SK hynix NEWSROOM

Technology

[Semiconductor 101] “Where” in the World Are Semiconductors Made and Applied? SK hynix Reveals All

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Imagine a world without smartphones, computers, or the internet. It would be unthinkable for many to live without these essentials, but that would be the case without the engine behind these technologies and many others—semiconductors. Despite the prevalence of these chips, their origins, usage, significance and more are still not widely known. Across six episodes, the Semiconductor 101 series will cover the **who, what, when, where, why, and how** of semiconductors to introduce the fundamentals of this crucial technology.

Much of the semiconductor world remains unseen. The chips themselves are the hidden force behind modern technologies, while few have seen inside the facilities where these advanced devices are painstakingly crafted. To shed light on where semiconductors are made and used, this latest episode of the Semiconductor 101 series takes an inside look into the facilities and regions that produce these chips, as well as the main applications of semiconductors.

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Where are semiconductors manufactured?

As shown in the first Semiconductor 101 article, various companies operate facilities which handle different aspects of the semiconductor manufacturing process. While there are a range of these facilities, the following are three of the most common types for each stage of the manufacturing process:

- **Wafer manufacturing facility:** Companies such as SK siltron, Sumco, and Shin-Etsu Chemical produce silicon wafers that act as the substrate, or foundation, for semiconductor devices. Crucial steps in wafer production take place at these facilities, including purifying the sourced silicon, slicing the purified silicon into thin wafers, and polishing. These wafers undergo further processing steps such as doping[1] to deliver desired features and structures before they are supplied to fabs.

- **Fabrication plant (Fab):** A fab is a specialized, highly secure facility which manufactures semiconductor devices such as integrated circuits[2]. In other words, fabs handle the front-end semiconductor manufacturing process. They must therefore contain advanced equipment to conduct key processes including oxidation, photolithography, etching, and deposition.

- **Assembly and test facility:** These facilities are responsible for the back-end manufacturing process, which essentially consists of packaging and testing. While packaging involves protecting the chip from damage and building mechanical and electrical connections, testing ensures a product's quality and reliability. These facilities are generally run by OSAT[3] companies, which receive fabricated wafers from customers and turn them into finished semiconductor products.

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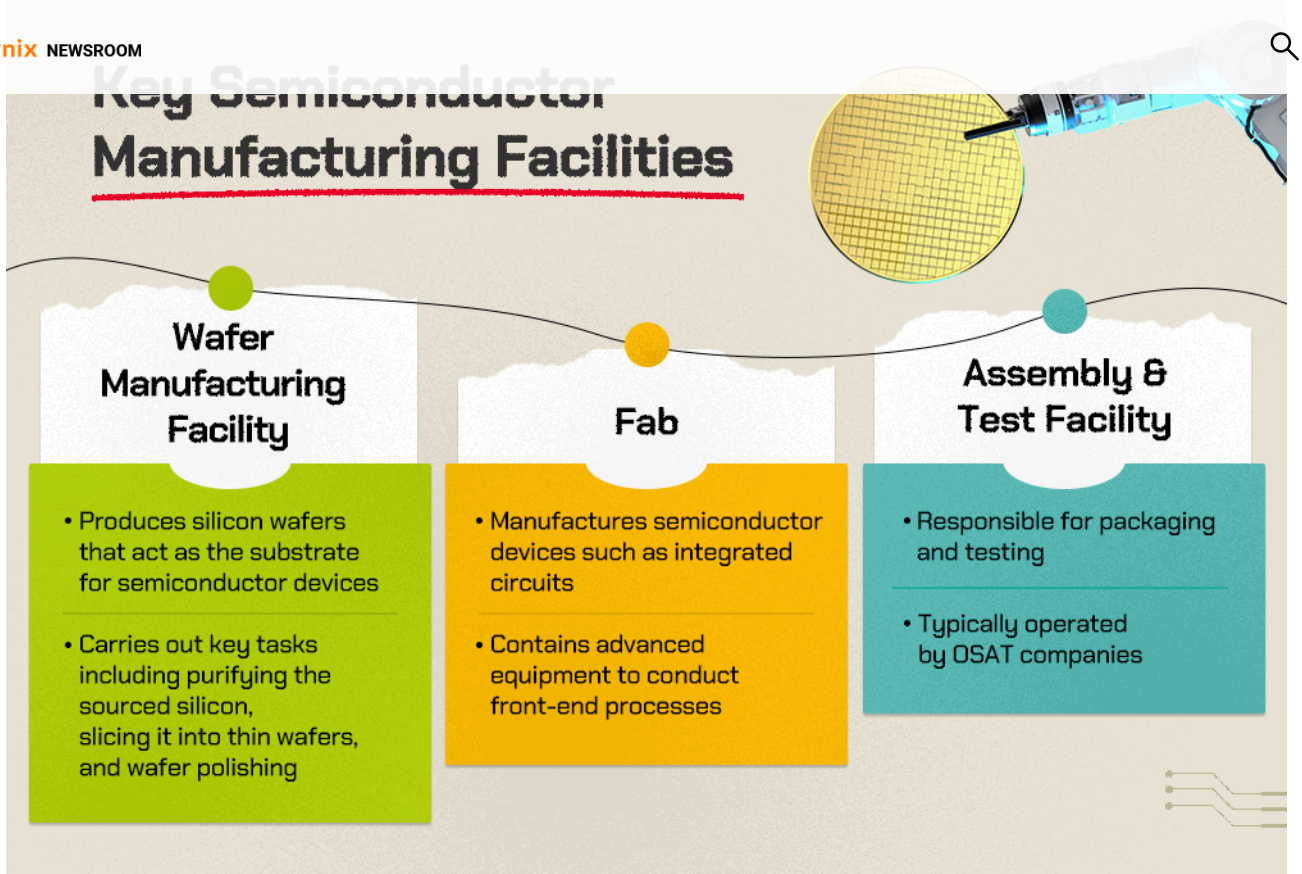

