 million households super high-speed data, video, and voice services in two to three years—rather than five years as previously announced."

It was gratifying that the FCC cited the High Tech Broadband coalition as a wellspring for its 2003 decision to largely deregulate deployment of new last-mile broadband facilities. The coalition was seen as credible, with equipment makers having a common interest with consumers in increasing broadband penetration. In 2005, SIA will work through its coalitions to encourage the FCC to accelerate the transition from analog to digital television and free up spectrum for public safety and advanced wireless services, and to promote Voice over Internet Protocol services. Broadband has tremendous potential for increasing homeland security as well as serving business and consumer interests, and should be expanded expeditiously.

FOSTERING RESEARCH & DEVELOPMENT AND DOMESTIC INVESTMENT THROUGH TAX POLICY

Taxation cuts to the heart of the industry's global competitiveness. SIA had two successes in the tax area during 2004: extension of the R&D credit and passage of the Homeland Investment Act.

The R&D credit expired on June 30, 2004. Since its enactment in 1981, the R&D tax credit has demonstrated that it is a powerful and effective incentive for firms to increase research spending, and Congress has endorsed the credit by extending it 10 times since its original enactment. In August, the Congress extended the credit for 18 months, retroactive to June 30. SIA will continue to press for a permanent R&D tax credit.

In the fall of 2004, the Congress passed a sweeping tax bill named the American Jobs Creation Act of 2004. SIA supported this legislation as an important means of bringing capital back to the United States. The bill includes a temporary "dividends-received deduction" that effectively lowers the tax for repatriated income to 5.25 percent (versus a tax of as much as 35 percent without the bill). In one estimate of the beneficial effect of this temporary tax relief on the U.S economy, J.P. Morgan has estimated that $650 billion will be returned to the U.S. and half a percentage point added to U.S. GDP growth over the next 12 to 18 months.

EXPORT CONTROLS: KEEPING THE FOCUS ON MILITARY, NOT COMMERCIAL, PRODUCTS

SIA pressed forward with numerous initiatives in 2004, with both the administration and Congress, to ensure that export-controls policy focuses on controlling that which is controllable and does not inadvertently put U.S. companies at a competitive disadvantage when selling widely available commercial products in the world market. We were able to work with the administration to ensure that license requirements were not reimposed on nonmilitary products that have been decontrolled for years. SIA also continued its work of assessing whether technologically advanced commercial products could inadvertently qualify as radiation-hardened devices under the International Traffic in Arms Regulations, which would make them subject to the same onerous controls that apply to military items.

EXPENSING OF STOCK OPTIONS: FIGHTING FOR A REALISTIC AND COMPETITIVE STANDARD

SIA and its member companies have experienced both challenges and victories on the stock option expensing issue this year. SIA was very active in supporting legislation in Congress that would have expensed the options given to the top five executives in a company and required an economic impact study before any further expensing standard could be recognized. The House voted overwhelmingly in favor of that bill, but the Senate did not take up the measure.

While SIA spent considerable time filing comments and participating in discussions with the Financial Accounting Standards Board (FASB) to explain why the draft standard was not feasible, industry views and proposals were not taken into account when FASB issued its final expensing standard in mid-December 2004. As drafted, the standard calls for expensing of options for all reporting periods after June 15, 2005, for most companies. We have also met with administration and other officials to review flaws in the valuation methodology, our concerns over timing, and the fact that there has been absolutely no field testing to determine if the rule is even feasible.

In 2005, SIA will continue to work in Washington with the SEC, the administration, and congressional champions to seek adequate field testing, a public review by experts of the valuation issue, and feasible timing for implementation of any new standards.

FIGHTING FOR U.S. COMPETITIVENESS

SIA will continue to encourage the government to adopt policies that promote free markets, open competition, and advanced technology products and systems, which benefit U.S. consumers, economic growth, and national security. It is vital that our export, tax, and regulatory policies, particularly expensing standards, do not put the U.S. at a competitive disadvantage in fiercely competitive global markets.

ENVIRONMENT, SAFETY, AND HEALTH

Semiconductors have provided the enabling technology for countless scientific advances in medicine, biosciences, and environmental protection. The world-wide semiconductor industry is committed to using these advances to drive continuous improvements in protecting the health and safety of its workers and the environment.

The U.S. semiconductor industry ranks in the top 5 percent of durable goods manufacturers for safety, with only 1.6 reportable injuries and illnesses per 100 employees, based on Bureau of Labor Statistics data for 2003. SIA member companies participate in an internal injury and illness reporting system, the Occupation Health System (OHS). OHS data for 2003 identified only 0.93 injuries and illnesses per 100 employees. This outstanding safety record is due in large part to the SIA's long and close involvement in matters related to environment, safety, and health:

- Studying potential health risks to cleanroom workers
- Working to reduce emissions of global warming gases
- Evaluating the impact of environmental regulations, domestically and globally
- Preserving the ability to use PFOS and PFAS in leading-edge processes

ENSURING THE HEALTH OF WORKERS

The industry recently completed an evaluation of cancer risk among cleanroom workers. A Scientific Advisory Committee (SAC) composed of experts in occupational medicine, epidemiology, industrial hygiene, and cancer biology evaluated existing data from available literature and participating companies.

The committee concluded there was no evidence of increased cancer risk to cleanroom workers, although it could not rule out the possibility that circumstances might exist that could result in increased risk. To study the matter further, SIA embarked on three initiatives:

RETROSPECTIVE SCOPING STUDY—a retrospective cohort-mortality scoping study to determine the feasibility of conducting retrospective epidemiology. To carry this out, a research team was retained under the direction of Johns Hopkins University.

HEALTH SURVEILLANCE STUDY—exploring health surveillance programs in non-semiconductor companies. This information will be provided to SIA member companies who can then assess what measures may be useful in their own programs.

PRIMARY PREVENTION INITIATIVES—developing programs to better understand properties of new chemicals and chemical processes, to investigate how non-semiconductor manufacturers introduce new chemicals into the workplace, and to evaluate whether it is possible to further reduce potential chemical exposure during maintenance of semiconductor manufacturing equipment. Teams of nationally renowned consultants conducted these programs, which were funded by SIA member companies.

Based on the study conducted by Johns Hopkins, it was determined that it would be feasible to conduct a meaningful, retrospective cohort-epidemiology study. With the approval of the SIA Board of Directors to fund and proceed, a request for proposal was prepared and distributed to qualified researchers. SIA is currently evaluating proposals to conduct this study, which will take several years to complete.

GOOD FOR OUR WORKERS, GOOD FOR OUR INDUSTRY

SIA has a long history of involvement with health and safety issues. In 1981, SIA created a forum for U.S. chip companies to develop a consensus on priorities and share information about state-of-the-art programs. We also established the OHS in 1983 to track health and safety trends and document injuries and illnesses in the industry.

In 1989, in response to conflicting reports about potential cleanroom hazards to reproductive health, SIA funded and implemented one of the largest epidemiological studies ever performed by private industry. The study's findings and recommendations led the industry to voluntarily agree to eliminate certain solvents that had been used in photolithography formulations.

WORKING TOGETHER TO ADDRESS ENVIRONMENTAL ISSUES

The U.S. semiconductor industry leads the way in developing alternatives to hazardous chemicals and pollutant emissions, and shares information about best practices with companies from other nations.

By eliminating the use of ozone-depleting substances and substituting environmentally benign solvents in manufacturing, the industry has reduced reportable emissions by nearly 75 percent in the United States since 1987.

Government Agencies

In 1995, SIA members voluntarily committed to significantly reduce atmospheric emissions of perfluorocarbons (PFCs), identified as global warming gases, by signing a memorandum of understanding with the Environmental Protection Agency (EPA). This voluntary agreement has served as a model for voluntary agreements between industries and governments worldwide.

In 1999, the global semiconductor industry agreed to reduce absolute PFC emissions to 10 percent below their respective baselines by 2010. In 2000, SIA members and the EPA signed a new memorandum of understanding for reducing PFC emissions based on the global agreement and inventory methods determined by the Intergovernmental Panel on Climate Change. This new agreement is expected to carry the industry through to the next decade.

In 2003, the SIA assisted the EPA in developing a generic photolithography scenario. Used internally by the EPA and other worldwide environmental regulatory bodies through the Organization for Economic Cooperation and Development, this document will serve as a guide for evaluating new chemicals introduced into photolithographic formulations.

World Semiconductor Council

SIA also seeks to reduce global warming gases worldwide through the Environment, Safety, and Health Task Force of the World Semiconductor Council (WSC), composed of representatives from the United States, Europe, Japan, Korea, and Taiwan. Agreement to work toward reducing emissions of global warming gases is a prerequisite for membership on the task force. In recognition of this effort, in 1998 the EPA granted WSC one of its first Climate Protection Awards.

That same task force also created a chemical management program focused on understanding risks associated with new processing chemicals and ways to promote pollution prevention. An energy savings program is also under way. The WSC has also adopted a series of guiding principles for environment, health, and safety. In support of these principles, the task force is developing quantitative targets to monitor and judge environmental performance on a global basis.

