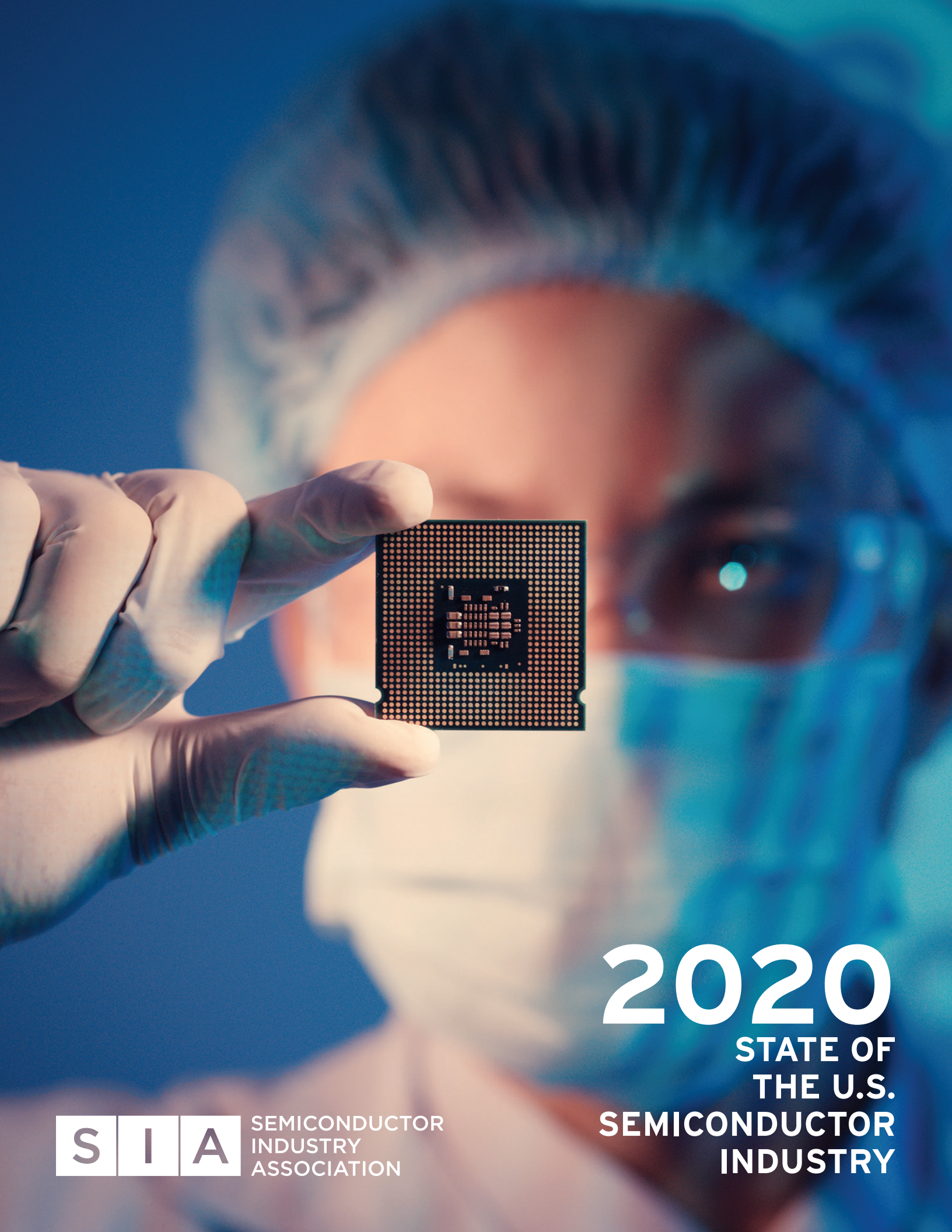
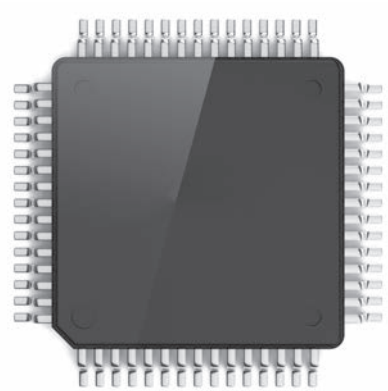


2020 STATE OF THE U.S. SEMICONDUCTOR INDUSTRY

SIA SEMICONDUCTOR INDUSTRY ASSOCIATION

INTRODUCTION

WITH TRANSISTORS 10,000 TIMES THINNER THAN A HUMAN HAIR – SO SMALL BILLIONS CAN FIT ON A CHIP THE SIZE OF A QUARTER – TODAY'S SEMICONDUCTORS ARE A TRIUMPH OF INNOVATION AND A HALLMARK OF AMERICA'S TECHNOLOGICAL PROWESS.



U.S. companies have for decades led the world in producing these tiny chips that power modern technologies. Our country's leadership in semiconductors is a big reason America has the world's largest economy and most advanced technologies.

Since the onset in early 2020 of the COVID-19 pandemic, semiconductor-enabled technology has been deployed to find treatments, care for patients, work and study from home, order groceries and other essential products, and sustain countless other systems that underpin modern society. It is a reminder of the importance of semiconductors in responding to the world's most urgent challenges and crises.

The U.S. semiconductor industry has continued to maintain its global leadership position in semiconductor technologies essential for the future, including artificial intelligence (AI), quantum computing, and advanced wireless networks such as 5G. The U.S. semiconductor industry has also maintained its global market share leadership, even though worldwide year-over-year sales growth in 2019 was negative, and has kept steady its very high levels of investment in research and development (R&D) and capital expenditure (capex).

These industry investments have sustained U.S. leadership in semiconductor innovation. U.S. companies are leaders in 5G technology and have developed virtually all the advanced semiconductors relevant for AI and big data, which power everything from supercomputers to Internet data centers.

The U.S. industry, however, faces a range of challenges. The COVID-19 pandemic has upended the global economy and disrupted worldwide supply chains, causing significant near-term market uncertainty. The rising cost of innovation for semiconductor manufacturing and design, particularly at the leading edge, continues to pose challenges. Additionally, while the U.S. remains the global leader in semiconductor design and R&D, the lion's share of chip manufacturing is now occurring in Asia. Finally, global geopolitical instability, especially regarding trade policy, is forcing the U.S. industry to consider how to remain competitive in a world of unforeseen uncertainty and policy constraints. The U.S. semiconductor industry relies on its deep global supply chains and access to overseas markets.

Overall, while the U.S. industry continues to lead the global industry, it also faces clear challenges as it seeks to maintain its leadership into the future.

