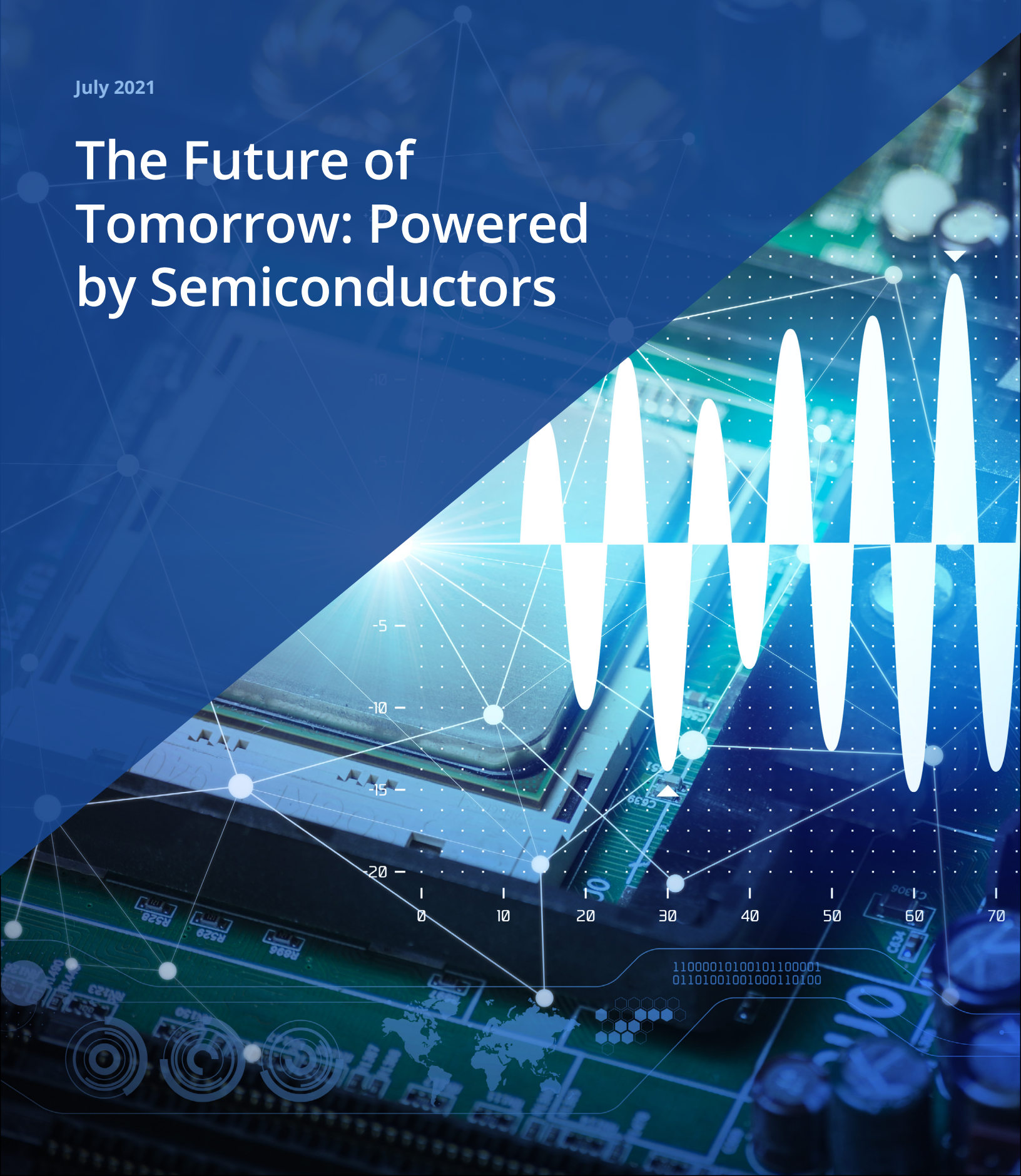


July 2021

The Future of Tomorrow: Powered by Semiconductors



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Semiconductors have emerged as a lynchpin of modern electronic technology, used in almost every modern device, from cell phones to automobiles. How can investors participate in the semiconductor revolution?