Various facilities are responsible for different aspects of the semiconductor manufacturing process

Where in the world are different types of semiconductors designed and manufactured?

The global semiconductor supply chain is spread across various regions that each specialize in one or a few stages of the design and manufacturing process. As a result, semiconductor chips are generally not made in a single location or country, but instead must be shipped across the world to be finished.

In terms of design, which involves defining the product requirements and the physical layout of the individual circuits, the U.S. leads the way—particularly for advanced logic chips. Meanwhile, the latter manufacturing stages are dominated by East Asian countries. As different nations specialize in certain types of chips, let's look at where three common semiconductor types are manufactured around the world based on a report from the Semiconductor Industry Association (SIA)[4].

- **Memory:** Boasting leading semiconductor memory companies including SK hynix, **South Korea** heads the memory field in terms of production capacity. The nation commands a majority share of DRAM fabrication capacity, well ahead of its nearest rivals. South Korea is also the joint leading producer of NAND flash[5], alongside **Japan**, where companies like Kioxia play a major role.

- **Logic: Taiwan** is the undisputed worldwide leader of logic semiconductor[6] production thanks largely to the global behemoth of semiconductor fabrication, TSMC. Taiwan holds a 69% share of manufacturing capacity for logic wafers under 10 nanometers (nm), and also leads the way for those measuring between 10 nm and 22 nm. Only **China** has a bigger market share in logic semiconductors that are larger than 28 nm.

- **Discrete, analog, and other (DAO):** These chips that serve various applications are manufactured all over the world. While **Japan** and **China** produce the most DAO chips with 25% of the market share each, **European countries** and **the U.S.** also contribute significantly to the global production of these diverse devices.

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Different nations across the world specialize in manufacturing certain semiconductor chips

Where is the largest semiconductor memory market?

With the explosion of data in the AI era, high-performance memory solutions such as DRAM and NAND flash are becoming increasingly critical to store and process this data. This growing importance is reflected in the projected growth of the global semiconductor memory market from an estimated 111.6 billion USD in 2023 to 240.6 billion USD by 2030. Breaking the market down by region, a Precedence Research report reveals the world's largest semiconductor memory markets in terms of revenue.