EQUITABLE REGULATIONS AND STANDARDS

SIA's environment subcommittee represents the semiconductor industry in negotiations with regulatory bodies. By supplying agencies such as the EPA with relevant data and industry perspective, these committees have negotiated equitable and beneficial changes.

Maximum Achievable Control Technology

SIA subcommittees have assisted the EPA in defining the Maximum Achievable Control Technology standard (MACT) for the industry, which is a technology-based air emission standard authorized by the Clean Air Act. While the effort to secure a semiconductor industry exemption from MACT requirements was unsuccessful, the standard is not expected to pose an undue burden on association members.

Perfluorooctyl and Perfluoroalkyl Sulfonates

In a joint effort, SIA and photoresist suppliers succeeded in retaining the use of perfluorooctyl sulfonates (PFOS) and perfluoroalkyl sulfonates (PFAS) in leading-edge photoresists and anti-reflective coatings. These materials are essential to the future of semiconductor manufacturing in this country, at least through 157nm lithography.

Based on perceived toxicity and environmental concerns, the EPA had intended to phase out PFOS and PFAS through the Significant New Use Rule (SNUR) process under the Toxic Substances Control Act. However, the coalition argued that these chemicals are used in small quantities and are soundly managed, posing no risk to worker health or the environment.

As a result of the cooperative effort among SIA, SEMI, and the EPA, a PFAS SNUR was finally published in the Federal Register in 2002. It provided an exemption for uses in photolithography. A mass balance model developed for use in evaluating the potential environmental impact has been adopted by the EPA for use with other chemicals. The EPA is championing the use of this approach in international forums with regulatory agencies worldwide.

Nanotechnology and the Environment, Safety, and Health

The semiconductor industry is rapidly entering into the era of nanotechnology. From the perspective of circuit dimensions and materials, there is a clear shift towards nanotechnology. While most semiconductor nanotechnology relates to the line and feature sizes, there is a clear indication that the use of nanomaterials is close at hand. SIA member companies and their suppliers are working together to make sure that new nanotechnologies and new nanomaterials are introduced in a way that does not adversely affect our workforce or our environment.

Fire and Building Codes

The SIA Fire and Building Safety (FABS) Committee works closely with authorities to ensure that industry needs are represented without sacrificing the integrity of fire and building codes. This is critical since semiconductor production facilities require precision construction at considerable expense.

To better oversee important changes in the building code development process, FABS reorganized as a national committee a few years ago. Two principal code developers, the National Fire Protection Association and the International Code Council, have taken the lead on these issues and represent broad geographic constituencies.

COMMITTED TO A SAFE AND HEALTHY FUTURE

All SIA environment, safety, and health committees are working to develop and incorporate environmental, safety, and health solutions early in the design of future processes, equipment, and cleanrooms. Toward this end, SIA member companies are key contributors to International SEMATECH and the NSF/SRC Engineering Research Center for Benign Semiconductor Manufacturing.

ECONOMY

The semiconductor industry sets the pace of global economic growth. Just as the industry's strength provides a leading indicator of the world's economic health, advanced semiconductor products and systems are bringing new opportunities, growth, and development to countries around the globe.

THE GROWTH CYCLE

The semiconductor industry enters 2005 in the midst of a strong, but decelerating, semiconductor cycle. After the global downturn of 2001 and flat sales in 2002, strong second half growth in 2003 yielded a 18.3 percent revenue gain to sales of $164.4 billion. Momentum accelerated in 2004, making this past year one of the best on record for the semiconductor industry. Propelled by a year-on-year growth rate of 28 percent, global sales reached $213 billion for 2004, surpassing the previous record of $204 billion set in 2000.

LONG-TERM GROWTH SLOWS TO 8–10 PERCENT

From its inception, the semiconductor industry has been cyclical. Cycles typically included two strong years of 20 percent growth, one year of slow growth, and one year of flat or declining growth.

Overriding these cyclical waves, however, was prodigious growth: the industry achieved a 16.1 percent compound annual growth rate (CAGR) from 1975 to 2000. Growth during this period was driven by technological advances, the increasing pervasiveness of electronics in society, and the increasing capability of the semiconductors that powered new products and systems.

This growth rate began to slow gradually starting in the mid-1980s, reaching about 15 percent in 1998. The severity of the 2001 downturn then prompted a reevaluation of the industry's long-term growth rate. With semiconductor sales of $213 billion in 2004, the rate is now expected to be in the 8–10 percent range. The SIA forecast released in November 2004 reflects this consensus and predicts a CAGR for the industry of 11.8 percent from 2003 to 2007.

THE GLOBAL CONSUMER—TRANSFORMING THE SEMICONDUCTOR INDUSTRY

Our industry has experienced a profound transformation. In the 1960s, when the semiconductor industry first emerged from anonymity, the key driver of the industry was the government and aerospace sector. Major applications were the Apollo space program and weapons systems such as the Minute Man intercontinental ballistic missile.

With the end of the Apollo program and the cuts in the defense budget after the Vietnam War, the key driver of the industry shifted in the early 1970s to the corporate information technology (IT) sector. The introduction of the IBM 360 (the first use of integrated circuits in a computer) and the mini-computer initiated the first IT boom in the late 1960s and early 1970s.

Corporate IT continued to dominate spending in the 1980s. With the introduction of the PC and local area networks, corporate IT grew to 60 percent of demand, while the government/aerospace sector declined to less than 10 percent of demand. Consumer products continued to gain in importance with the introduction of new products such as video games and the VCR.

In the 1990s, consumers emerged as the primary force driving semiconductor sales. If consumer products are defined as products purchased by individual consumers with their *own* money, consumers now drive roughly *half* of all semiconductor sales. With the Internet boom and declining PC prices, individuals now consume more than 30 percent of units sold in the PC marketplace. Consumers dominate the cell phone market, more than 10 percent of end semiconductor demand, by commanding more than 90 percent of sales. The automotive segment is similar. Semiconductor suppliers will need to refine their view of global markets, as the technology buyer of today may be a teenager listening to an MP3 player while text messaging and sending pictures on a cell phone. Just as the corporate IT sector once largely determined spending, the global consumer now dominates the technology spending of the early 21st century.

A TRULY GLOBAL MARKETPLACE

In the 1980s, Asia was primarily a place for low-cost semiconductor assembly and low-end consumer electronic product sales. Today, the region not only leads in electronic equipment production—from low-end to advanced products—but it is also a significant consumer of sophisticated electronics. China is now the largest market for cellular handsets, representing 20 percent of demand, and the second largest market for personal computers. South Korea has the most advanced nationwide cellular network in the world. The electronic equipment and semiconductor industries have evolved into a truly global market.

THE OUTLOOK: FLAT REVENUES IN 2005 AT RECORD LEVELS AND RESUMED GROWTH IN 2006

Revenue growth in the semiconductor industry in 2005 will be essentially flat with 2004. This is a relatively benign trough year of the cycle, particularly in contrast to 2001's 32 percent revenue decline. Without the volatile memory sector, which will fall 10 percent in 2005, semiconductor sales would actually rise 3 percent in 2005. 2006 will see a slow acceleration in growth to 6.3 percent and revenue of $227 billion. In 2007, the industry will exceed $250 billion in revenues for the *first* time, posting 14.2 percent sequential growth in sales to $259 billion. This is a remarkable advance for an industry of this size.

Three factors are contributing to the shallow trough of 2005: inventory management, capacity, and resilient end markets.

As soon as excess inventory began to accumulate in the supply chain in the second quarter in 2004, companies throughout the electronics supply chain reacted effectively to reduce inventories, in contrast to the inventory accumulation of previous cycles. Instead of the 10-quarter resolution of the previous cycle, excess inventory will be out of the supply chain within three quarters, ending in the first quarter of 2005.

Capital spending has also been restrained in this cycle, representing 23 percent of sales in comparison to 2000's 30 percent spending level.

In contrast to 2001, end market unit growth will largely slow in 2005, rather than decline, with some pockets of strong growth, as follows:

- Consumer Market—In the consumer area, with the emergence of digital TV, which contains higher semiconductor content than standard TVs, unit sales should rise 50 percent in 2005, above the 47 percent growth of 2004.
- Communications Market—In the wireless communications market, unit growth in handsets will slow from 30 percent in 2004 to 8 percent in 2005, still driven by 2.5G and 3G handsets, whose semiconductor content is 25 percent higher than previous generations to support digital cameras, color displays, and wideband data capability.
- PC Market—The personal computer market should slow to 10 percent unit growth from 14 percent in 2004, as corporations complete the Y2K upgrade cycle but consumers continue to adopt new applications such as streaming video and broadband connectivity.

TRANSFORMING INDUSTRIES, ECONOMIES, AND SOCIETIES WORLDWIDE

Advances powered by semiconductors give businesses and consumers new flexibility, freedom, and opportunity. Activities that once confined people to the home or office can now be performed at any time any place, almost anywhere in the world. The semiconductor industry is bringing new opportunity, socio-economic advance and new human development to nations and societies around the world.