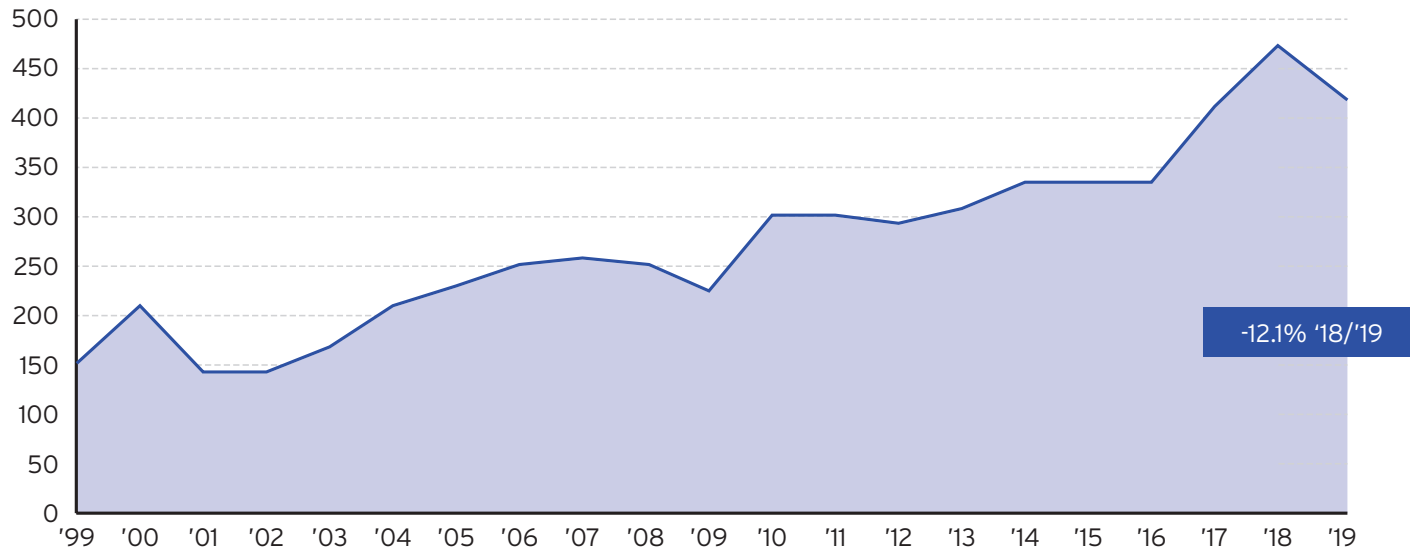
THE GLOBAL SEMICONDUCTOR MARKET

Fifty years ago, semiconductors helped put people on the moon and got them back home safely. More recently, semiconductors have made it possible to make autonomous vehicles a viable near-term technology. Semiconductors have become essential to the operation of everything from the economy to national security. Market demand for semiconductors is fundamentally linked to how chips continue to bring new conveniences to our world, making the impossible possible. This is why the semiconductor industry's long-term growth prospects remain bright. In the near-term, however, the COVID-19 pandemic and other macroeconomic factors present significant uncertainty.

Following record sales in 2018, the global market decreased in 2019, and the outlook for 2020 has been negatively affected by the COVID-19 pandemic.

Following record sales of $468.8 billion in 2018, global sales in 2019 decreased by 12 percent to $412.3 billion, due largely to cyclicality in the memory market. The World Semiconductor Trade Statistics (WSTS) Semiconductor Market Forecast released in June 2020 projected worldwide semiconductor industry sales will increase slightly to $426 in 2020, a downward revision from its Fall 2019 forecast for 2020, due mainly to the negative impact of the COVID-19 pandemic on the global economy and supply chains at the start of 2020. In 2021, WSTS forecasts global sales will rebound to $452 billion.

GLOBAL SEMICONDUCTOR SALES ($B)



SEMICONDUCTOR DEMAND DRIVERS

Semiconductors enable a wide variety of products, from smartphones and computers to cars and industrial equipment, while also creating emerging markets, such as AI, quantum computing, and advanced wireless networks, including 5G. Semiconductors spark the engine of technological advancement. Advanced semiconductors create better products, which lead to greater demand and sales revenue, which enable larger industry investments in R&D to develop even more advanced semiconductors and make new applications possible. For example, being able to pack low-power analog and radio frequency (RF) electronics onto chips made the cell phone possible. Once all this was packaged together and connected to the Internet, today's smartphones were made possible. This innovation cycle also made the digital economy possible, as increasing more powerful microprocessors and networking chips resulted in computers capable enough to power the Cloud. Today, it is opening up new frontiers of demand.

Current end-use driver shares remain stable.

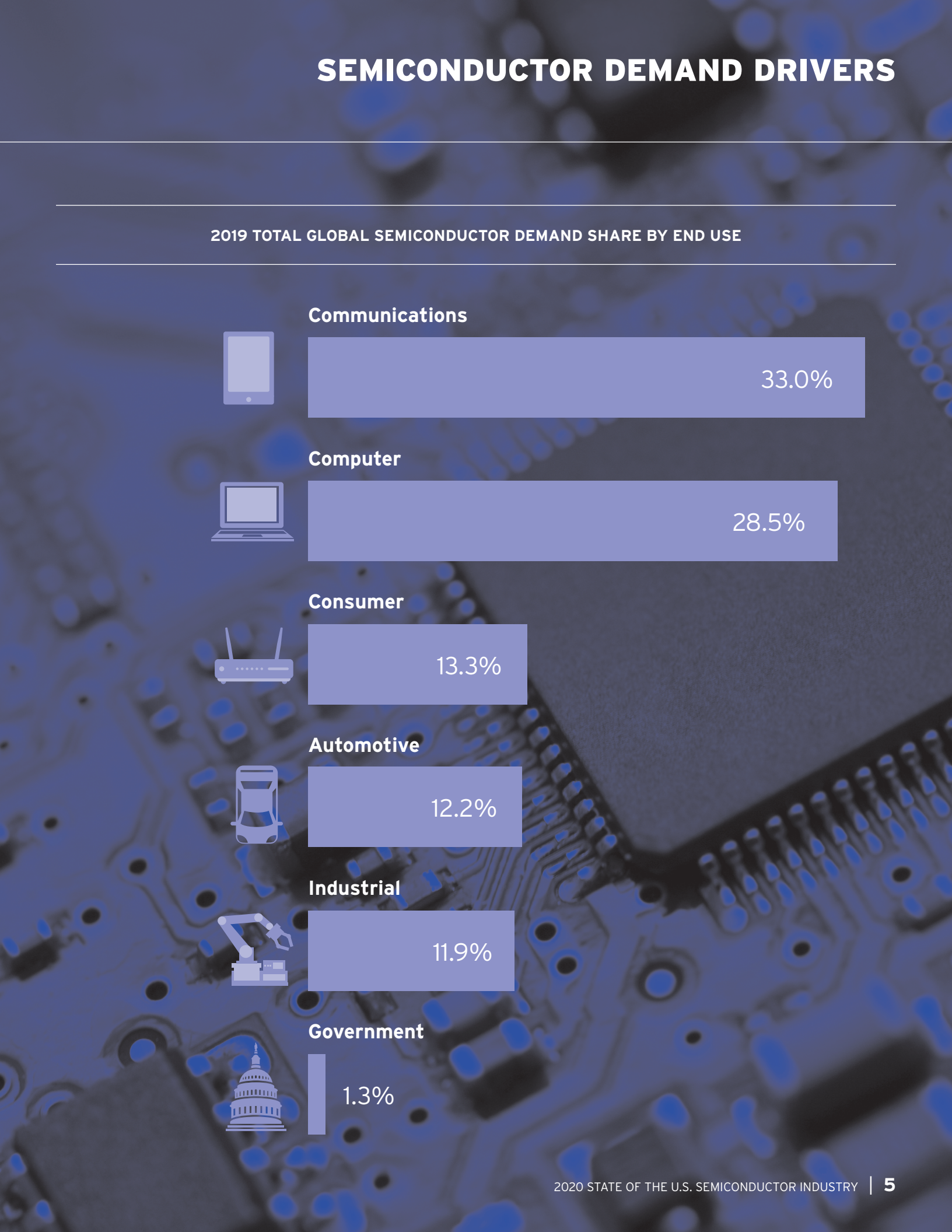
In 2019, end-use sales of semiconductors decreased across almost all categories, while end-use category shares remained stable from 2018. A major factor in the decrease in end-use sales was the decrease in memory product sales due to pricing.

2019 DEMAND BY END-USE

End-Use Category	Communication	Computer	Consumer	Automotive	Industrial	Government
Annual Growth	-10.5	-18.7	-5.2	-6.9	-13.0	13.0
Total Value ($B)	**136.0**	**117.3**	**54.7**	**50.2**	**48.9**	**5.2**

SEMICONDUCTOR DEMAND DRIVERS

2019 TOTAL GLOBAL SEMICONDUCTOR DEMAND SHARE BY END USE



EMERGING SEMICONDUCTOR DEMAND DRIVERS

Key emerging semiconductor applications continue to grow end-use demand.

AI, quantum computing, and advanced wireless networks are opening up new frontiers of semiconductor demand U.S. companies are poised to benefit from. If history is a guide, many applications that are unimaginable today will emerge in the future. When the first handheld cell phones – and later smartphones – appeared, people thought only executives would use them. Just over 40 years ago, the first four-function handheld calculators were sold in airline magazines for $500 each — an amount equivalent to almost $2,400 today. Then, handheld phones were receivers attached with wires to the actual phone on a desk or wall. Amazingly, calculator and phone functions are now virtually free in every smartphone sold, with the real value-add being the camera and internet connection. None of this could have occurred before there was first innovation in semiconductors.