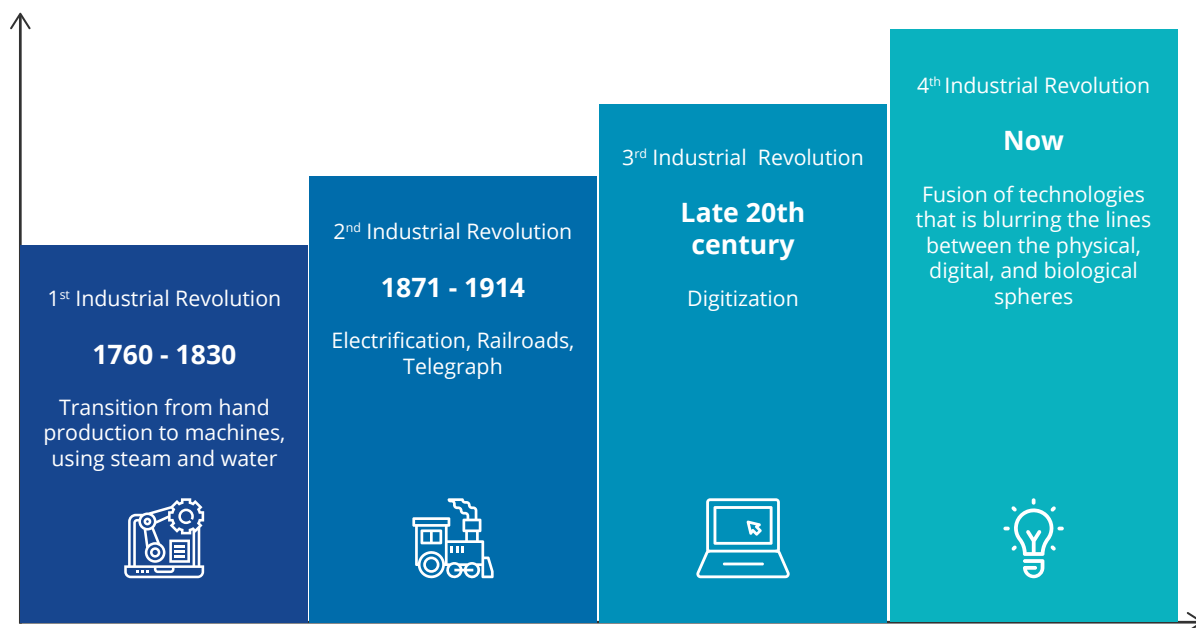
The ubiquitous use of semiconductors, along with the dynamic characteristics of the industry, help make this industry a compelling investment opportunity, in our view. In this whitepaper, we provide an in-depth breakdown of the industry to help investors better understand what's driving the long-term potential of this space. Key trends currently shaping this investment opportunity include:

Key takeaways:

- Semiconductors are a crucial component for many of the innovative technologies that are driving the global economy
- Semiconductor processing power has continued to increase exponentially over time, allowing for faster and better technology to be produced
- As technology has improved, demand has risen, alongside a number of secular growth trends such as artificial intelligence (AI)
- Semiconductor companies enjoy a number of different economic moats
- The semiconductor industry has successfully adapted to a pandemic driven economy
- Chip shortage (due to a perfect storm of factors) has led to a supply/demand imbalance, which is expected to continue into the foreseeable future

A technological revolution is underway, potentially bringing us to the brink of the fourth industrial revolution. Lines between the physical, digital and biological spheres that were once clear, are now blurred.

The Evolution of Industrial Revolutions



Source: World Economic Forum

The first Industrial Revolution started in Britain around 1760. It was powered by a major invention: the steam engine. The steam engine enabled new manufacturing processes, leading to the creation of factories.

The second Industrial Revolution came roughly one century later and was characterized by mass production in new industries like steel, oil and electricity. The light bulb, telephone and internal combustion engine were some of the key inventions of this era.






The inventions of the semiconductor, personal computer and the internet marked the third Industrial Revolution starting in the 1960s, which is also commonly referred to as the “Digital Revolution.”

The third Industrial Revolution refers to how technologies like AI, autonomous vehicles and the internet of things are merging with humans’ physical lives. Think of voice-activated assistants, facial ID recognition or digital health-care sensors.

The fourth Industrial Revolution is different from the third revolution for two reasons: the gaps between the digital, physical and biological worlds are shrinking, and secondly, technology is changing faster than ever.