WORLD MARKETS

The semiconductor industry continues its expansion to every corner of the globe, advancing and enriching the lives of people the world over by improving health and safety, enhancing education and learning, and offering new opportunities for work, recreation, and entertainment. Free and open international trade is a primary engine of global growth and development, and continues to be a principal goal of SIA's policy agenda.

In 2004, SIA pursued a number of global trade objectives, including:

- Improving intellectual property protection in China
- Increasing market access in China
- Advancing environmental initiatives and trade liberalization through the WSC
- Eliminating new tariffs on emerging semiconductor devices
- Supporting new trade agreements
- Upholding strong antidumping laws and effective antidumping remedies.

IMPROVING INTELLECTUAL PROPERTY PROTECTION IN CHINA

Intellectual property protection in China has become an increasingly important issue. SIA has been pursuing the issue with the U.S. and Chinese governments, as well as through the World Semiconductor Council (WSC)—composed of executives from SIA members and our Japanese, Korean, European, and Taiwanese counterparts—and the related Governments/Authorities Meeting on Semiconductors (GAMS)—which brings together the U.S., Japan, Europe, Korea, and Chinese Taipei, and convenes once a year to receive WSC recommendations.

As part of SIA efforts in this area, SIA held the first IP Seminar in China in November 2004, in conjunction with the U.S. and Chinese governments and the China Semiconductor Industry Association.

The seminar addressed a cross section of important topics, including the benefits of IP protection in fostering China's development, a review of international IP trade agreements, IP protection measures taken by China, China's layout design law, a review of WSC recommendations on layout design, and guidelines foundries could use to comply.

At SIA's urging, the WSC adopted a formal recommendation that governments/authorities should employ a fast-track procedure allowing for a quick review of counterfeit activity and appropriate and effective action to stop it. All members also agreed to encourage manufacturers/foundries to establish IP layout protection guidelines so that semiconductor designers or suppliers of designs provide written assurances regarding their rightful ownership of the semiconductor layout design.

The WSC also noted that the WTO requires that countries have both IP laws and effective enforcement procedures, and that enforcement in some countries remains ineffective and lacking in deterrence. In December 2004 the Chinese government announced improved criminal enforcement policies for IP cases, which, while short of what we had sought, can have an important deterrent impact if fully implemented.

IP protection in China will remain a high priority for the SIA and the U.S. government in 2005.

INCREASING MARKET ACCESS IN CHINA

In 2004, SIA worked closely with the U.S. and Chinese governments in removing two major obstacles facing the U.S. semiconductor industry in China—a discriminatory value-added tax (VAT) rebate and a proprietary wireless encryption standard (WAPI).

Under the VAT scheme, foreign producers of semiconductors were forced to pay a higher VAT rate than domestic Chinese producers, favoring domestic production over imports. China committed to end the VAT policy, but has indicated it will issue a replacement subsidy policy, expected in April 2005. The WAPI standard would have placed Chinese companies at a disadvantage in world markets and would also have required U.S. chip makers to transfer technology to Chinese firms for wireless products. In both cases, our relationships with key Chinese government officials proved useful in resolving our differences.

SIA will continue to work with the U.S. government in monitoring China's WTO commitments, in particular with respect to semiconductor development incentives, intellectual property, national treatment, and product standards. SIA is closely monitoring potential new Chinese government measures designed to encourage the development of the semiconductor industry, including a proposed "IC development fund." SIA is determined to ensure that any promotional measures are developed and implemented in a transparent manner and are consistent with China's WTO obligations.

ADVANCING ENVIRONMENTAL PROTECTION AND TRADE LIBERALIZATION THROUGH THE WSC

Once again in 2004, SIA successfully pursued many key policy objectives through the WSC.

ENVIRONMENT, SAFETY, AND HEALTH—The WSC has an active environmental program. Our goal is to support sound, scientifically based, positive environmental policies and practices. Specific projects include PFC emission reduction, energy savings, chemical management, and quantitative targets. We have met or exceeded our targets every year. On energy savings, the WSC is actively supporting cooperation and the sharing of information among members to foster the efficient utilization of energy resources. Chemical management is also a key focus of WSC efforts—specifically in the areas of chemical risk assessment and pollution prevention.

TRADE LIBERALIZATION—The WSC took positions on a number of trade issues, including support for intellectual property protection, full transparency of government policies and regulations, nondiscrimination for foreign products in all markets, voluntary and industry-led standards, an end to investment restrictions tied to technology transfer requirements, and zero duties on multi-chip packages.

SIA continues to believe that integrating the Chinese semiconductor industry into the WSC, and the PRC into the GAMS, is vital. Doing so will provide us a valuable forum through which to address issues before they become harmful.

ELIMINATING TARIFFS ON MULTI-CHIP PACKAGES

In the past, SIA supported deals—particularly the Information Technology Agreement—that eliminated tariffs on virtually all information technology goods in all major world markets. Recently, however, new advances in technology that were unanticipated when the tariff deals were signed have led customs authorities around the world to begin to reimpose duties on some semiconductor products. So-called multi-chip packages (MCPs) are a key example of this situation.

Evolution in the packaging of certain semiconductor devices—which allows more than one piece of silicon inside a package but does not alter the underlying basic functionality of the product—has caused these products to be reclassified for customs purposes and led to the imposition of duties for the first time in years. SIA maintains that this is an evolution in packaging, not a revolutionary change in product, and that these products should be treated for tariff purposes as any other semiconductors, which are duty-free in *all* major markets.

The agreement SIA seeks would eliminate tariffs in the U.S. (currently 2.6 percent), Korea (down from 8 percent to 2.6 percent following U.S. pressure), and Europe (ranging up to almost 4 percent), and would lock in Japan and Taiwan at zero.

The WSC took a strong stand on the tariff issue at its May 2004 meeting, requesting that GAMS "achieve zero duties on multi-chip integrated circuits as soon as possible." Members of GAMS are working hard towards a tariff elimination agreement, which would call for signatories to eliminate all tariffs on MCPs. The United States Trade Representative is actively engaged with its counterparts from the European Union, Korea, Japan, and Chinese Taipei, seeking to have an agreement take effect in 2005.

SIA will seek to broaden coverage to include all WTO members as soon as possible.

SUPPORTING NEW TRADE AGREEMENTS

SIA supported last year's successful passage of the Australia and Morocco free trade agreements (FTAs), which include strong rules and set a good precedent for future free trade agreements.

SIA will continue to monitor the FTAs under negotiation, such as bilateral and regional agreements in the Middle East, Latin America, Asia, and Southern Africa, and support passage of concluded agreements, such as CAFTA and Bahrain. In 2005, other major trade issues expected in Congress are renewals of trade promotion authority and WTO membership.

SIA supports expanded trade liberalization in the current WTO Doha Round negotiations, and is encouraging extension of the Information Technology Agreement to additional countries and products. SIA will continue to advocate reduction of tariff and nontariff barriers, removal of impediments to e-commerce, and elimination of copyright levies on digital products.

UPHOLDING ANTIDUMPING LAWS AND EFFECTIVE ANTIDUMPING REMEDIES

Existing WTO rules on antidumping promote competition on a fair basis, creating an environment where success is determined by products, technology, and manufacturing capabilities, not by "dumping"—the practice of selling below the cost of production or using price discrimination to gain export market share. The antidumping remedy is especially important to U.S. semiconductor firms, given the sector's history of injurious dumping by other countries. Many WTO members favor weakening WTO rules on antidumping and subsidies, while SIA opposes any changes that would weaken the law.