IMAGINING A SEMICONDUCTOR-ENABLED FUTURE

Smart cities use semiconductors to collect location, direction, and speed data from smartphones to coordinate traffic lights and optimize traffic flows. As vehicles become more autonomous in the future, they will connect with traffic light cameras that can detect construction, a downed tree, or more critically, a child playing in the road. It is for this reason 5G is so important.

In the future, the same semiconductor technologies will be used to build more efficient factories connected by the Internet of Things (IoT), along with robots to make assembly more efficient. Intelligent private Clouds with 5G connectivity will provide the AI needed to run the smart factories.

U.S. INDUSTRY MARKET SHARE

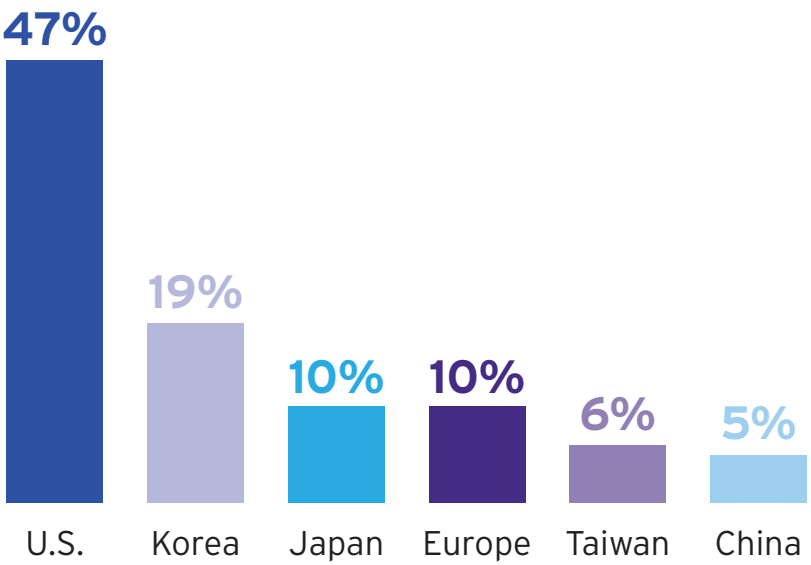
Semiconductors were invented in the United States, and the U.S. industry remains the leader in the market today. While America's position has been challenged many times over the decades, it has always prevailed due to its amazing resilience and ability to run faster. This does not mean the United States will go unchallenged in the future. The importance of semiconductors is so great that most Information-Age nations strive to be competitive in at least some aspect of this critical industry, while the world's most ambitious nations seek to chase the U.S.

The U.S. semiconductor industry has nearly half the global market share and has displayed steady annual growth.

Since the late 1990s, the U.S. semiconductor industry has been the global sales market share leader with almost 50 percent annual global market share. In addition, U.S. semiconductor firms maintain a leading or highly competitive position in R&D, design, and manufacturing process technology.

Global sales market share leadership also allows the U.S. semiconductor industry to benefit from a virtuous cycle of innovation; sales leadership enables the U.S. industry to invest more into R&D which in turns helps ensure continued U.S. sales leadership. As long as the U.S. semiconductor industry maintains global market share leadership, it will continue to benefit from this virtuous cycle of innovation.

2019 GLOBAL SALES MARKET SHARE



A VIRTUOUS CYCLE OF INNOVATION

U.S. INDUSTRY MARKET SHARE

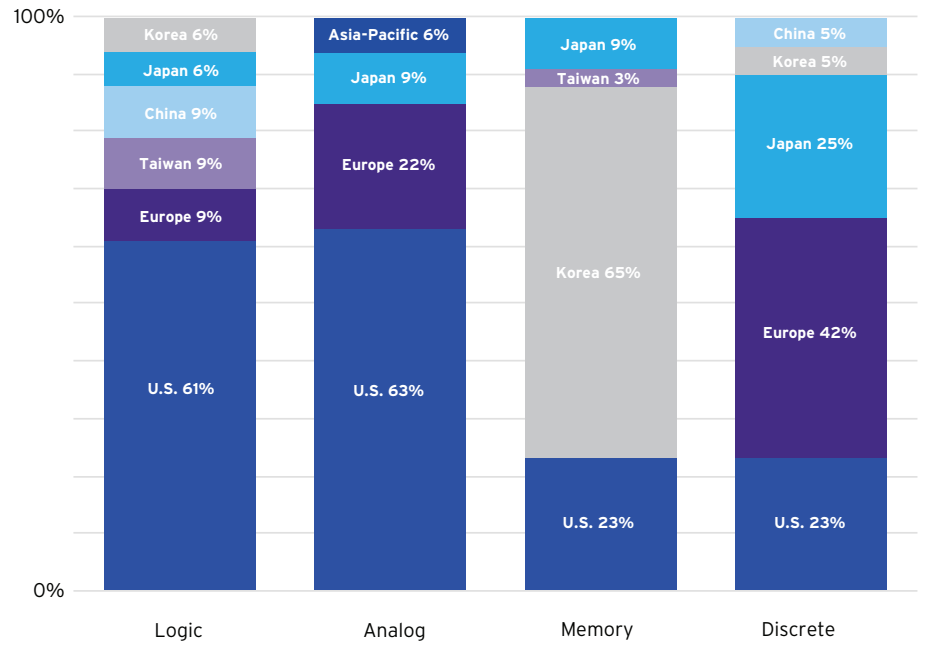
U.S.-based semiconductor companies are a market leader by business model and subproduct, but for some business model subsegments, the U.S. industry lags its Asian-based competitors.

The U.S. semiconductor industry maintains market share leadership in sales of logic and analog semiconductors. However, for memory and discrete semiconductors, other countries' industries lead.

Similarly, in terms of business model, the U.S. leads in some areas but not all.

For example, Asia continues to dominate the outsourced aspects of semiconductor production. Nearly 80 percent of semiconductor foundries and assembly/test operations are concentrated in Asia. While global supply chains have driven value and efficiency gains for the industry, they also have highlighted the need for the United States to consider strategic investments in this space.

U.S. SEMICONDUCTOR INDUSTRY MARKET SHARE (by Subproduct)



U.S. SEMICONDUCTOR INDUSTRY MARKET SHARE (by Business Model)

51% Global IDM* Market

65% Global Fabless Market

10% Global Pure-Play Foundry Market

40% Global Equipment Market

~15% Global Outsourced Assembly/ Test Market

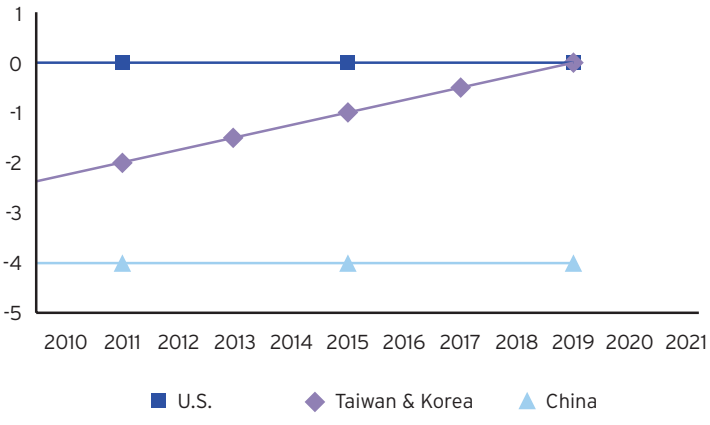
*An Integrated Device Manufacturer, or IDM, is a semiconductor company that designs, manufactures, and sells semiconductors.

U.S. TECHNOLOGY COMPETITIVENESS

The U.S. semiconductor industry is the undisputed technology leader in advanced semiconductor chip design. This includes the platform technologies needed for AI, with dominant market shares in microprocessors, graphics chips, and programmable logic processors. Today's most advanced ICs for leading-edge logic applications use 10 nanometer (nm) technology and pack over 20 billion transistors on chips about the size of a quarter. The U.S. is also well positioned in critical designs of 5G-related semiconductors, with leading positions in chips that enable wireless communications, network management, and data storage. Finally, U.S. firms are leading efforts to develop new chips for autonomous cars, including advanced image sensors, data processors, and on-board radar.