The Fourth Industrial Revolution Has Begun

Semiconductors play a crucial role in the development of each of these disruptive industries

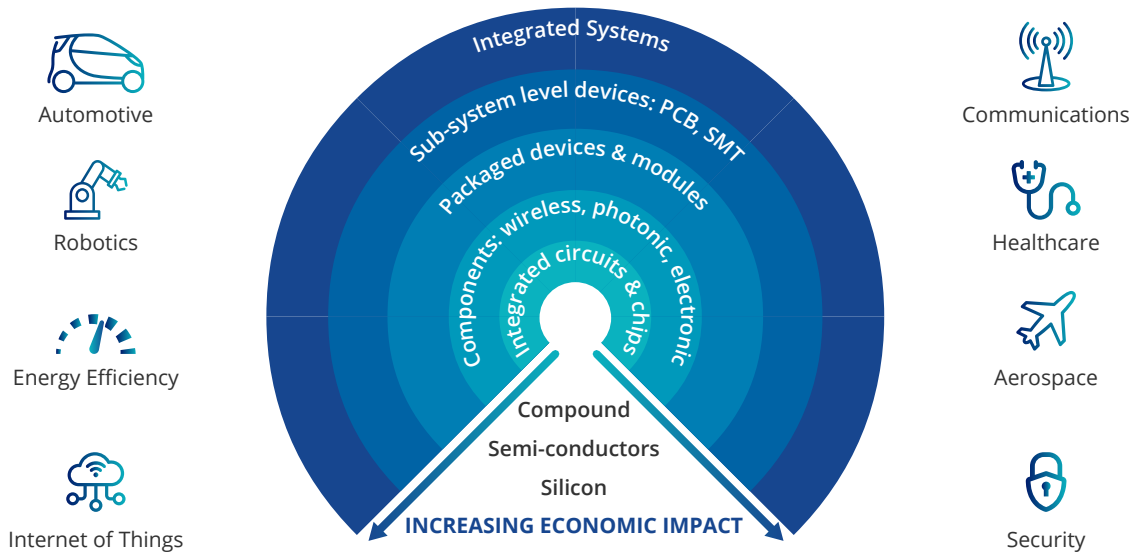
ADVANTAGE				
Autonomous Driving	Artificial Intelligence (AI)	Robotization	5G	Internet of Things
				
<ul style="list-style-type: none"> ▪ Drastically reducing traffic casualties, thanks to machines making decisions ▪ Reducing transport costs ▪ Increasing usage of automatically rechargeable electric cars ▪ Low cost taxi services 	<ul style="list-style-type: none"> ▪ Improving artificial analysis and customer support services ▪ Voice controlled personal assistants ▪ Intelligent camera systems, reducing risk of burglary 	<ul style="list-style-type: none"> ▪ Household assistance ▪ Improving quality and reducing cost in manufacturing ▪ Increasing agricultural efficiency 	<ul style="list-style-type: none"> ▪ Remaining in contact with others ▪ Immersive gaming and virtual reality ▪ Mobile artificial intelligence and remote working 	<ul style="list-style-type: none"> ▪ Energy usage reduction through smart thermostats and electrical devices ▪ Automatic refrigerator replenishment

Source: CDIC, Deloitte.

Semiconductors Are All Around Us.

The so-called “brains of modern electronics” semiconductors enable tremendous computing power through small devices.

Technology Powered by Semiconductors



Source: VanEck

Semiconductors are essential technology enablers that power many of the cutting-edge digital devices in use today.

They control the computers, and mobile devices we use to communicate, the cars and planes we rely on in order to travel, the machines that diagnose and treat illnesses, the military systems that protect us and the electronic gadgets we use to listen to music, watch movies, and play games, just to name a few.