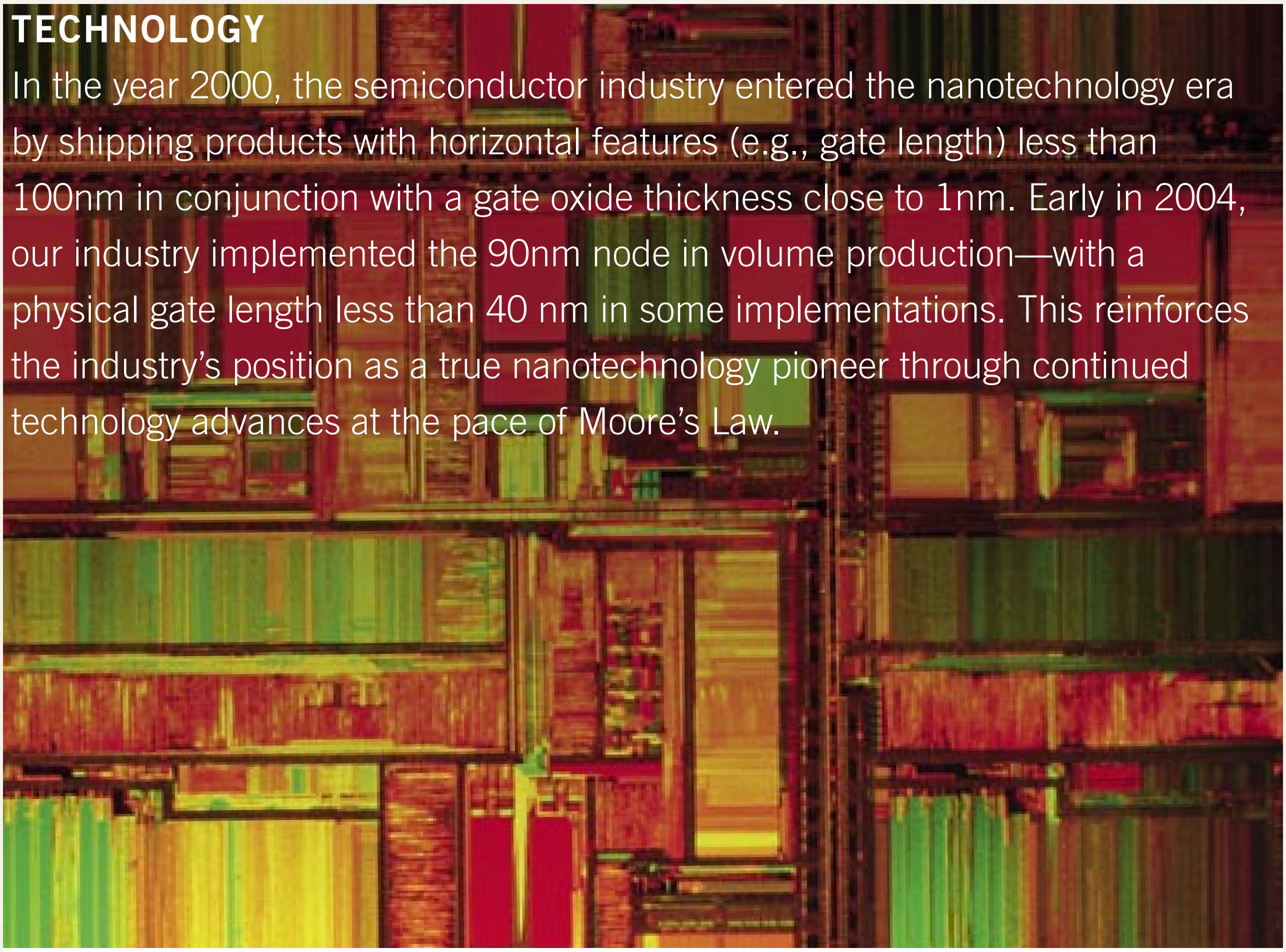
SIA will continue to support the maintenance of an effective remedy against dumping and opposes any weakening of U.S. antidumping laws or the ability of WTO members to impose measures to remedy injurious dumping. SIA also believes that subsidies hold the potential to disrupt market-based competition and distort trade. Specific financial intervention by governments to assist individual companies should be discouraged and should be subject to remedial action where such assistance causes injury or other adverse trade effects.

FIGHTING FOR FREE, FAIR, AND OPEN WORLD TRADE

SIA will decisively combat impediments to free trade, in the form of subsidies, tariffs, tax rebates, restrictive standards or dumping, the pernicious practice of selling below cost or domestic market value to gain foreign market share. The association will continue to fight for free, fair, and open trade in global markets as the greatest engine of global growth and development the world has ever known.

TECHNOLOGY

In the year 2000, the semiconductor industry entered the nanotechnology era by shipping products with horizontal features (e.g., gate length) less than 100nm in conjunction with a gate oxide thickness close to 1nm. Early in 2004, our industry implemented the 90nm node in volume production—with a physical gate length less than 40 nm in some implementations. This reinforces the industry's position as a true nanotechnology pioneer through continued technology advances at the pace of Moore's Law.



Pushing the technological limits of semiconductor design and manufacturing even further requires a large and coordinated effort in research and development among corporations, governments, and universities. To maintain the industry's remarkable velocity—and the technological leadership of U.S. semiconductor companies—the SIA forms consortia and other partnerships to fund advanced research and pool resources and ideas. SIA pursued four major technology initiatives this past year:

- Publishing the 2004 update to the International Technology Roadmap for Semiconductors.
- Continuing our involvement with the Focus Center Research Program, a government–industry–academia collaboration focused on cutting-edge research to take CMOS technology—the workhorse of semiconductors—to its ultimate limits.
- Launching a new Nanoelectronics Research Initiative, a government–industry–academia collaboration focused on "beyond CMOS" nanotechnology.
- Lobbying and building partnerships to increase federal spending on the sciences, mathematics, and engineering.

THE INTERNATIONAL TECHNOLOGY ROADMAP FOR SEMICONDUCTORS

Working with the Semiconductor Research Corporation (SRC) and International SEMATECH, SIA helps semiconductor companies collaborate on technology challenges. One way we do this is by publishing the International Technology Roadmap for Semiconductors (ITRS), which identifies industry trends, highlights technical obstacles, and helps companies align product cycles with developing technologies.

The 2004 ITRS update represents the seventh international version of this roadmap, reflecting input from nearly 1,000 experts and researchers from Europe, Japan, Korea, Taiwan, and the U.S.

INNOVATION HIGHLIGHTS

2004 brought exciting developments in semiconductor technologies:

- Despite significant technology challenges, the industry continued to maintain the pace predicted by Moore's Law—the doubling of transistors every two years.
- Transistor speed continued to advance at the historical improvement rate of 17 percent per year, although the challenges became more complex due to a concurrent increase in leakage currents.
- Strained silicon was introduced into manufacturing as a means of increasing transistor current or/and reducing leakage current.
- Research intensified on major technology innovations like high-K dielectrics, metal gate electrodes, and

multiple-gate MOS transistors, which are forecast to enter manufacturing before the end of the decade. These represent major shifts, where some basic device materials and structures will undergo change for the first time in more than 30 years.

- Mixed-signal and analog chips continue to grow in importance, driven especially by consumer and communications-related markets.
- State-of-the-art microprocessors now run well in excess of several GHz. Memory designs are geared increasingly to specific applications. And new memory technologies —including magnetic and ovonic memories—are on the horizon.

BASIC KNOWLEDGE FUELS INDUSTRY PROGRESS

To overcome formidable obstacles in design and manufacturing of devices and circuits, the semiconductor industry must conduct advanced research and train graduate students in all technology disciplines. That is why SIA formed the SRC, which, since its inception in 1982, has graduated more than 3,000 advanced degree students.

FOCUS CENTER RESEARCH PROGRAM

In collaboration with the U.S. government, SIA created the Focus Center Research Program (FCRP) in 1999. This program brings together the U.S. semiconductor industry, the federal government, and 30 of the nation's most prestigious universities. They collaborate on cutting-edge research deemed critical to the growth of U.S. technology industries. It is the most ambitious research project the U.S. chip industry has undertaken since SIA companies formed the SEMATECH consortium in 1987.

FCRP researchers investigate technology solutions for key issues (as highlighted by the ITRS) that will arise eight to 10 years in the future. The FCRP's five national focus centers channeled over $25 million in 2003 into new research activities in these areas and expect to spend some $27 million in 2005. Importantly, representatives from the organizations that fund each center work with research teams to bring these advanced new technologies to market.

Here is an overview of the exciting research currently taking place at these focus centers:

- System Design—The Gigascale System Research Center created and developed platform-based design as a paradigm-shifting design methodology for complex systems-on-a-chip. GSRC also began work on a living systems roadmap through close collaboration within GSRC, industrial partners, and the SIA roadmap effort.
- Interconnects—The Interconnect Focus Center developed an interconnect framework for 40Terabit/s optical bandwidth, a 3D integration process for hyperintegration of devices in a circuit, and continued work on optical interconnects and on innovative microchannel cooling for "hot" chips.
- Circuits—The Center for Circuits and Systems Solutions (C2S2) addressed the formidable power and leakage issues using novel circuit techniques, and demonstrated 33 percent energy saving and 43 percent leakage reduction for an example technology. C2S2 also developed the via patterned gate array (VPGA) as a new solution to address the manufacturing complexity and process variability issues for application specific interconnects.
- Devices—The Center for Materials, Structures, and Devices developed and demonstrated significantly improved device mobility (speed) with a strained Si channel, novel high-K dielectrics with a Ge channel MOSFETs, and the first integration of nanotubes with CMOS technology.
- Nanomaterials and Nanodevices—A fifth focus center, Functional Engineered Nano Architectonics, commenced operation in 2004 with an emphasis on nanomaterials and nanodevice research.

These centers are now working with an integrated research agenda to ensure efficiency and reduce redundancy in the research effort for scaling CMOS technology to its ultimate limits.

NANOELECTRONICS RESEARCH INITIATIVE

Most experts agree that CMOS will reach the end of its progression in about 15 years—hitting physical, technological, and economic limits. The Nanoelectronics Research Initiative is proposed as a mission-oriented platform to accelerate and augment research "beyond CMOS" technologies. The Technology Strategy Committee of the SIA has defined its mission as follows:

> "By 2020 discover and reduce to practice via technology transfer to industry novel non-CMOS devices, technology and new manufacturing paradigms, which will extend the historical cost/function reduction, along with increased performance and density for another several orders of magnitude beyond the limits of CMOS."