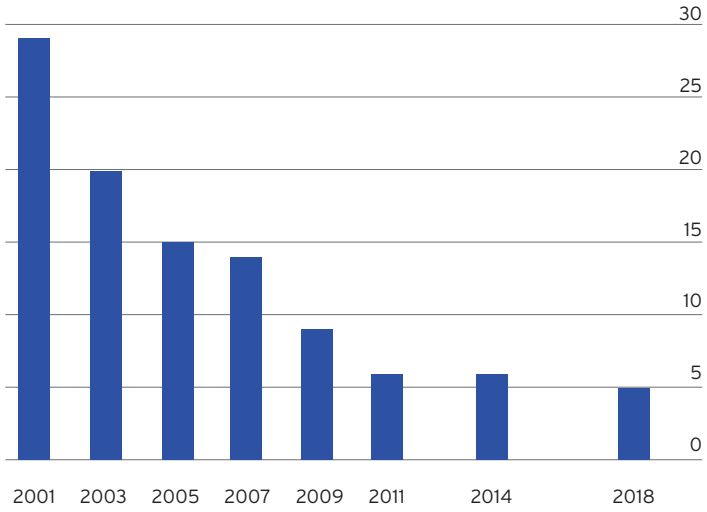
The United States also remains a leader or a significant competitor in logic process technology, i.e. the manufacturing that enables advanced processors, graphics, and AI chips. America's lead has diminished, however, due to rising manufacturing and technology costs and mounting overseas competition. In 2010, the U.S. was a full two years ahead of its closest competitors, Korea and Taiwan. In 2019, the U.S. was essentially neck-and-neck in logic process technology, as all three nations have raced to bring leading-edge 7/10 nm technology to market. Given the criticality of advanced semiconductor manufacturing technology, the U.S. must make significant investments to strengthen its global position.

LOGIC MANUFACTURING POSITION
(YEARS BEHIND THE LEADER)



FEWER SEMICONDUCTOR FIRMS MANUFACTURING AT LEADING EDGE

In 2001, nearly 30 semiconductor firms manufactured leading-edge chips. As time has progressed and leading-edge semiconductors have become more difficult and costly to produce, that number has decreased significantly. The remaining chip companies manufacturing at the leading edge are from only three countries: Taiwan, Korea, and the United States.



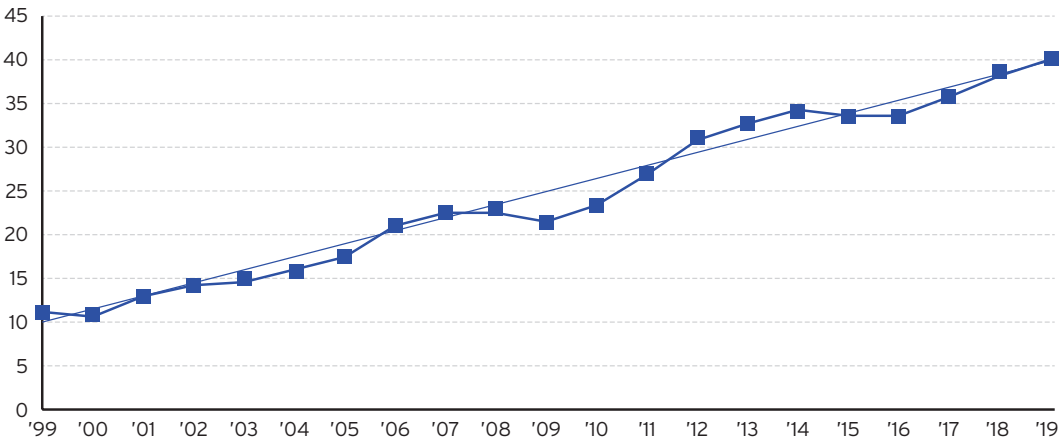
*Data unavailable for all years

U.S. TECHNOLOGY COMPETITIVENESS

U.S. semiconductor industry R&D expenditures are consistently high, reflecting the inherent link between U.S. market share leadership and continued innovation.

U.S. semiconductor industry R&D expenditures grew at a compound annual growth rate of approximately 6.6 percent from 1999 to 2019. R&D expenditures by U.S. semiconductor firms tend to be consistently high, regardless of cycles in annual sales, which reflects the importance of investing in R&D to semiconductor production. In 2019, total U.S. semiconductor industry investment in R&D totaled $39.8 billion.

R&D EXPENDITURE ($B)



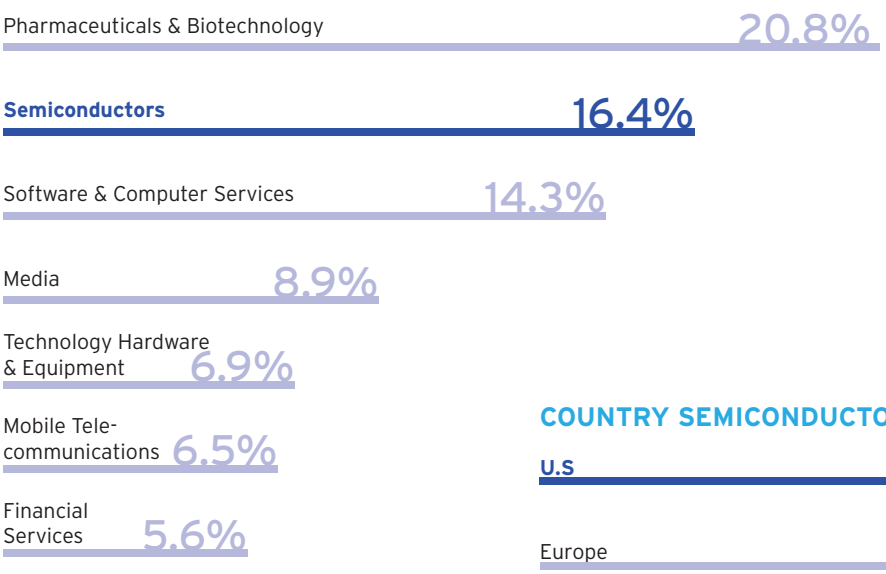
THE GLOBAL RACE FOR 5G SUPREMACY

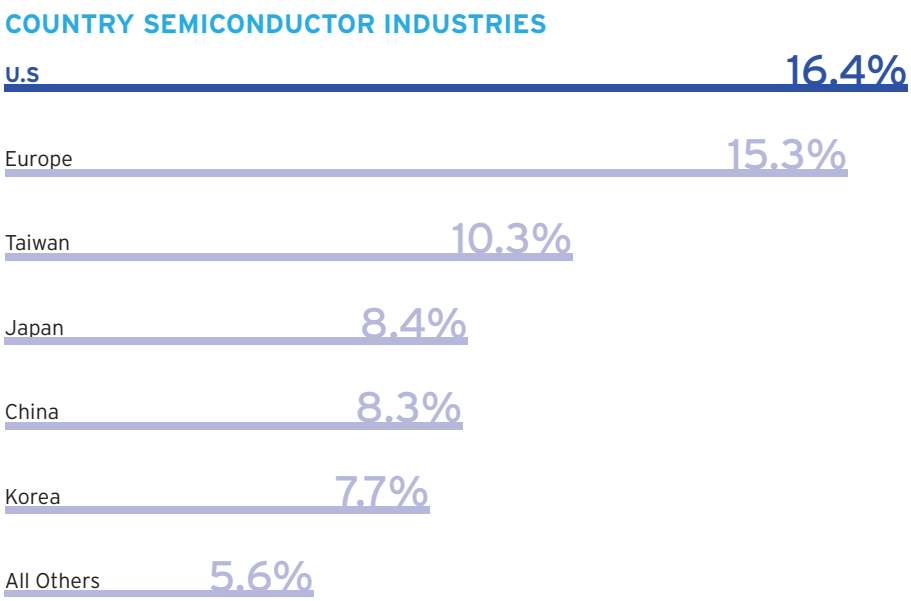
5G is the most hotly contested area in communications today. Its greater speed and bandwidth will be critical to enabling smart cities and building the infrastructure that autonomous vehicles need. Semiconductors are critical for the deployment for 5G, as they enable the radios that transmit signals, the devices that connect to the network, and the backbone networks that carry all the data. Here, American companies hold a leadership position in semiconductors, but political and regulatory uncertainties, especially vis-à-vis the China market, have weakened the competitive position of U.S. firms. Meanwhile, China is aggressively pursuing 5G. It is building out its 5G infrastructure and embedding the technology in phones faster than the U.S. It also plans to use demand to drive its infrastructure by having $300 5G smartphones on the market by the end of 2020. Lack of access to China's huge market could significantly hinder the development of American competitiveness in this critical area.