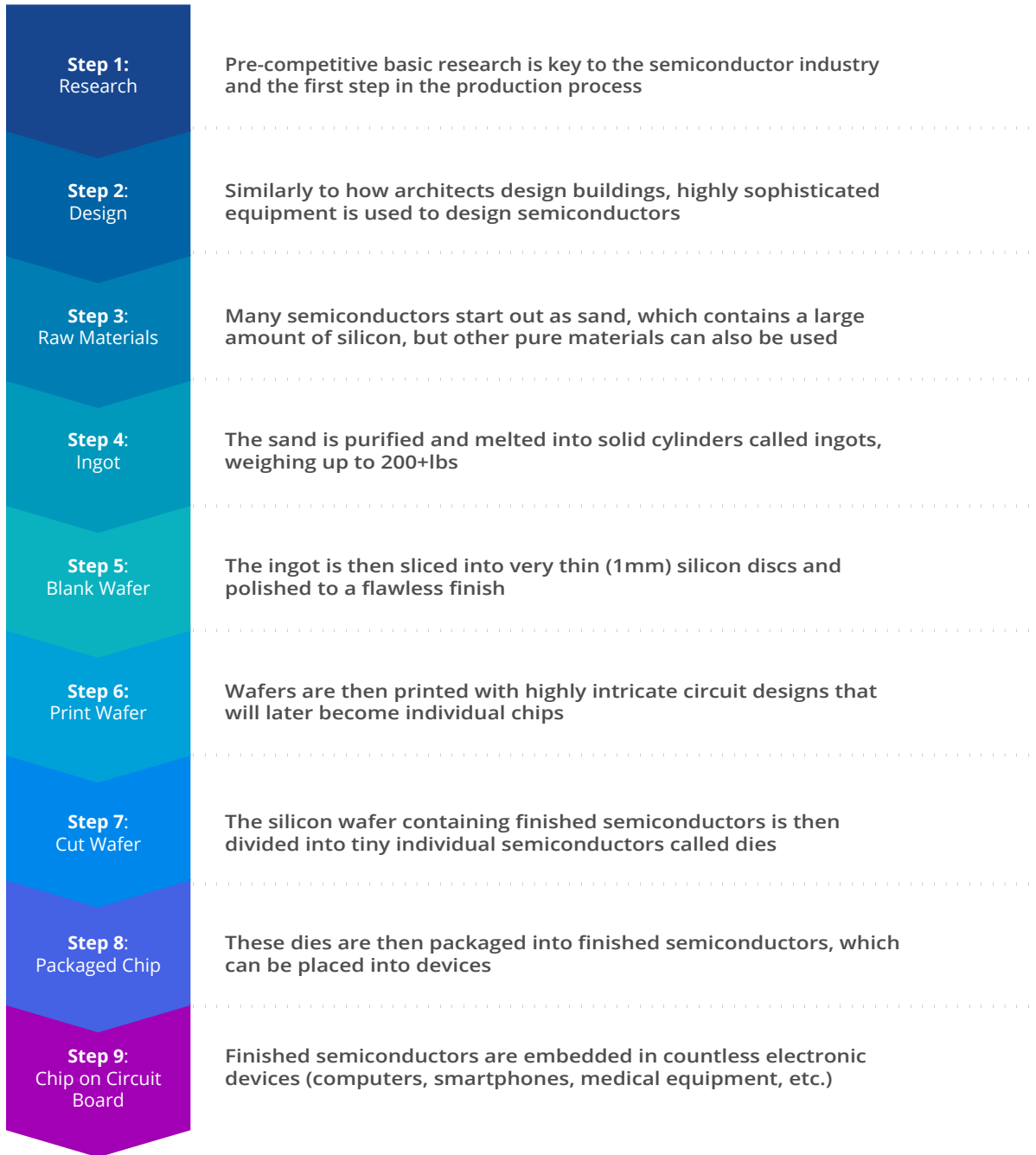
And not only does semiconductor technology make these devices possible, it also makes them more compact, less expensive and more powerful.

How Are Semiconductors Made?

Semiconductors are created throughout a complicated, multi-step process as illustrated below. First, the semiconductor company must conduct competitive basic research to determine market fit and opportunity. Highly sophisticated equipment is used to design semiconductors, similar to how architects design buildings. Many semiconductors start out as sand, which contains a large amount of silicon, but other pure materials can also be used. The sand is purified and melted into solid cylinders called ingots, weighing up to two hundred pounds.

The ingot is then sliced into very thin (1mm) silicon discs and polished to a flawless finish. Wafers are printed with highly intricate circuit designs that will later become individual chips. The silicon wafer containing finished semiconductors is divided into tiny individual semiconductors called dies. These dies are then packaged into finished semiconductors, which can be placed into devices. Finished semiconductors are embedded into the specific electronic device.