The effort would involve the government, industry, and academia working together to link existing efforts, identify gaps, and seed research to bridge the gaps; and to demonstrate proof of concept for a few select ideas.

REVERSING THE DECLINE IN FEDERAL FUNDING

In the 1990s, federal funding declined precipitously in the areas most critical to our industry's continued success: the physical sciences, mathematics, and engineering. This has seriously reduced the number of faculty and students in these disciplines, slowing the pace of university research and creating a shortage of skilled workers for our companies. In the past year, SIA has energetically addressed this problem:

- SIA has engaged deeply with government agencies to ensure that sufficient research resources are committed to maintain progress along the path projected by Moore's Law.
- SIA built a partnership between the National Science Foundation and SRC that will support significant funding of ITRS-related research.
- SIA was successful in increasing government funding of the Focus Center Research Program to $17 million in 2004.

INNOVATION DEMANDS INVESTMENT

We rely on semiconductor technology and take it for granted in our everyday lives. But the marvels of today are really the fruits of research seeds planted decades ago—investments that either funded discoveries and new technologies or helped educate the very engineers and scientists who now form our workforce. The very fact that these advances required decades of investment stands as a warning against complacency in our future investment strategy.

Our future performance as an industry depends on our capability to create new knowledge and develop it into technologies that drive our economy, guarantee our national security, and improve health and the quality of life. Only with significant government support of R&D can we progress on the current course of miniaturization and address nanotechnology's enormous challenges with tremendous benefit for all.

WORKFORCE

U.S. semiconductor companies face varied challenges in sustaining a well-qualified semiconductor workforce equipped to continue the transformative innovations already under way—from sparking an early passion for science and engineering, through higher education, to retaining the best and the brightest from the world over and ensuring that our human resource policies and practices are as advanced and current as our technology.

EVOLUTION OF THE SIA WORKFORCE STRATEGY COMMITTEE

This committee was established in 1998 to address a shortage of high-tech workers. In 2004, an in-depth needs analysis with member companies prompted us to refocus our mission. Our money, resources, and efforts will be directed over the next few years to four key areas:

- Understanding and impacting the current and anticipated supply, quality, and diversity of high-tech workers needed by the industry.
- Meeting the need for improved math and science achievement in the K-16 grades, with a focus on improving the quality of sixth- through twelfth-grade math and science teachers.
- Understanding and addressing the most important human resource/workforce issues affecting our member companies through discussion, benchmarking, and best-practice sharing.
- Effective public policy and lobbying efforts on issues that affect the semiconductor workforce.

ADDRESSING THE SHORTAGE OF FUTURE ENGINEERING TALENT

Electrical engineering degrees granted in 2003 increased modestly from 2002, but not sufficiently to cover the anticipated shortfall of engineers needed for semiconductor and nanotechnology jobs in the foreseeable future.

The number of students enrolling in EE and CS majors is also starting to drop. There was a 1–5 percent decline in enrollments in 2004 compared to 2003, and many schools are reporting that interest level in these majors is declining. A severe underrepresentation of women, African Americans, Hispanics, and Native Americans in the populations of students enrolled in, and graduating with, technical and scientific degrees is compounding the problem.

IMPROVING THE SUPPLY AND QUALITY OF ELECTRICAL ENGINEERS FOR THE INDUSTRY

SIA is partnering with the Semiconductor Research Corporation (SRC) on a nationwide Chip Design Challenge to increase visibility and interest in the analog and DSP skill areas. This exciting program was announced to the country's EE departments in November 2004. SIA has funding of over $200K from these member companies: AMD, AMI, Analog Devices, Cadence, Freescale, IBM, Intel, NSC, and TI. The contest will reward schools that submit the most innovative system-on-chip designs in two phases with prize money, access for members to the students involved, and ultimately the opportunity for selected schools to have their designs fabricated in 2006 through a partnership with MOSIS.

In November 2004 we also launched the SIA Stay Tech program (SST). SIA's goal is to improve the retention of already enrolled EE students. The fast path to improving the supply of this critical talent for our members is to keep more students in the program. The national fall-out rate for underserved EE students is over 60 percent. The SST program will award four or five grants to schools selected for their innovative proposals to improve EE retention in 2005.

TRAINING THE BEST TECHNICIAN WORKFORCE

Meeting the rapidly changing workforce needs of the semiconductor industry is a key focus of the Maricopa Advanced Technology Education Center (MATEC), an organization supported by the National Science Foundation. For the past several years, SIA has been a close partner with MATEC in providing curriculum as well as faculty training and development for semiconductor manufacturing programs at nearly 100 two- and four-year institutions nationwide. MATEC has developed more than 50 curriculum modules addressing all aspects of semiconductor manufacturing.

FOCUS ON K-12 TEACHER AND STUDENT ACHIEVEMENTS

Our member companies are focused on improving the overall quality of our country's K-12 education system. In the last three years alone our member companies have invested more than $220,000,000 in these programs, reaching over 340,000 teachers and more than 6,500,000 students. Details of these innovative programs can be found in our annual K-12 Catalog, featuring current educational initiatives, best practices, and available resources among SIA member companies. The catalog can be downloaded from www.sia-online.org/iss_workforce.cfm.

Tomorrow's graduate students, who will usher in the revolutionary technologies made possible by nanotechnology, are in junior high school today. Government has the primary responsibility for ensuring that these students have the math and science preparation to allow them to take advantage of nanotechnology's opportunities, but industry is contributing importantly to the effort.

SIA's collective efforts, along with others who understand the critical importance of K-12 student achievement in science and math, have increased funding for the national Math and Science Partnership program from $228 million in fiscal year 2003 to $290 million in fiscal 2004. The program is an important component of the "No Child Left Behind" Act, passed into law in January 2002.

SIA has also actively supported implementation of the National Science Foundation Authorization Act of 2002. The law calls for a doubling of the NSF budget over five years, and includes the Science, Mathematics, Engineering, and Technology Talent program, which offers competitive grants to universities and colleges to increase and retain the number of students completing degrees in these fields, and the Robert Noyce Scholarship program, offering grants to institutions of higher learning to encourage students in math, science, and engineering to pursue K-12 teaching careers.

The significant challenge of preparing students for the opportunities offered by tomorrow's technologies requires that industry do its part. We are continuing our partnership with Semiconductor Equipment and Materials International (SEMI) in sponsoring Workforce Development Institutes for high school teachers. The two-day institutes are educational programs for high school teachers to learn math and science experiments and teaching techniques to help engage students in pursuing technical degrees and semiconductor careers. Member companies are sending teachers to these programs with excellent results.

SIA is also a major sponsor of the annual Summer Institute of SECME—Science, Engineering, Communication, and Mathematics Enhancement—an intensive, two-week professional development program for nearly 600 K-12 educators across the country.

ATTRACTING AND RETAINING TOP FOREIGN NATIONALS

U.S. industry and our nation's graduate schools continue to need the skills of foreign nationals who graduate from our universities. Due to the current H-1B visa cap and other issues, the number of the world's best students applying to U.S. graduate schools in EE plummeted over 50 percent in 2004. This is a dangerous trend that must be reversed to ensure that we continue to attract top students, keep the most competitive graduates in the U.S, and ensure a continuing stream of the innovations and inventions that have defined this industry.

Under an H-1B visa, foreign nationals who graduate from U.S. universities can stay in the country to work for U.S. firms. As of October 1, 2003, the annual H-1B visa cap reverted to 65,000, down from an annual cap of 195,000 established in 2000.

To remain competitive globally, the industry seeks to hire the best new engineers graduating from American universities. According to 2004 Engineering Workforce Commission statistics on EE degrees, more than 54 percent of master's degrees and more than 65 percent of PhDs awarded in engineering at U.S. universities went to foreign nationals. In a typical employment year, about 2 percent of the total H-1B allotment is used by the semiconductor industry. These are small numbers in comparison to the total, but those 1,400 individuals have some of the best minds on the planet. We must have the ability to continue to hire and retain this talent in the U.S. or we will lose them to a competitive offshore market.

SIA worked closely with Compete America, as well as directly with key elected representatives to introduce legislation that will exempt at least a portion of the master's and PhD candidates from the H-1B cap each year. More work needs to be done, both to attract and retain the world's best students here in the U.S. and to encourage more U.S. students to pursue advanced degrees.

UNDERSTANDING OUR WORKFORCE DYNAMICS

Each year our Workforce Committee completes an in-depth survey of industry trends. In 2004 we have added a number of new elements to this analysis to help us better understand the workplace, employment trends, attrition, skills usage, employment categories, and compensation practices. These important issues will help us better prepare our member companies for being best-of-class, responsive HR organizations. In 2004 we also introduced some in-depth HR best-practice sharing and benchmarking to help members network and expand their knowledge.

OUR WORKFORCE IS OUR FUTURE

Attracting increased numbers of talented students to scientific and mathematical fields, and providing skilled teaching and other incentives needed to see students through to completion of undergraduate and graduate degrees, remain top SIA priorities. Our nation cannot afford to allow current rates of attrition in critical engineering fields to jeopardize its continuing technology leadership. In addition to its sizable investment in K-12 and university educational programs, SIA remains committed to lifelong training of a qualified workforce and to retention of talented domestic and foreign nationals in the numbers needed to advance and benefit from semiconductor and microelectronic technologies.