The U.S. semiconductor industry maintains one of the highest levels of R&D as a percent of sales of any U.S. industry.

The U.S. semiconductor industry was second only to the U.S. pharmaceuticals & biotechnology industry in terms of the rate of R&D spending as a percent of sales. While global competitors are increasing their R&D investments to compete with the U.S. industry, American firms spend more on R&D as a percent of sales than any other country's semiconductor industry. These high levels of reinvestment into R&D is what drives innovation in the U.S. semiconductor industry and what in turn helps it maintain its global sales market share leadership position and generate jobs throughout the United States.

R&D EXPENDITURES AS A PERCENTAGE OF SALES (Both Graphs)





U.S. MANUFACTURING AND WORKFORCE

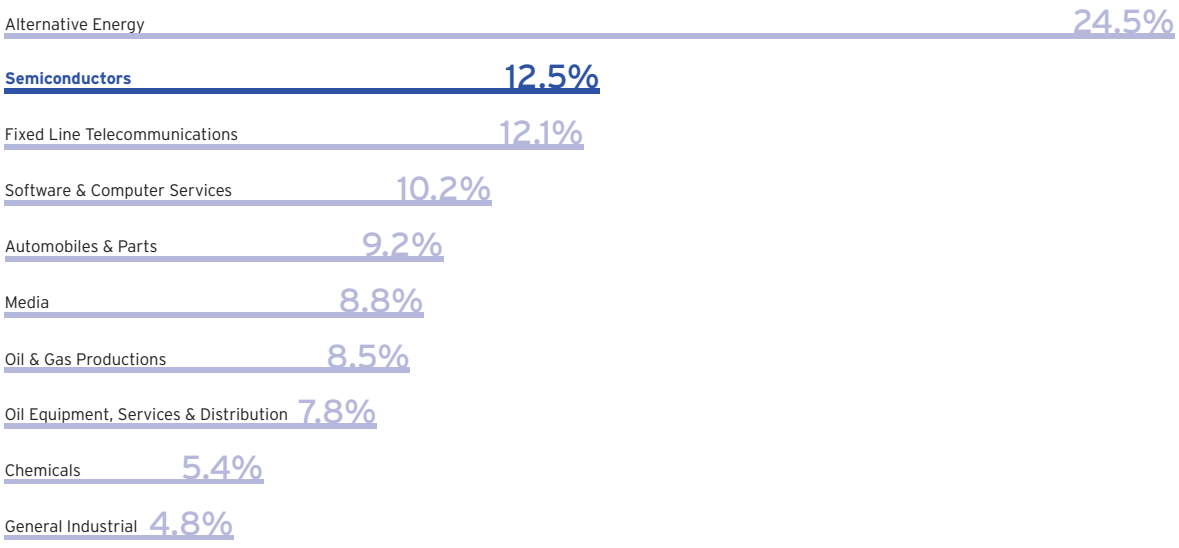
America's lead in semiconductors is highly dependent on two critical factors: 1) being able to invest in advanced semiconductor design and manufacturing; and 2) having a competitive workforce. U.S. total capex investments were second only to Korea in 2019, and the U.S. led in spending for plant and equipment to manufacture advanced logic, where it accounted for 44 percent of the world's total. A key U.S. advantage has been the ability to attract talented people from all over the globe who come to study at American universities and choose to stay. Having access to a highly educated workforce, strong in STEM, is critical to the future of America's leadership in semiconductors.

Semiconductor capital spending by the U.S. semiconductor industry is robust.

The U.S. semiconductor industry is among the global leaders in capex. This is indicative of the U.S. industry's role as a major manufacturing leader in the global industry. Also, a significant amount of this spending is for equipment that helps run state-of-the-art fabs across the United States. Close to half of all U.S. semiconductor industry fab capacity is based in the United States and spread across 18 states, spurring U.S. exports and jobs. Other countries, however, are starting to spend more on capex and are becoming more competitive with the U.S. For example, over the past three years, the Korean semiconductor industry has increased its fab capex significantly, and the number of new fabs constructed in China has grown capex there significantly, as well.

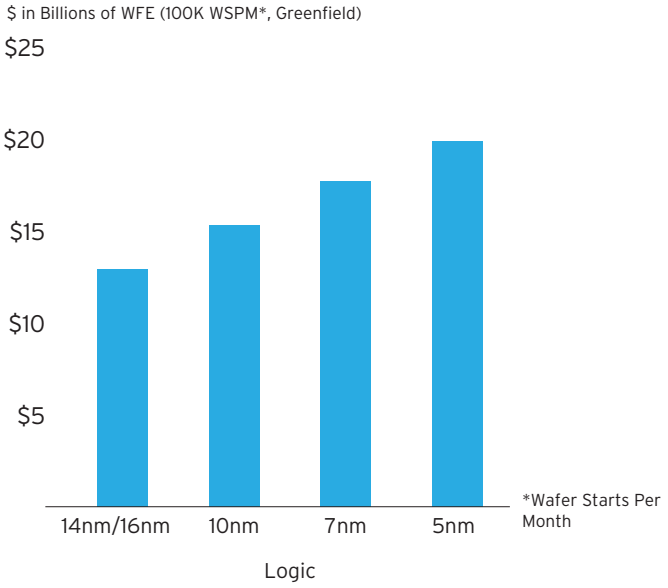
In fact, the United states today now only accounts for 12.5 percent of total installed semiconductor manufacturing, with more than 80 percent of production now happening in Asia. In today's uncertain geopolitical environment, the United States needs to do more to incentivize domestic semiconductor manufacturing. In particular, U.S. fabless companies now almost exclusively rely on Asian producers for leading-edge, 7-nm-and-below chip production, something that has been highlighted by policymakers as a national security concern.