In 2023, **Asia-Pacific** was far and away the leader, commanding around 43% of the market. Coming in second is **North America** with a 27% share, followed by **Europe** with a 22% share. Meanwhile, **Latin America** and **Middle East and Africa** held a 5% and 2% share of the market, respectively.

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Asia-Pacific is home to the largest semiconductor memory market, followed by North America

Where are SK hynix's semiconductor memory products manufactured in South Korea?

Currently, SK hynix operates four semiconductor memory production facilities in South Korea. To meet heightened demand for memory products, the company is set to boost its domestic manufacturing capacity by constructing additional sites in the future.

Current Sites

SK hynix operates three fabs at its headquarters in Icheon—M10, M14, and M16. The most recent facility is M16, which was built in 2021 to mainly produce DRAM products. In Cheongju, the company runs a fab called M15 which strengthens the company's NAND flash business.

Future Sites

Scheduled for completion in 2027, the Yongin Semiconductor Cluster will enable SK hynix to boost production of AI memory products. The 4.15 million-square-meter site, the equivalent of around 580 soccer fields, will include four state-of-the-art fabs and a semiconductor cooperation complex. The company will also invest about 5.3 trillion KRW (4 billion USD) for the construction of M15X in Cheongju, enabling it to expand production capacity of next-generation DRAMs including the flagship HBM[7].

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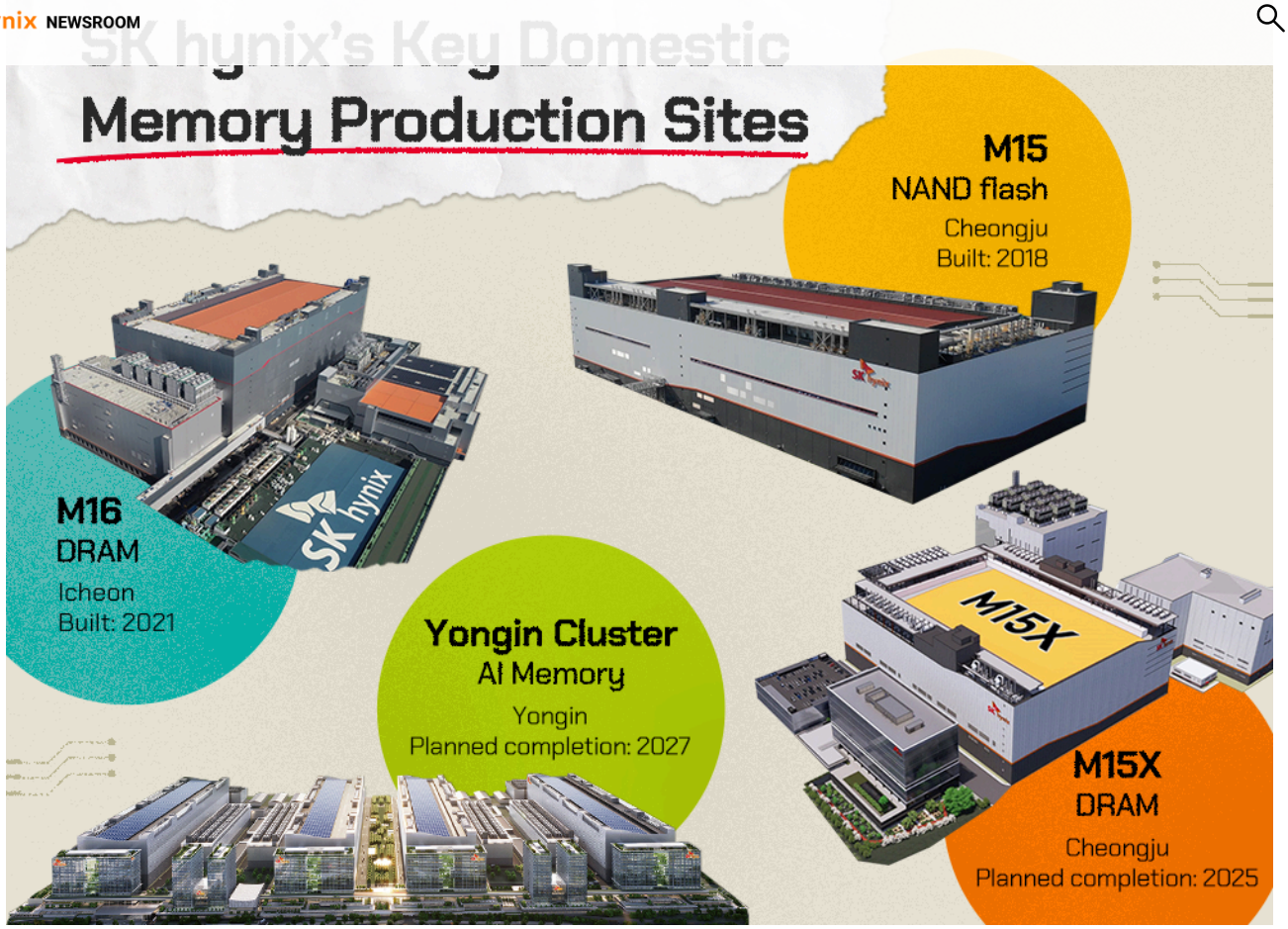