2004 ROBERT N. NOYCE AWARD

CRAIG R. BARRETT

CHIEF EXECUTIVE OFFICER, INTEL CORPORATION

In November 2004, Craig R. Barrett received the prestigious Robert N. Noyce Award, named in honor of the industry pioneer. The SIA Board cited Barrett's extensive contributions to the U.S. semiconductor industry over a long career.

"Craig Barrett has long been a leading statesman for the U.S. semiconductor industry," said SIA President George Scalise. "He has been an effective champion for improving education and advancing semiconductor technology. Craig was a principal driver of the Focus Center Research Program and a leader in creating the Nanoelectronics Research Initiative. He is a former chairman of SIA, co-chairman of the Business Coalition for Excellence in Education, and chairman of the National Academy of Engineering. He is a most deserving recipient of the 2004 Robert N. Noyce Award."

The award is the industry's highest honor, and is presented annually to recognize individuals for outstanding achievement and leadership in support of the U.S. semiconductor industry. In 1990, the SIA Board of Directors created this award to honor the memory of Robert Noyce, co-founder of Intel and a scientist, engineer, and entrepreneur of world stature whose life work and inventions contributed immensely to the way we live, work, and play.

NOYCE AWARD WINNERS

2004 Craig R. Barrett
2003 Gov. George Pataki
2002 Gordon Moore*
2001 Ray Stata
2000 Federico Faggin
2000 Marcian Edward (Ted) Hoff, Jr.
2000 Stanley Mazor
1999 Erich Block
1998 Wilfred Corrigan
1998 Jerry Sanders
1997 Charlene Barshefsky
1996 Charles Sporck
1995 Jack Kilby
1994 Gordon Moore
1993 Robert Galvin
1992 Ian Ross
1991 Joseph Canion

*SIA Lifetime Achievement Award


Steven R. Appleton


Brian L. Halla


Hector de J. Ruiz


John T. Dickson


John Daane


Ray Stata


Dwight W. Decker


T.J. Rodgers


Michel P. Mayer


John E. Kelly, III


Craig R. Barrett


Richard Beyer


Wilfred J. Corrigan


Richard K. Templeton


Willem P. Roelandts

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President and Chief Executive Officer
Texas Instruments Incorporated

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Chairman, President and Chief Executive Officer
Xilinx, Incorporated

COMMITTEES

OUR COMMITTEES, FORMED BY REPRESENTATIVES FROM ALL OF OUR MEMBER COMPANIES, ARE THE CRITICAL ENTITIES WHICH ENABLE THE SIA TO ACHIEVE OUR CORE GOALS AND OBJECTIVES.

Public Policy Committee

This team focuses on legislative and regulatory issues that affect the semiconductor industry—particularly export controls, taxes, intellectual property, and science policy. This committee, the SIA, and member companies all work directly with members of Congress, their staff, executive branch officials, foreign governments, and trade associations.

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Agere Systems

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Don Netko
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Paul Kempf
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W. Richard Marz
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Kevin Dempsey
Alan Wolff
Dewey Ballantine
SIA Counsel

Joint Steering Committee

The Joint Steering Committee (JSTC) of the World Semiconductor Council supports the ongoing work of the WSC, meeting three times a year. SIA member companies serve on the JSTC with their counterparts representing the semiconductor industries from Europe, Korea, Japan, and Taiwan.

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Jeanette Morgan
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Brenda Harrison
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Anne Craib
Daryl Hatano
SIA Staff

Amy Burke
Alan Wolff
Dewey Ballantine
SIA Counsel

Workforce Committee

The Workforce Strategy Committee has four focus areas:

1. **Increasing the current and future supply, quality, and diversity of the high-tech workforce.**
2. **Improving K-16 math and science achievement, primarily through programs for 6th–12th grade math and science teachers.**
3. **Helping our member companies understand the most important HR / Workforce issues through discussion, benchmarking, and best-practice sharing.**
4. **Effective advocacy of public policies that impact the high-tech semiconductor workforce.**

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Law Committee

This committee advises the SIA Board and other SIA committees on legislative and legal matters, especially on environment, safety, health, and intellectual property issues. The committee also files friend of the court briefs on appellate cases of importance to the industry.

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Amy Burke
Kevin Dempsey
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Environment Committee

This team prioritizes public policy and regulatory issues at federal, state, and local levels. It also guides the industry on the use of chemicals, emission reductions, global warming, tool design, energy, and recycling.

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Jim Cochran
Greg Connor
TSMC/WaferTech

Chuck Fraust
SIA Staff

Environment, Safety, and Health Task Force

The Environment, Safety, and Health Task Force (ESH TF) of the World Semiconductor Council supports the work of the JSTC with respect to global ESH issues. Key ESH managers from the member companies meet with their counterparts from Europe, Korea, Japan, and Taiwan twice a year at JSTC meetings to develop and implement cooperative, global ESH programs.

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Safety and Health Committee

Safety and industrial hygiene professionals work with this group to analyze important issues that impact industry workers and surrounding communities.

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Chuck Fraust
SIA Staff

Technology Strategy Committee

Working with the Semiconductor Research Corporation and International SEMATECH, this committee defines strategies to promote and maintain our world leadership in semiconductor technology. It also formulates the industry's premier forecasting tool, the International Technology Roadmap for Semiconductors (ITRS), a 15-year outlook on key technological trends and barriers facing our industry.

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Clark McFadden
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SIA China and Japan Chapters

This chapter provides a forum for local SIA member company representatives to discuss issues of mutual interest, and to meet with government officials and domestic industry representatives. SIA also participates in a multi-association advocacy office, USITO, in Beijing.

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World Semiconductor Council

Every year, the WSC brings together the industry associations of the world's leading semiconductor-producing nations to collaborate on important global policy issues.

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John Dickson
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George Scalise
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Statistics Committee

The SIA Statistics team develops statistical information about market conditions as well as product and industry trends to help companies make better business decisions. The committee is also responsible for producing the semi-annual SIA semiconductor forecast, a three-year outlook for the industry.

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Working closely with authorities when requirements for semiconductor production facilities change, this committee ensures that the industry's needs are represented, without sacrificing the integrity of fire and building codes.

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Agere Systems is a global leader in semiconductors for storage, wireless data, and public and enterprise networks. The company's chips and software power a broad range of computing and communications applications, from cell phones, PCs, PDAs, hard disk drives and gaming devices to the world's most sophisticated wireless and wireline networks. Agere's customers include the top manufacturers of consumer electronics, communications and computing equipment. Agere's products connect people to information and entertainment at home, at work and on the road—enabling the connected lifestyle.

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Agilent Technologies is a global technology leader in communications, electronics, life sciences and chemical analysis. The company's 28,000 employees serve customers in more than 110 countries. Agilent is the world's 25th largest semiconductor supplier and has two main semiconductor businesses. The automated test business provides test solutions that are used in the manufacture of semiconductor wafers, memory and devices; electronics (primarily printed circuit-board assemblies); and flat panel displays. Our semiconductor products business is a leading supplier of semiconductor components, modules and subsystems for consumer and commercial electronics applications.

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Allegro MicroSystems, Inc. maintains a leadership position in the integrated magnetic sensor, power management and integrated motor driver product segments, supplying advanced mixed-signal power semiconductors and Hall-effect sensors for the automotive, communications, consumer, office automation and industrial markets. Frost & Sullivan named Allegro the 2004 Sensors Company of the Year. In addition, Allegro has received quality awards from leading manufacturers worldwide, IECQ manufacturer's approval, QS 9000, and ISO 9001 registration. Allegro is an American-managed, wholly-owned subsidiary of Sanken Electric Co., Ltd., with worldwide resources in design and applications engineering, process technology, packaging, quality control, and manufacturing.

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Altera Corporation is a leading provider of programmable logic devices. Founded in 1983, Altera invented the first reprogrammable logic device that gave system designers around the world the ultimate in design flexibility. Since then, Altera has continued to innovate and expand its technology leadership in what is today a $3B dollar industry. Now, more than ever, customers in the communications, industrial, computer, and digital consumer markets are leveraging Altera's programmable technology as their competitive edge. Altera common stock is traded on the Nasdaq Stock market under the symbol ALTR.

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AMI Semiconductor (AMIS) is a leader in the design and manufacture of silicon solutions for the real world. As a widely recognized innovator in state-of-the-art integrated mixed-signal products, mixed-signal foundry services and structured digital products, AMIS is committed to providing customers with the optimal value, quickest time-to-market semiconductor solutions. Offering unparalleled manufacturing flexibility and dedication to customer service, AMI Semiconductor operates globally with headquarters in Pocatello, Idaho, European corporate offices in Oudenaarde, Belgium, and a network of sales and design centers located in the key markets of the North America, Europe and the Asia Pacific region.