CAPITAL EXPENDITURES AS A PERCENT OF SALES

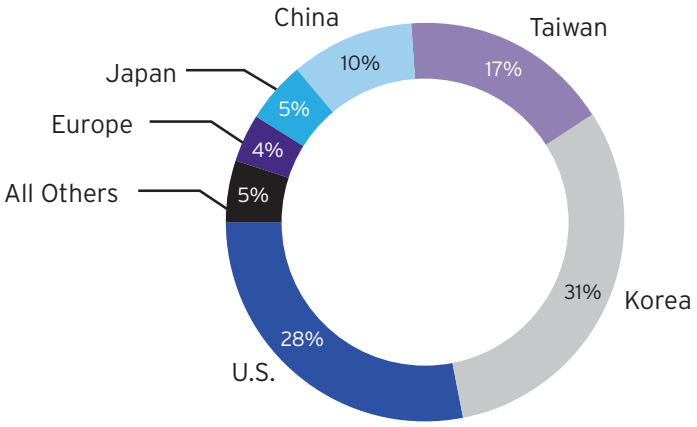


U.S. MANUFACTURING AND WORKFORCE

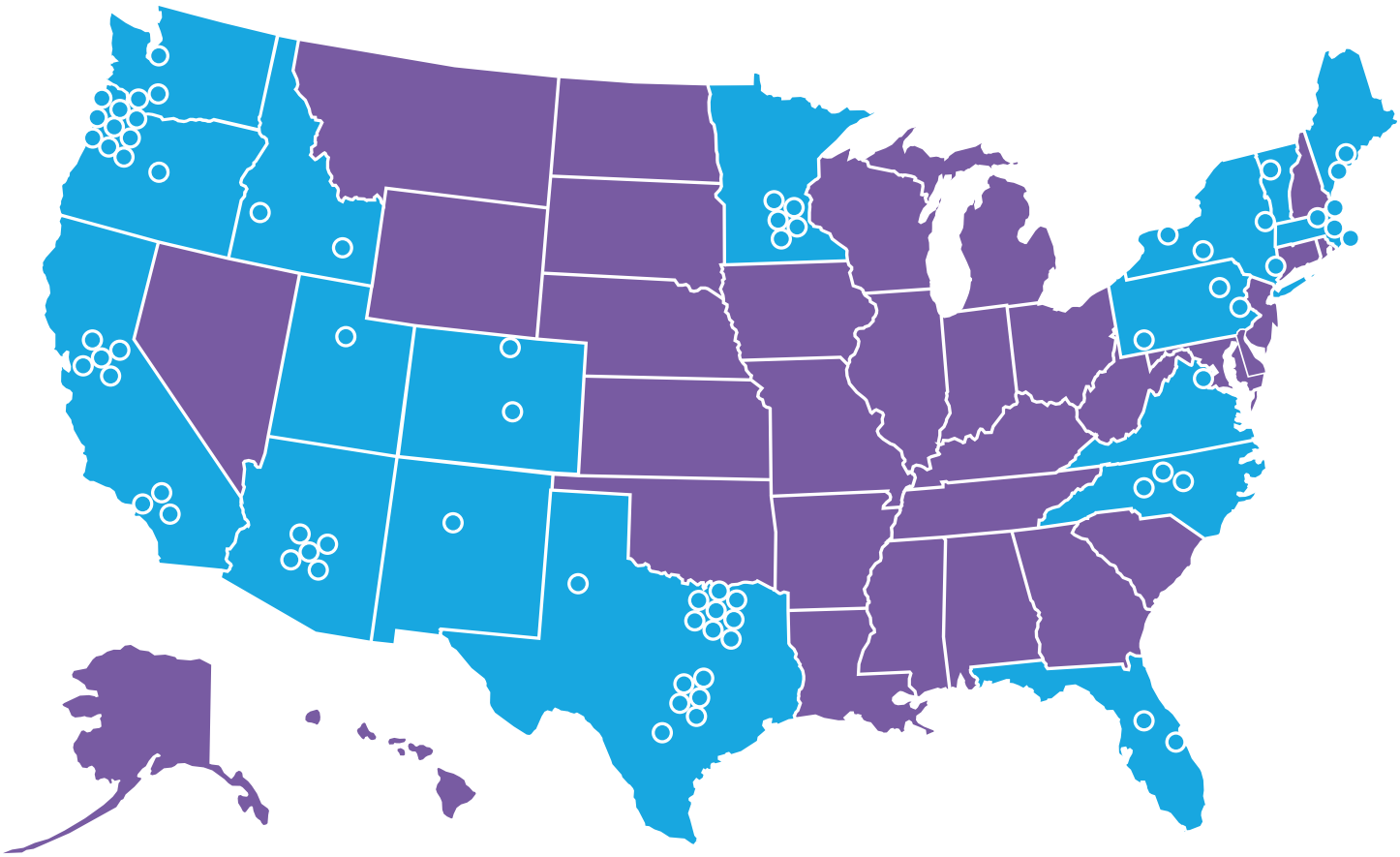
CAPITAL INTENSITY TRENDS – FOUNDRY/LOGIC



PERCENT SHARE OF SEMICONDUCTOR CAPEX, 2019



SEMICONDUCTOR MANUFACTURING ACROSS AMERICA



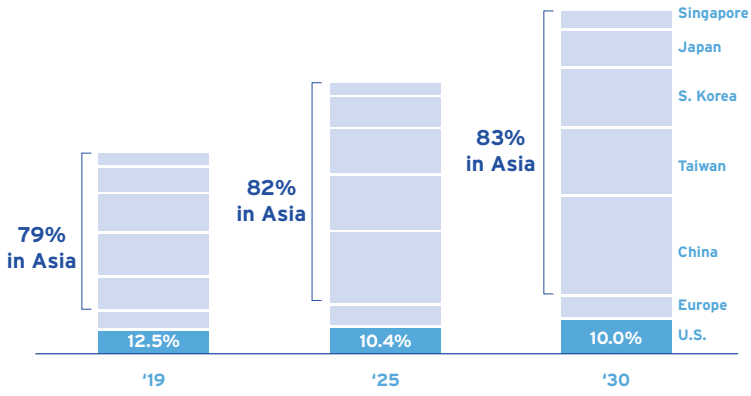
U.S. MANUFACTURING AND WORKFORCE

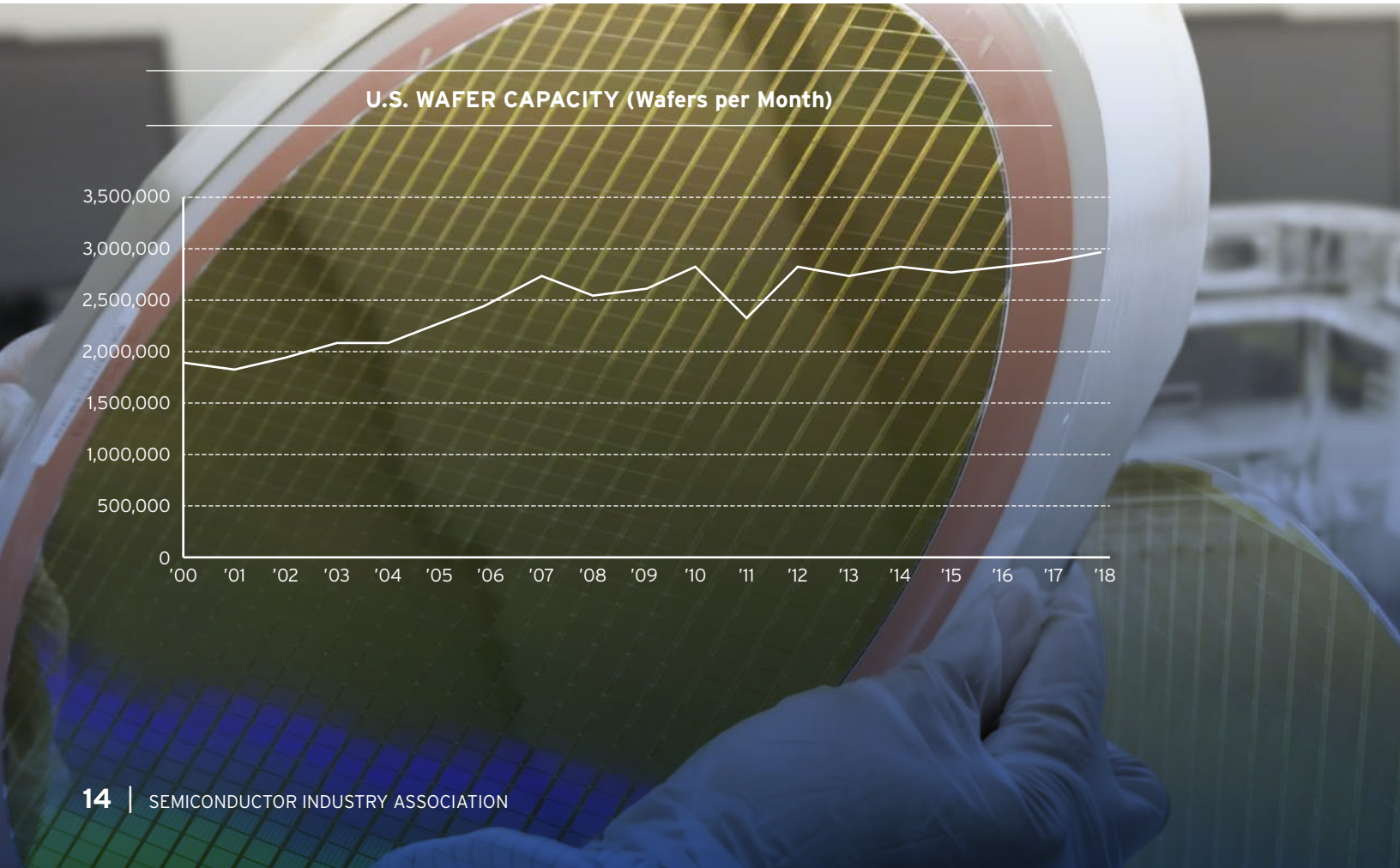
Semiconductor manufacturing capacity in the United States has been stable.