Semiconductor production stages

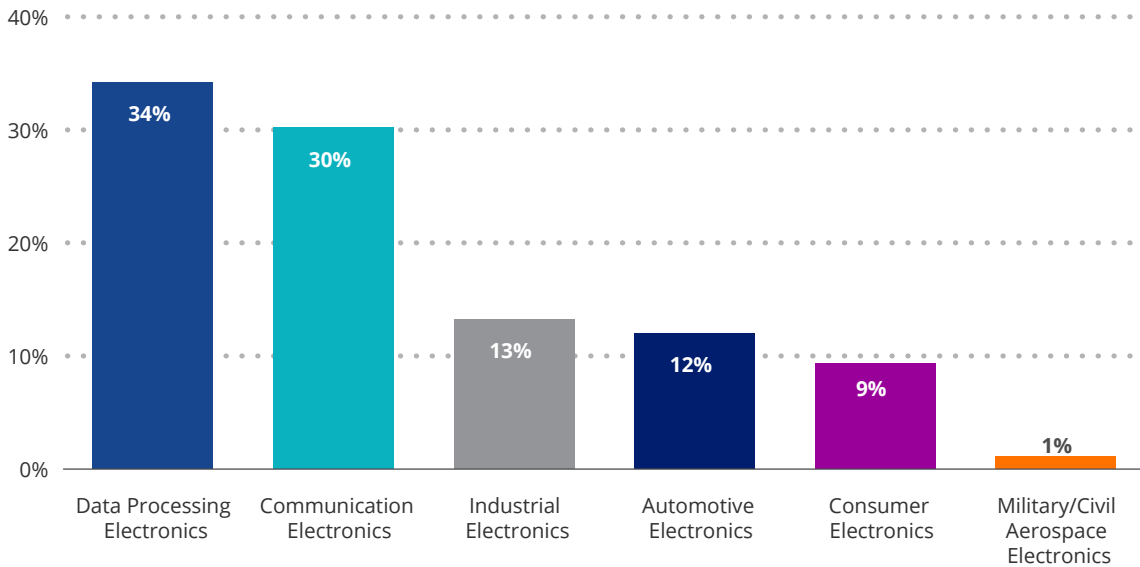


Source: VanEck

Semiconductor Industry Revenue by Segment

Semiconductors are used in a variety of sectors such as data processing, communications, industrial, automotive, consumer and military/civil aerospace electronics.

Projected Global Semiconductor Revenue by Segment (2022*)



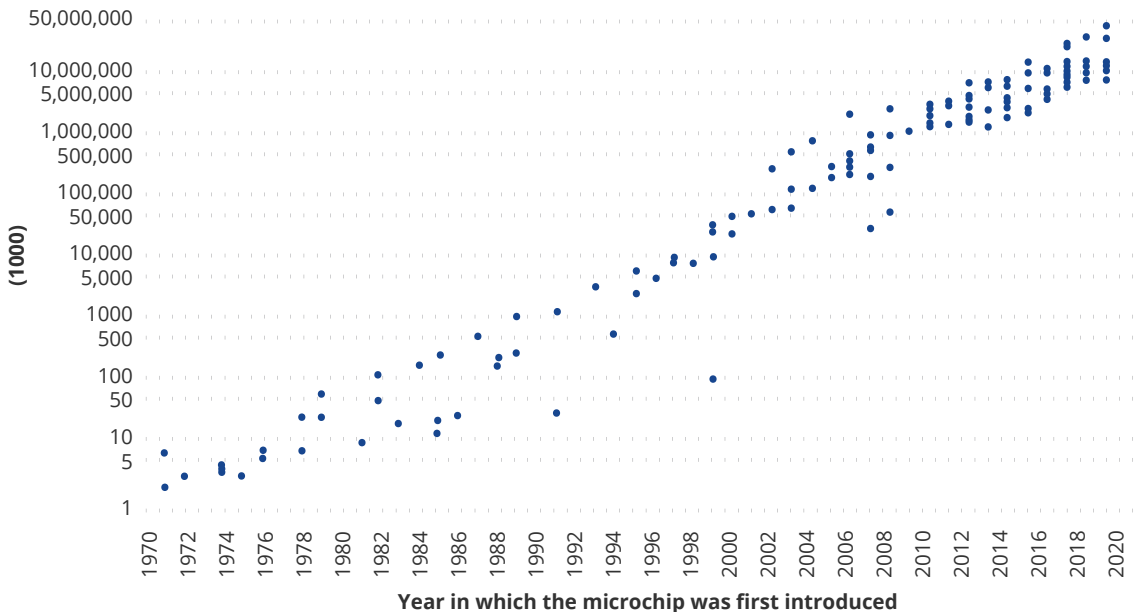
Source: Deloitte, "Semiconductors – the Next Wave Opportunities and winning strategies for semiconductor companies", April 2019

* Figures are estimated projections

Semiconductor Computing Power Rises Exponentially

Developments in semiconductor technology during the past 50 years have made electronic devices smaller, faster, and more reliable. Think of all the encounters you have with electronic devices, each has important components that have been manufactured with electronic materials.