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Analog Devices, Inc. (NYSE: ADI) designs, manufactures and markets high-performance analog, mixed-signal and digital signal processing integrated circuits (ICs) that address a wide range of real-world signal processing applications. ADI's products play a fundamental role in converting real-world phenomena such as temperature, motion, pressure, light and sound into electrical signals to be used in applications ranging from industrial process control, factory automation, radar systems and CAT scanners to cellular base stations, broadband modems, wireless telephones, computers, cars and digital cameras.

ADI has manufacturing facilities in Massachusetts, California, North Carolina, Ireland, and the Philippines. The Company operates design centers at over thirty locations throughout the world.

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Atheros Communications is the leading developer of networking technologies for secure, high-performance wireless local area networks. As the industry innovator and market-share leader in multi-mode wireless solutions compliant with the IEEE 802.11 specifications, Atheros is driving transparent connections among electronic devices in the office, home and on the road. Atheros technology is being used by many of the world's leading wireless equipment manufacturers including Accton, Actiontec, Acrowave Systems, AirVast Technology, ALPS, Ambit, Askey, ASUS, BenQ, Contec, CyberTAN, Delta Networks, D-Link, Gemtek, Gigabyte Technology, Global Sun Tech, HP, IBM, ICOM, Intel, Intermec, I-O Data, Linksys, NEC, NETGEAR, Philips, Proxim, Samsung, Senao, SMC Networks, Sony, Symbol, TDK, TECOM, USI, W2 Networks, Wistron NeWeb, Z-Com and others. For more information, visit www.atheros.com or send email to info@atheros.com.

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Broadcom Corporation is a leading provider of highly integrated silicon solutions that enable broadband communications and networking of voice, video and data services.

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California Micro Devices Corporation is a leading supplier of application specific analog semiconductor products for the mobile, computing and digital consumer markets. Key products include Application Specific Integrated Passive™ (ASIP™) devices plus power management and interface ICs. They provide critical signal integrity, electromagnetic interference (EMI) filtering, electrostatic discharge (ESD) protection and power management.

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Conexant Systems, Inc. (NASDAQ: CNXT) is a worldwide leader in semiconductor solutions for broadband communications, enterprise networks and the digital home. The fabless company has leveraged its expertise and leadership position in modem technologies to enable more Internet connections than all of its competitors combined, and continues to develop highly integrated silicon solutions for broadband data and media processing networks.

Key products include DSL and cable modem solutions, home network processors, broadcast video encoders and decoders, digital set-top box components and systems solutions, and dial-up modems. Conexant has approximately 2,400 employees worldwide.

Cypress Semiconductor Corporation
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Cypress Semiconductor Corporation (NYSE: CY) is Connecting From Last Mile to First Mile™ with high-performance solutions for personal, network access, enterprise, metro switch, and core communications-system applications. Cypress Connects™ using wireless, wireline, digital, and optical transmission standards, including USB, Fibre Channel, SONET/SDH, Gigabit Ethernet, and DWDM. Leveraging its process and system-level expertise, Cypress makes industry-leading physical layer devices, framers, and network search engines, along with a broad portfolio of high-bandwidth memories, timing technology solutions, and reconfigurable mixed-signal arrays. More information about Cypress is accessible online at www.cypress.com.

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Committed to being the world's leading supplier of image sensor solutions for performance imaging markets, **Eastman Kodak Company's Image Sensor Solutions** (ISS) division is solving its customers imaging needs by providing high performance image sensors to a global market. ISS focuses on the development, manufacture and marketing of solid state charged-coupled device (CCD) and complementary metal-oxide semiconductor (CMOS) image sensors for applications ranging from satellite and medical imaging applications to digital cameras and machine vision products.

A leader in CCD technology for well over twenty years, Kodak offers a broad product portfolio of world-class, high performance solid state image sensors, including full-frame, interline and linear CCD as well as CMOS imagers.

Fairchild Semiconductor Corporation
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Fairchild Semiconductor (NYSE: FCS) is the leading global supplier of high performance power products critical to today's leading electronic applications in the computing, communications, consumer, industrial and automotive segments. As The Power Franchise®, Fairchild offers the industry's broadest portfolio of components that optimize system power through minimization, conversion, management and distribution functions. Fairchild's 9,000 employees design, manufacture and market power, analog & mixed signal, interface, logic, and optoelectronics products from its headquarters in South Portland, Maine, USA and numerous locations around the world.

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Freescale Semiconductor, Inc. (NYSE:FSL, FSL.B) is a global leader in the design and manufacture of embedded semiconductors for the automotive, consumer, industrial, networking and wireless markets. Freescale became a publicly traded company in July 2004 after more than 50 years as part of Motorola, Inc. The company is based in Austin, Texas, and has design, research and development, manufacturing or sales operations in more than 30 countries. Freescale, a member of the S&P 500®, is one of the world's largest semiconductor companies.

IBM Microelectronics
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IBM develops, manufactures and markets state-of-the-art semiconductor and interconnect products and services including industry-leading Power Architecture microprocessors. IBM semiconductors are a major contributor to the company's position as the world's largest information technology company. Its chip products and solutions power IBM eServer and TotalStorage systems as well as many of the world's best-known electronics brands.

IBM semiconductor innovations include dual-core microprocessors, copper wiring, silicon-on-insulator and silicon germanium transistors, strained silicon, and eFUSE, a technology that enables computer chips to automatically respond to changing conditions.

More information is available at http://www.ibm.com/chips.

Infineon Technologies North America Corp.
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Infineon Technologies AG, headquartered in Munich, Germany, offers semiconductor and system solutions for the automotive and industrial sectors, for applications in the wired and mobile communications markets, security IC solutions as well as memory products. With a global presence, Infineon operates in the US from San Jose, CA, in the Asia-Pacific region from Singapore and in Japan from Tokyo. In fiscal year 2004 (ending September), the company achieved sales of approximately $8.93 billion (Euro 7.19 billion) with about 3 5, 6 00 employees worldwide. Infineon is ranked as the world's fifth largest semiconductor manufacturer and listed on the DAX index of the Frankfurt Stock Exchange and on the New York Stock Exchange (ticker symbol: IFX) and is a member of the Philadelphia Semiconductor Index (SOX) . Further information is available at www.infineon.com.

Integrated Device Technology, Inc.
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IDT is a global leader in preemptive semiconductor solutions that accelerate packet processing for advanced network services. IDT serves communications equipment vendors by applying its advanced hardware and software technologies to create flexible, highly integrated solutions that enhance the functionality and processing of network equipment. IDT accelerates intelligent packet processing with products such as switching solutions, network search engines, flow-control management ICs and its family of Interprise™ integrated communications processors. The portfolio also comprises products optimized for communications applications, including telecom products, FIFOs, multi-ports, and timing solutions. In addition, the product mix includes high-performance digital logic and high-speed SRAMs.

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International Rectifier Corporation
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International Rectifier Corporation (IR) (NYSE:IRF) is a pioneer and world leader of power management technology. IR's analog and mixed signal ICs, advanced circuit devices, integrated power systems and components enable high performance computing and eliminate energy waste from motors, the world's single largest consumer of electricity. Makers of computers, appliances, lighting, automobiles, satellites, aircraft, and defense systems rely on IR's power management benchmarks to enable their next generation products. Among other core patents, International Rectifier invented the HEXFET® Power MOSFET creating a $4B industry. The Company employs 5800 people with operations in 20 countries throughout North America, Europe, and Asia.

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Intersil Corporation, a NASDAQ 100 Index company, is a technology leader specializing in the design and manufacture of high performance analog semiconductors. Based in Milpitas, California, Intersil's product strategy is focused on broadening its portfolio of Application Specific Standard Products (APSP) and General Purpose Proprietary Products (GPPP) targeted for four high-growth markets—Communications, Computing, High-end Consumer and Industrial. Intersil's leadership products include amplifiers, analog front ends, communication interfaces, data converters, digital potentiometers, display solutions, DSL solutions, optical storage products, power management products, power sequencers, real time clocks, smart batteries, switches/MUX's, VoIP products and ICs for military, space and rad-hard applications.

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Jazz Semiconductor is an independent wafer foundry focused primarily on specialty CMOS process technologies, including SiGe BiCMOS and RFCMOS for the manufacture of highly integrated analog and mixed-signal semiconductor devices. Jazz's executive offices and its U.S. wafer fabrication facilities are located in Newport Beach, California. Jazz has expanded its wafer capacity in China through manufacturing partnerships with Advanced Semiconductor Manufacturing Corporation and Hua Hong NEC Electronics Co., Ltd.

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Lansdale Semiconductor, Incorporated, is a semiconductor aftermarket manufacturer, specializing in bipolar Integrated Circuits (ICs). Lansdale purchases product lines needed to support older systems from the original manufacturers. Lansdale continues to support those products by manufacturing products just like the originals for as long as they are required.

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National Semiconductor, the industry's premier analog company, creates high performance analog devices and subsystems. National's leading-edge products include power management circuits, display drivers, audio and operational amplifiers, communication interface products and data conversion solutions. National's key markets include wireless handsets, displays, PCs and laptops. The company's analog products are also optimized for numerous applications in a variety of electronics markets, including medical, automotive, industrial, and test and measurement. Headquartered in Santa Clara, California, National reported sales of $1.98 billion for fiscal 2004, which ended May 30, 2004. Additional company and product information is available at www.national.com.