Unlike many other parts of the tech manufacturing sector, the U.S. semiconductor industry's manufacturing output has remained stable for many years. This stability has led to a steady base of manufacturing jobs in U.S. fabs as well as a major source of U.S. exports to overseas markets. However, while the semiconductor manufacturing base in the United States remains on solid footing, capacity growth around the world has outpaced that in the United States, which in turn has steadily eroded the share of global manufacturing capacity at home. In 2019, all six of the new semiconductor fabs that opened globally were outside the United States, with four being built in China, which is putting significant government dollars behind these new facilities. Putting policies in place to incentivize domestic fab construction that are competitive with those offered abroad by other governments should be a priority for U.S. policymakers.

Asia Projected to Capture Nearly All Manufacturing Growth

2019-2030 Installed Global Wafer Capacity Projection

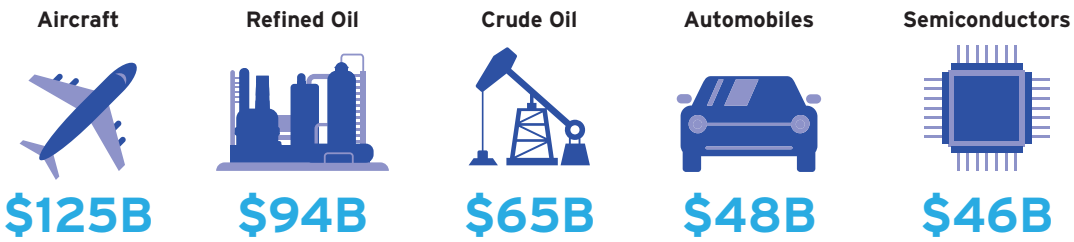




Semiconductors are one of America's top exports.

U.S. exports of semiconductors totaled $46 billion in 2019, fifth-highest among U.S. exports behind only airplanes, refined oil, crude oil, and automobiles. This consistently high level has been due to a couple factors: 1) over 80 percent of semiconductors sold today are sold outside of the U.S. market; and 2) a significant amount of semiconductor fab capacity resides in the United States.

TOP U.S. EXPORTS IN 2019

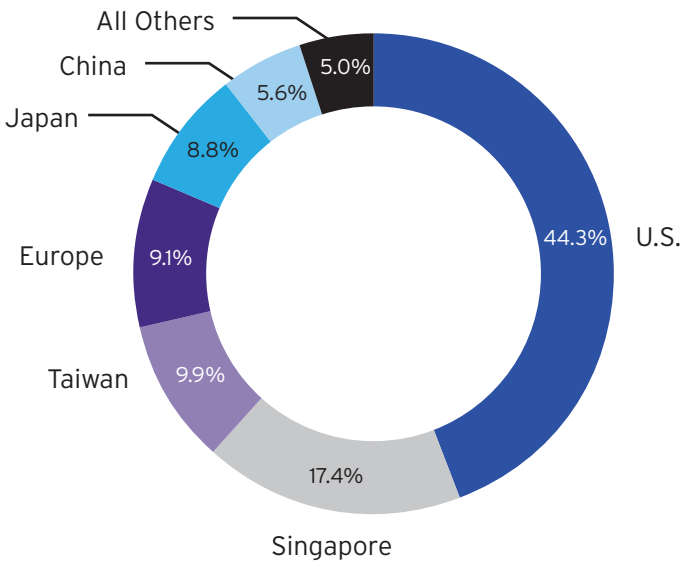


U.S. semiconductor manufacturers maintain more of their manufacturing base in the United States than in any other country.

In 2019, about 44 percent of U.S.-headquartered firms' front-end semiconductor wafer capacity was located in the United States. Other leading locations for U.S.-headquartered front-end semiconductor wafer fab capacity were Singapore, Taiwan, Europe, and Japan. It is notable that China has attracted less U.S. investment in front-end fabrication than the other major markets.

Unfortunately, the average rate of chip manufacturing output has grown five times faster overseas than it has in the United States over the last decade. This is largely due to robust incentive programs nations have put in place to attract semiconductor manufacturing. The United States must consider similar incentives in order to remain competitive.

PERCENT OF U.S.-HEADQUARTERED FIRM SEMICONDUCTOR WAFER CAPACITY BY LOCATION



The U.S. semiconductor industry accounts for roughly a quarter of a million direct U.S. jobs and over a million additional indirect U.S. jobs.

241,134

direct jobs in the U.S. semiconductor industry

ONE

U.S. semiconductor job supports

4.89

jobs in other parts in the U.S. economy...

...that's more than

1,000,000 ADDITIONAL

American jobs

U.S. SEMICONDUCTOR INNOVATION POLICY LANDSCAPE

The federal government is a key partner in developing policies that promote a strong and innovative U.S. semiconductor industry.

Over the past year, U.S. policymakers have taken steps toward advancing the industry's research, workforce, and trade and intellectual property (IP) priorities.

Research: In 2019, the U.S. government continued to fund semiconductor research programs at the Departments of Energy (DOE) and Defense (DOD), the National Institute of Standard and Technology (NIST), and the National Science Foundation (NSF). The Administration has also recently announced new research programs aimed at supporting the U.S. semiconductor industry, including DOE's quantum information science initiative and DOD's Electronics Resurgence Initiative (ERI) and Microelectronics Innovation for National Security & Economic Competitiveness (MINSEC) programs.

Workforce: Legislation in Congress, approved by the House but not yet the Senate, would eliminate unjustified and counterproductive per-country caps on employment-based visas in favor of a fair, "first-come, first-served" system.

Trade & IP: The United States-Mexico-Canada Agreement (USMCA), a free trade agreement that would strengthen the U.S. semiconductor industry, has been signed by the President and approved by Congress. In addition, over the past year the federal government has increased its prosecution of IP trade theft cases.

While progress in these three areas is welcome, more government action is needed to ensure a strong U.S. semiconductor industry and help the industry overcome challenges from China and other global competitors.

U.S. SEMICONDUCTOR INNOVATION POLICY LANDSCAPE

To ensure continued U.S. leadership in the global semiconductor industry, the U.S. must adopt an ambitious competitiveness and innovation agenda.

1. Research:

- Triple U.S. investments in semiconductor-specific research across federal scientific agencies from approximately $1.5 billion to $5 billion annually to advance new materials, designs, and architectures that will exponentially increase chip performance.
- Double U.S. research investments in semiconductor-related fields such as materials science, computer science, engineering, and applied mathematics across federal scientific agencies to spur leap-ahead innovations in semiconductor technology that will drive key technologies of the future.

2. Domestic Manufacturing:

- Establish a new manufacturing grant program to spur construction of new onshore advanced semiconductor manufacturing facilities in the U.S., including leading-edge logic foundries, advanced memory, and analog fabs to supply defense, critical infrastructure, and broader essential commercial needs.
- Provide tax incentives for semiconductor manufacturing, such as a refundable investment tax credit for the purchase of new semiconductor manufacturing equipment.