SK hynix operates DRAM and NAND flash memory production sites in South Korea and plans to build an AI memory facility

Where is semiconductor memory applied today?

From the moment you wake up to the morning alarm on your smartphone, semiconductor memory plays a key role in your daily routine. These advanced memory solutions are the foundations for modern technologies which can be found in everyday locations and situations, some examples of which are listed below:

Home

Whether checking social media, playing games, or doing just about anything on your phone, semiconductor memory is required for data storage and ensuring smooth performance. The laptop and smart TV in your home also require internal storage to store and retrieve data, as well as learn usage patterns. Following advancements in on-device AI memory chips, many household appliances now possess customized functions that boost security, speed up processes, and reduce power consumption.

Car/Public Transport

When driving to work, you benefit from memory-backed advanced driver assistance systems (ADAS) such as lane departure warnings, as well as advanced infotainment technology. As you're stuck at traffic lights, memory is used in the signal's control systems which store data to manage traffic flow and keep intersections safe. Taking public transport

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instead? Subways and train control systems require memory to maintain precise schedules and manage train movements on time. Meanwhile, bus tracking and management systems monitor buses and their arrival times at stops.

Hospital

Having your annual health checkup? In hospital, medical imaging devices such as MRI and CT scanners use memory to store images required for diagnosis. Patient monitoring systems, which keep track of data including heart rate and blood pressure, also rely on memory along with electronic health record systems which store patients' medical history, test results, and doctor notes.

Classroom

As the AI revolution has also impacted education, teachers and students alike can now benefit from a range of AI tools backed by semiconductor memory. For teachers, AI applications can boost productivity in areas such as lesson planning and grading, while students can use such tools for research, writing assistance, and tailored support.

Semiconductor memory is found in many essential technologies used around the world

[1]***Doping***: *Process where specific impurities are intentionally added to modify the electrical properties of the silicon.*

[2]***Integrated circuit***: *A collection of components including transistors, resistors, and capacitors grouped on a single board of semiconductor material.*

[3]***Outsourced semiconductor assembly and test (OSAT)***: *Vendors that provide third-party semiconductor assembly, test, and packaging (ATP) services.*

[4]***Source***: *Statistics for this section are based on wafer production capacity and are from the SIA's report "Emerging Resilience in the Semiconductor Supply Chain" (May 2024), which uses data from the U.S. Department of Commerce, SEMI, and BCG Analysis.*

[5]***NAND flash***: *A non-volatile storage chip that does not require power to retain data.*

[6]***Logic semiconductor***: *Semiconductor chips that are known as the "brains" of electronics as they can process information and perform calculations to execute various tasks.*

[7]***High Bandwidth Memory (HBM)***: *A high-value, high-performance product that revolutionizes data processing speeds by connecting multiple DRAM chips with through-silicon via (TSV).*

Having looked at "where" semiconductors are manufactured and used, the next episode will ask "why" these intricate **devices are crucial in today's world.**

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