Transistor Count

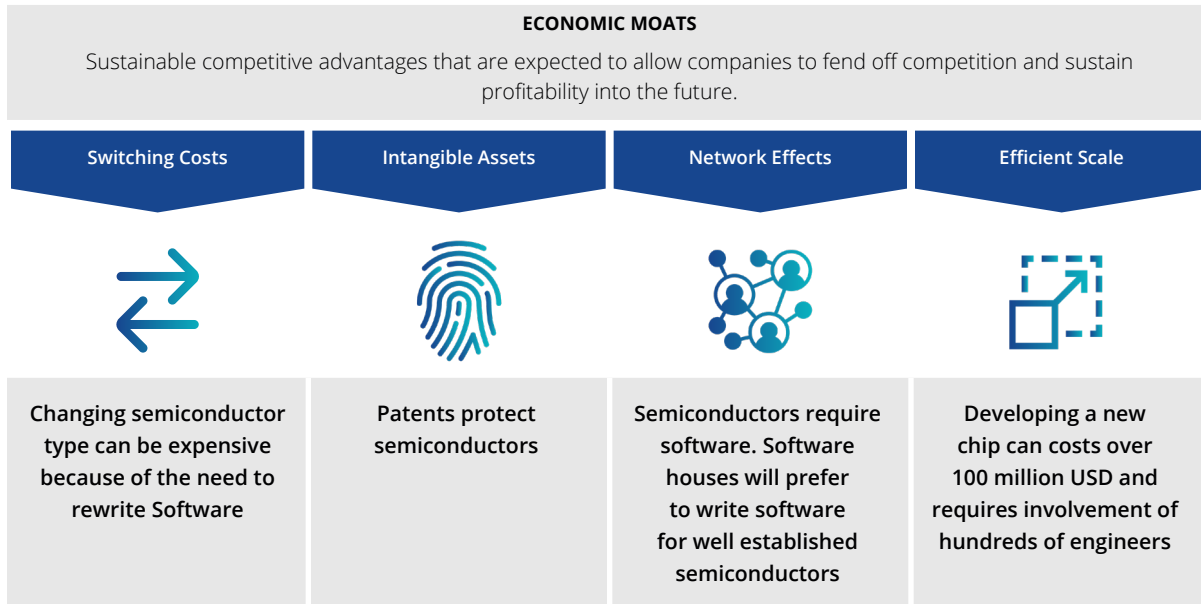


Source: Wikipedia

A single semiconductor chip has as many transistors as all of the stones in the Great Pyramid in Giza and today, there are more than 100 billion integrated circuits in daily use around the world—that's equal to the number of stars in our corner of the Milky Way galaxy.

Common Semiconductor Industry Moats

Economic moats are sustainable competitive advantages that are expected to allow companies to fend off competition and sustain profitability into the future. Semiconductor companies can position themselves favorably, by creating and maintaining economic moats.



Source: CDIC, Deloitte.

How the Pandemic Has Shaped the Semiconductor Industry

<p>The impact of COVID-19</p> <p>Semiconductor companies race to embrace digital technologies, but at a slower pace than other industries.</p> <p> 50% Say digital transformation accelerated by months or years.</p> <p> 63% Have increased the use of cloud and/or automation.</p>	<p>Growth products and applications</p> <p>Smart tech packed with advanced chips will drive future revenue.</p> <p> Wireless/5G, IoT, and automotive are the most important applications driving revenue over the next year.</p> <p> 72% Believe 5G specifically will become a significant driver of revenue growth within 2 years.</p>
<p>Financial expectations</p> <p>Optimism is on the rise as the industry recovers quickly from COVID-19</p> <p> Leaders expect revenue, profitability, capex, and R&D investments to increase.</p> <p> 34% Reveal R&D spending is not efficiently aligned.</p>	<p>Industry issues and strategic priorities</p> <p>Nationalist trade environment challenges semiconductor companies.</p> <p> 53% Name territorialism the biggest industry issue.</p> <p><5% Rank inclusion and diversity, reducing carbon footprints, and formalizing ESG reporting as one of their top three strategic priorities.</p>

Source: KPMG Global Semiconductor Industry Survey findings, as of 2021.

The semiconductor industry has weathered the pandemic better than most industries, ending 2020 with similar growth to pre-pandemic levels. Only 50% of semiconductor firms say Covid-19 accelerated their digital transformation, lagging other industries that used the pandemic as a catalyst for change. The top change in business resulting from Covid-19 has been the increased use of cloud and/or automation technologies, which are now being used to support permanent work-from-anywhere models.