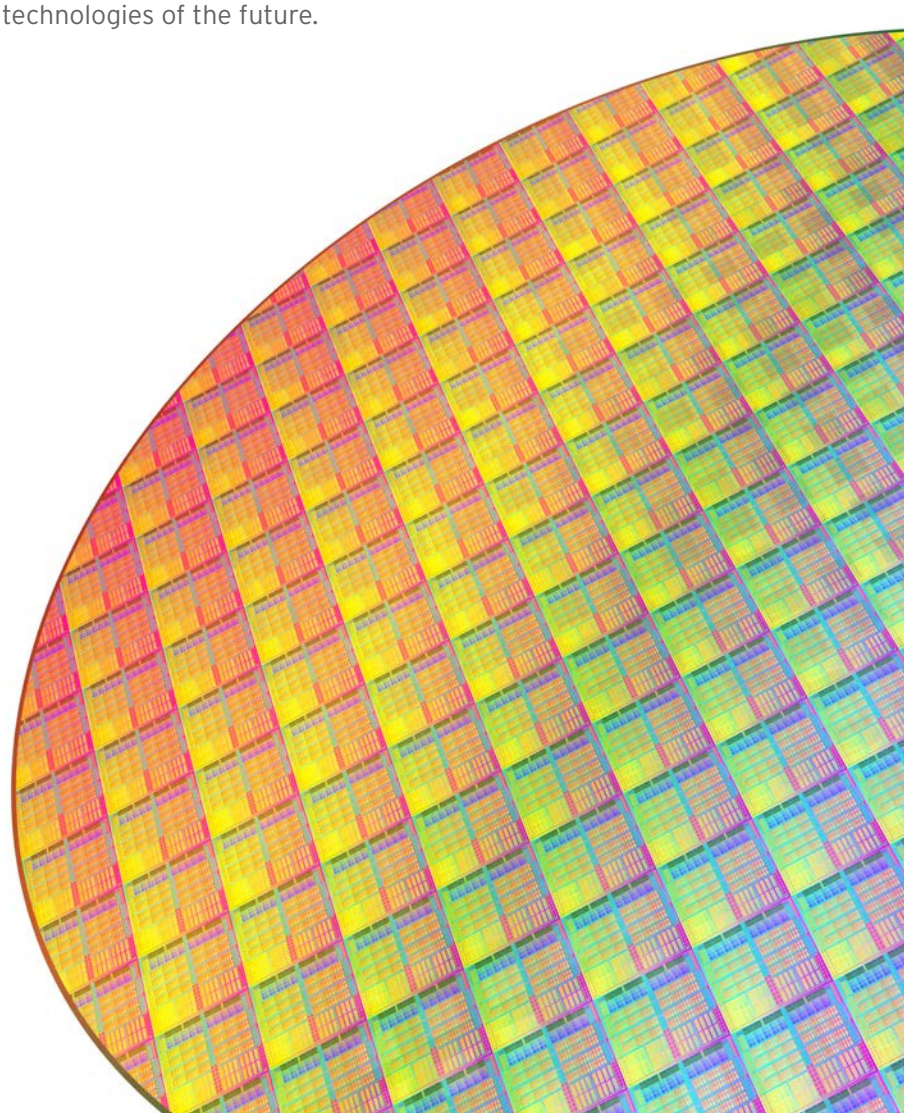
3. Workforce:

- Reform the high-skilled immigration system so qualified STEM graduates from U.S. colleges and universities, as well as STEM graduates from around the world, can work, innovate, and contribute to U.S. leadership in the semiconductor industry and boost our economy.
- Increase U.S. investments in STEM education by 50 percent and implement a national STEM education initiative to double the number of American STEM graduates by 2029.

4. Trade and IP:

- Approve and modernize free trade agreements, including the United States-Mexico-Canada Agreement, that remove market barriers, protect IP, and enable fair competition.
- Increase resources for law enforcement and intelligence agencies to prevent and prosecute semiconductor intellectual property theft, including the misappropriation of trade secrets.

By implementing these policies, Congress and the Administration can take key steps to protect American leadership in semiconductor technology and win the global competition for the technologies of the future.

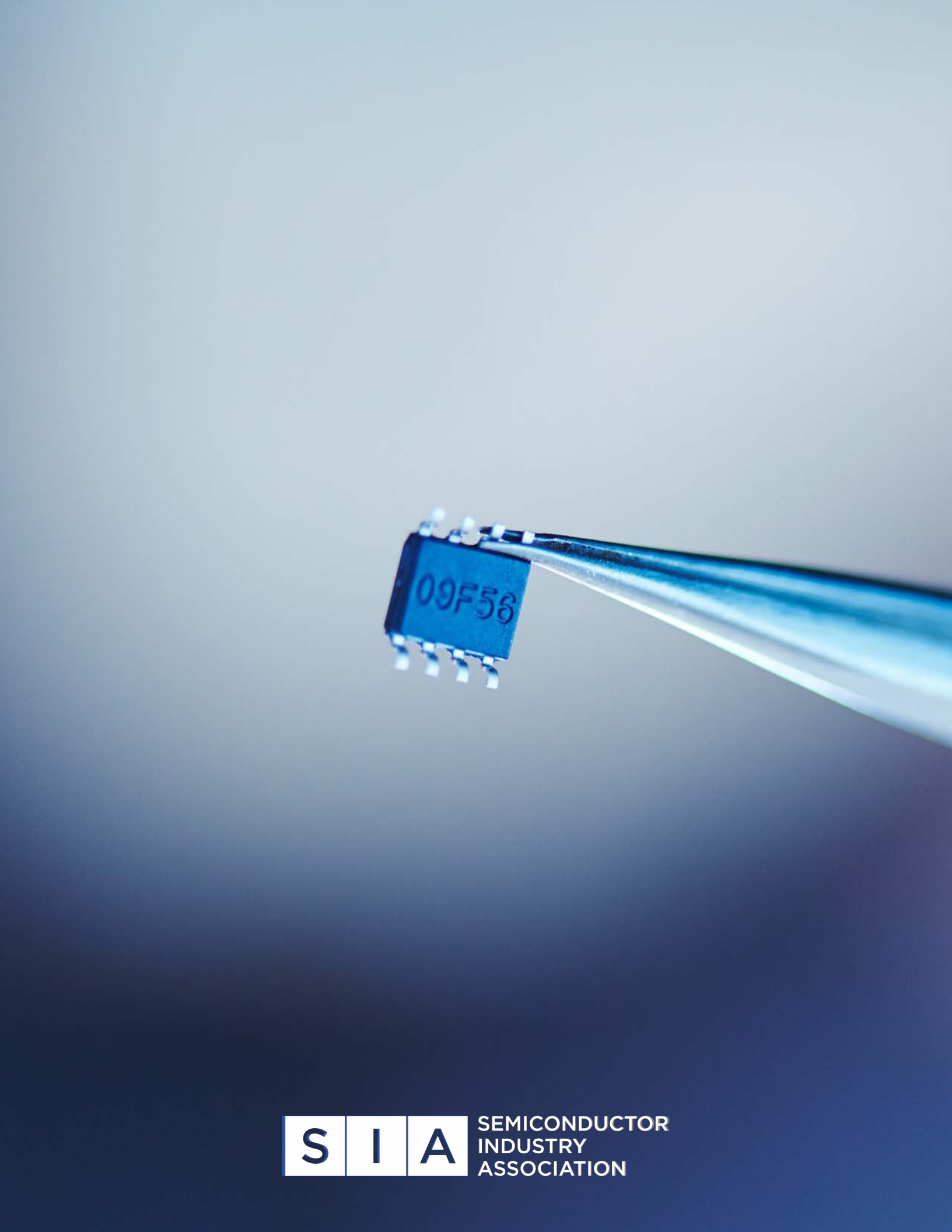


METHODOLOGY

This report is based on data development both in partnership with VLSI Research and independently by the Semiconductor Industry Association. Figures pertaining to the industry's employment are based on data from the U.S. Census Bureau and the U.S. Department of Labor. Figures regarding the industry's international trade activity are based on an analysis of official U.S. government trade data from the U.S. International Trade Commission. Figures regarding industry manufacturing, capacity, and capital spending were based on data from SEMI, VLSI Research, EU Scoreboard, McKinsey, The Economist, Tokyo Electron, J.P. Morgan, and IC Insights. Market data was based on World Semiconductor Trade Statistics data. Lastly, industry R&D data was based on company financial reports, as well as data from the EU Scoreboard.

ABOUT SIA

The Semiconductor Industry Association (SIA) is the voice of the semiconductor industry, one of America's top export industries and a key driver of America's economic strength, national security, and global competitiveness. Semiconductors – the tiny chips that enable modern technologies – power incredible products and services that have transformed our lives and our economy. The semiconductor industry directly employs nearly a quarter of a million workers in the United States, and U.S. semiconductor company sales totaled $193 billion in 2019. SIA members account for nearly 95 percent of all U.S. semiconductor industry sales. Through this coalition, SIA seeks to strengthen leadership of semiconductor manufacturing, design, and research by working with Congress, the Administration, and key industry stakeholders around the world to encourage policies that fuel innovation, propel business, and drive international competition. Learn more at www.semiconductors.org.



SIA
SEMICONDUCTOR
INDUSTRY
ASSOCIATION