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NVIDIA Corporation (NASDAQ: NVDA) is a market leader in graphics and digital media processors. NVIDIA graphics processing units (GPUs), media and communications processors (MCPs), and wireless media processors (WMPs) have broad market reach and are incorporated into a variety of platforms, including consumer and enterprise PCs, notebooks, workstations, mobile phones, and game consoles. NVIDIA is headquartered in Santa Clara, California and employs more than 2000 people worldwide. For more information, visit the company's Web site at www.nvidia.com.

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With its global logistics network and strong portfolio of power semiconductor devices, **ON Semiconductor** (Nasdaq: ONNN) is a preferred supplier of power solutions to engineers, purchasing professionals, distributors and contract manufacturers in the computer, cell phone, portable devices, automotive and industrial markets. For more information, please visit ON Semiconductor's website at http://www.onsemi.com.

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PHILIPS

Philips Semiconductors, headquartered in Eindhoven, The Netherlands, employs over 32,000 employees in more than 50 countries. With sales of some $4.6 billion in 2002, Philips is one of the world's top ten semiconductor suppliers. Philips is the leading provider of semiconductor-based solutions for connected consumer and communications applications. The semiconductor division has manufacturing and assembly sites, design centers and systems labs and offices throughout the world. Manufacturing locations are in the U.S., Asia-Pacific and Europe serving customers globally.

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pixelworks

Pixelworks is a leading provider of system-on-chip ICs for the advanced display industry. Pixelworks' solutions provide the intelligence for advanced televisions, multimedia projectors and flat panel monitors by processing and optimizing video and computer graphics signals to produce high quality images. Many of the world's leading manufacturers of consumer electronics and computer display products utilize our technology to enhance image quality and ease of use of their products.

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PMC
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PMC-Sierra is a leading provider of integrated processors and high speed mixed signal semiconductors for communications, enterprise and storage area network equipment. The company offers worldwide technical and sales support, including a network of offices throughout North America, Europe and Asia. PMC-Sierra is included in the S&P 500 Index which consists of 500 stocks chosen for market size, liquidity, and industry group representation. The company is publicly traded on the NASDAQ Stock Market under the PMCS symbol. For more information, visit http://www.pmc-sierra.com.

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Q SEMI
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QP Semi, formerly known as QP Labs, is a QML certified manufacturer of semiconductor components for high reliability applications. We specialize in supporting customers who are experiencing problems with the acquisition and processing of obsolete and end-of-life components. Our experience and capability in circuit design, fab partnerships, assembly, test and qualification provide turnkey solutions for obsolete and end-of-life components.

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QuickLogic Corporation invented and pioneered the Embedded Standard Products (ESP) architecture—innovation that delivers the guaranteed performance and lower cost than standard semiconductor products with the flexibility and time-to-market benefits of programmable logic. With the help of the metal-to-metal interconnect technology, ViaLink, our FPGA and ESP products provide the combination of bulletproof security and low power. Our customers produce many of today's sophisticated electronics systems in markets like wireless communications, industrial control, video/audio, graphics and imaging, and high-performance computing. For more information on our products and services, please visit: www.quicklogic.com.

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Rambus is one of the world's leading providers of advanced chip interface products and services. Since its founding in 1990, the company's innovations, breakthrough technologies and integration expertise have helped industry-leading chip and system companies solve their most challenging and complex I/O problems and bring their products to market. Rambus' interface solutions can be found in numerous computing, consumer, and communications products and applications.

Rambus is headquartered in Los Altos, Calif., with regional offices in Chapel Hill, North Carolina, Taipei, Taiwan and Tokyo, Japan. Additional information is available at www.rambus.com.

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Rochester Electronics, Inc. provides the world's most comprehensive support for discontinued semiconductors. Rochester is the authorized supplier from over 40 manufacturers, including AMD, Analog Devices, Fairchild, Infineon, Intersil, Intel, Motorola, National, On Semiconductor, Texas Instruments, as well as many more.

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Samsung Austin Semiconductor is one of the most advanced semiconductor fabrication plants in the world. Using state-of-the-art equipment and processes, Samsung Austin produces Dynamic Random Access Memory (DRAM) chips – the chips most commonly used in personal computers, workstations and servers. Although the company is a US-charted corporation, the majority is owned by Samsung Electronics, the giant $20-billion Korean high-technology company. Founded in January 1996, the company began producing 64 megabit DRAM memory chips in September 1997. In late 1998, the 128-megabit DRAM was introduced into the product mix. Samsung continues to bring new equipment and technology into play, as it has more than doubled its capacity in output in its brief history.

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Headquartered in Sunnyvale, California, **SST** designs, manufactures and markets a diversified range of nonvolatile memory solutions, based on proprietary, patented SuperFlash technology, for high volume applications in the digital consumer, networking, wireless communications and Internet computing markets. SST also offers its SuperFlash technology for embedded applications through its world-class manufacturing partners and technology licensees including 1st Silicon Sdn. Bhd., Grace Semiconductor Manufacturing Corporation, IBM, Motorola, NEC Corporation, Oki Electric Industry Co., Samsung Electronics Co., SANYO Electric Co., Seiko Epson Corp., Shanghai Hua Hong NEC Electronics Co., Taiwan Semiconductor Manufacturing Co., Toshiba Corporation, Vanguard International Semiconductor Corporation and Winbond Electronics Corp.

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STMicroelectronics (NYSE:STM) is a global leader in developing and delivering semiconductor solutions across the spectrum of microelectronics applications. An unrivaled combination of silicon and system expertise, manufacturing strength, Intellectual Property (IP) portfolio and strategic partners positions ST at the forefront of System-on-Chip (SoC) technology and its products play a key role in enabling today's convergence markets.

In 2003, the Company's net revenues were $7.238 billion with net earnings of $253 million.

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TDK Semiconductor Corporation, part of $6.2 billion TDK Corporation (NYSE: TDK), designs and manufactures advanced analog and mixed-signal integrated circuit products and modules for consumer, telecom, and industrial applications worldwide. The company is headquartered in Irvine, CA and has design centers in Irvine and Mountain View, CA. Customers are served through sales offices in the United States, Europe, Japan, Asia/Pacific, and through local manufacturers' representatives worldwide. Additional company and product information can be found at http://www.tdksemiconductor.com.

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Texas Instruments Incorporated is a leading provider of innovative DSP and analog technologies that meet customers' real world signal processing requirements. In addition to Semiconductor, the company's businesses include Sensors & Controls, and Educational & Productivity Solutions. TI is headquartered in Dallas, Texas, and has manufacturing, design or sales operations in more than 25 countries.

Texas Instruments is traded on the New York Stock Exchange under the symbol TXN. More information is located on the World Wide Web at www.ti.com.

Founded in 1995, **Transmeta Corporation** designs, develops and sells highly efficient x86-compatible software-based microprocessors that deliver a compelling balance of low power consumption, high performance, low cost and small size. Our products are valuable for diverse computing platforms demanding energy efficiency, low heat and x86 software compatibility. We also develop advanced power management technologies for controlling leakage and increasing power efficiency in semiconductor and computing devices.

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TSMC is the world's largest dedicated semiconductor foundry, providing the industry's leading process technology and the foundry industry's largest portfolio of process-proven library, IP, design tools and reference flows. The company operates two advanced 300mm wafer fabs, five eight-inch fabs and one six-inch wafer fab. TSMC also has substantial capacity commitments at its wholly-owned subsidiary, WaferTech and TSMC (Shanghai), and its joint venture fab, SSMC. In early 2001, TSMC became the first IC manufacturer to announce a 90-nm technology alignment program with its customers. TSMC's corporate headquarters are in Hsinchu, Taiwan. For more information about TSMC, please see http://www.tsmc.com.

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Founded in June 1996, **WaferTech** is a semiconductor manufacturer located on 260 acres in Camas, Washington, within the Pacific Northwest's Silicon Forest. WaferTech, the first and only pure-play foundry in the United States, is a subsidiary of TSMC. WaferTech works with customers seamlessly through world foundry leader TSMC and TSMC's "Virtual Fab" customer network. Through the precise duplication of advanced TSMC technology, WaferTech offers TSMC's production-proven SRAM, embedded SRAM, embedded Flash, Logic and mixed-mode CMOS technology in dimensions from 0.35 micron to 0.15 micron.

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Founded in 1984, **Xilinx** is the world's leading supplier of programmable solutions, with more than 50 percent market segment share. The company has earned a stellar reputation for corporate best practices, notably ranking in the top ten for four years straight on *FORTUNE* Magazine's annual listing of the "100 Best Places to Work" in America.

The company's portfolio of solutions includes advanced ICs, design software, IP, and services and support for high-speed connectivity, DSP, embedded and logic applications. With Xilinx, customers can drastically reduce development time for automotive, computer, consumer, peripheral, communications, networking, industrial control, instrumentation and high reliability military/aerospace products.

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