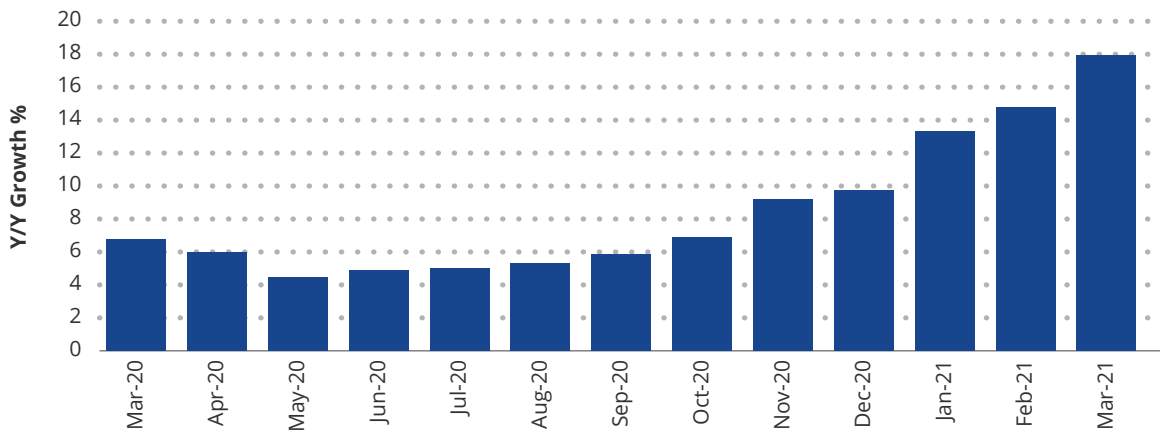
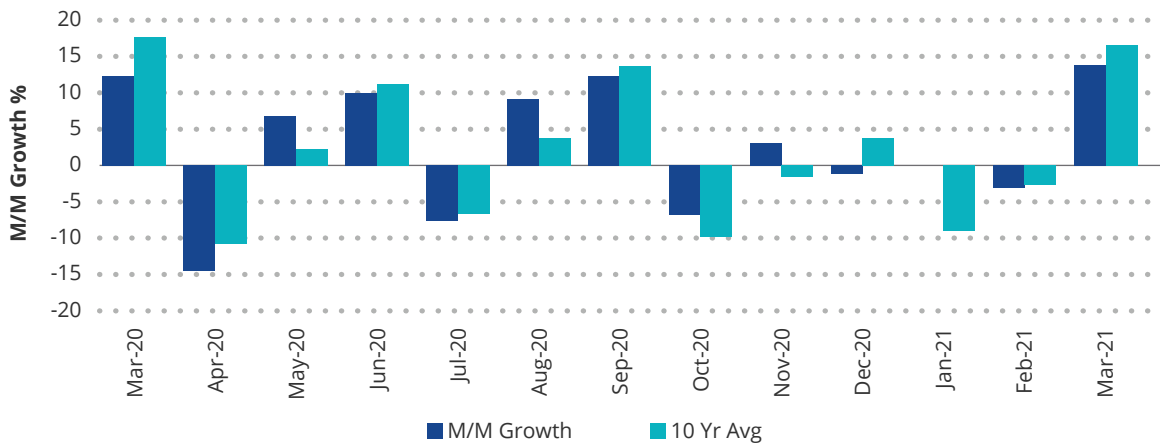
Industry leaders expect company revenue, industry profitability, capital spending, and research & development (R&D) to increase over the next year. While most companies (63%) expect to increase their workforce size over the next year, the figure is lower than last year (74%). Semiconductor companies are becoming increasingly efficient in aligning their R&D spending with market opportunities, but a large portion of the market still has room for improvement.

Wireless communications (including 5G) and internet of things (IoT) are tied as the most important applications driving industry revenue over the next year. Despite assumptions of a pandemic-induced decline, automotive applications rank as the 3rd most impactful driver of semiconductor revenue over the next year, ahead of other applications like cloud computing, data centers, artificial intelligence and consumer electronics. In terms of application rankings, sensors and Micro Electro Mechanical Systems (MEMs) are the product category that represents the largest growth opportunity.

Territorialism, supply chain risk and talent risk are the top 3 industry issues, and perfectly match the top three threats to growth, identified by leaders in the overall tech sector. Growth, talent management and supply chain resilience are the top strategic priorities, reflecting long-term mentality. Increasing inclusion and diversity, reducing carbon footprints and formalizing ESG reporting are also top priorities for leadership agendas.

Accelerating Sales Growth Through the Pandemic

Global Semiconductors Sales

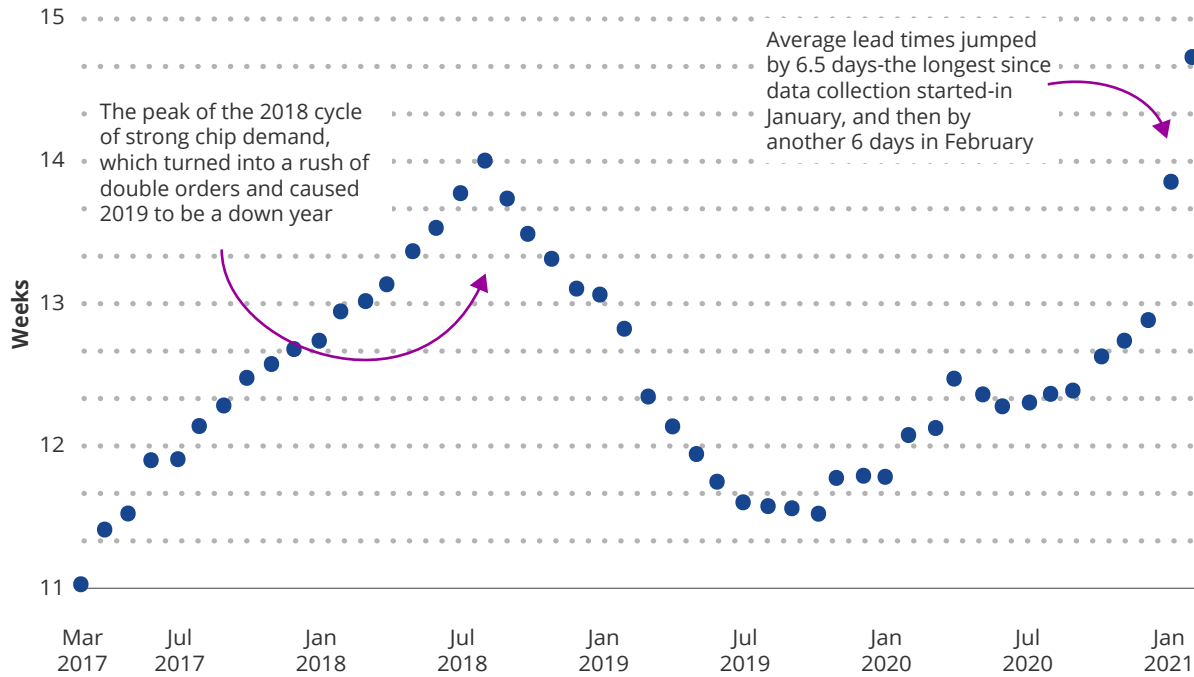


Source: Semiconductor Industry Association, Morgan Stanley Research, as of March 2021

Global semiconductor sales have been increasing since last June. China led regional sales in March, followed by Japan and the rest of Asia Pacific, the U.S. and Europe.

Strong demand for electronic devices, in part because of widespread remote working and homebased learning, coupled with the push towards digitization, have helped the chip industry strongly hold its ground against the ramifications of the pandemic, although this has led to a chip crunch.

Semiconductor Shortage Has Worsened Delivery Timelines



Note: Average calculated on data from four different distributors.

Source: SFG Research

Demand for microchips was on the rise even before the pandemic disrupted supply chains and altered consumer needs.

Accelerating Sales Growth Through the Pandemic

Lately, the water-intensive chip industry has had to contend with the elements—a fire in a Japanese chip manufacturer that is popular with carmakers, followed by a drought in Taiwan, home to the world’s largest chipmaker, Taiwan Semiconductor Manufacturing Co. (TSMC), among others, has exacerbated an already-existing supply shortage.

The chart illustrates that the lead time, the duration between ordering a chip and getting it, has now stretched from around 12 weeks to 16 weeks.

How to Invest in the Semiconductor Revolution

For investors looking for exposure to the dynamic semiconductor industry, an exchange traded fund, such as [VanEck Vectors™ Semiconductor UCITS ETF](#) provides access a basket of highly liquid semiconductor companies. SMH focuses on some of the most liquid pure play companies in the industry based on market cap and trading volume. For investors looking to participate in the semiconductor revolution, VanEck Vectors™ Semiconductor UCITS ETF provides diversified exposure to the industry without forcing investors to try pick individual winners.



Risk: You may lose money up to the total loss of your investment due to the Main Risk Factors and additional risk such as Risk of Investing in the Semiconductor Industry, Risk of Investing in the Information Technology Industry, Risk of Investing in Medium-Capitalisation Companies, Foreign Currency Risk. This list is non exhaustive, please refer to the sales prospectus for the complete list of main and additional risks.

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