

UK-APAC Tech Growth Programme

# Northeast Asia's semiconductor market - opportunities for UK companies

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# Executive summary

## Japan

The Japanese market presents significant opportunities for UK semiconductor-related companies, especially those looking to leverage Japan's established strengths and contribute to current challenges where Japanese corporations require international collaboration.

Japan excels in semiconductor materials and manufacturing equipment, underscoring Japan's importance in the global semiconductor supply chain and providing a solid foundation for potential partnerships and collaboration with foreign companies.

Japan's semiconductor industry has maintained its presence globally with a robust collection of integrated device manufacturers (IDMs) such as Kioxia, Renesas, Toshiba, Sony Semiconductor, and Rohm.

Japan also excels in advanced packaging and chiplet technologies, which are essential for producing high-performance, low-power chips used in applications such as AI. These capabilities enable the integration of multiple chips, addressing the increasing demand for sophisticated semiconductor solutions.

However, Japan faces challenges in areas such as IC design, semiconductor IP, EDA tools, and ATP services.

The country's semiconductor industry is keen on advancing its front-end fabrication technologies to maintain its leading status and continuously seeks to enhance semiconductor production processes. To ensure the advancement of fabrication facilities, the Japanese government has shown great support for the semiconductor industry to overcome existing challenges and promotes balanced growth and development of critical market-driven technologies. Initiatives are focused on strengthening domestic capabilities in materials, equipment, and fabless operations, as well as fostering the development of the semiconductor industry technologies for future foundational horizontal technologies such as communications, AI, cloud computing, and software.

Japan's semiconductor industry is poised for continued expansion, driven by technological advancements in consumer and industrial electronics, electric and autonomous vehicles, next-generation telecommunications like 5G and 6G, and high-performance computing for data centres. However, concerns regarding supply chain security persist, primarily due to the heavy reliance on outsourcing critical technologies used in the fabrication processes. To counter these vulnerabilities, the Japanese government is intensifying international cooperation and partnerships, including with countries possessing strong technological ecosystems in semiconductors.

For UK companies looking to enter the Japanese market, understanding the industry demands and competitive landscape is crucial. Establishing a presence through exhibitions, trade missions, or partnering with local agents or business development agencies can be effective strategies.

Market entry process follows the usual steps, but there are factors specific to Japan that a UK company should consider – longer sales cycles (on average 6 to 12 months longer), extensive Q&A during technology evaluations, a consensus-based bottom-up decision-making process, and language barriers. Overall, entering the Japanese market requires patience and commitment to a long-term play.

Japanese companies have become comfortable with online meetings since COVID-19, which makes it easier for overseas companies to progress discussions. However, some presence in Japan is typically necessary to successfully convert opportunities. In initial stages a UK company can work with distribution partners, form a joint venture, or enter in licensing/franchise agreements before setting up a local entity. It is recommended to have a local sales agent or hire an initial in-country employee to ensure the effectiveness of your market entry strategy.

## Market opportunities - Japan

### IP:

A mature IDM ecosystem and nascent fabless industry is looking for innovative IP to improve its global competitiveness



### IC Design:

Relatively weak domestic fabless companies mean Japan's electronics companies rely more on foreign suppliers



### EDA:

The Japanese government and industry is placing more emphasis and support into next-gen chips for AI, Quantum and photonics that may require niche EDA tools



### Compound:

Partner with existing IDMs' foundries and suppliers to create and bolster low-cost mass production



### Advanced packaging:

Japanese IDMs and fabless companies are interested in advanced packaging technologies to help them meet the demands of modern semiconductor designs



### Materials:

Specialised materials which can improve existing chip performance or durability are sought after



### Energy:

Companies specialising in power semiconductors for solar inverters, energy storage systems and smart grids can find a receptive market in Japan



### Automotive:

Companies specialising in power electronics, sensors, compound and chip design for automotive applications can find significant opportunities in this sector



## Korea

Korea stands at the forefront of the global memory semiconductor industry, led by two prominent IDMs, Samsung Electronics and SK hynix. The semiconductor sector holds a pivotal position in the nation's economy, with Korean companies commanding approximately 61 percent of the global memory chip market. Moreover, Korea maintains a competitive edge in the global foundry industry, accounting for approximately 17 percent of market share, representing one of only two locations capable of the highest end semiconductor manufacturing, the other being Taiwan. However, despite its strength in fabrication, Korea relies heavily on foreign partners for upstream technologies such as IP, EDA, materials, components, and equipment.

The main opportunities for UK companies lie in IP, packaging, equipment, IC design, compound semiconductors, and EDA.

Korea stands out as a dominant force in the global memory semiconductor market, boasting a substantial 70.5 percent share in the DRAM sector and a significant 52.6 percent share in NAND globally. The Korean semiconductor industry prioritises advancing its fabrication capabilities to maintain its leadership position and is actively developing technologies to enhance semiconductor production and processes. It is particularly interested in advanced packaging and chiplet miniaturisation technologies, which can meet the demand for high-performance, low-power chips in applications like AI by integrating multiple chips.

Korea's greatest challenge is in its upstream capabilities, the fabless value chain, and with developing future technologies such as compound semiconductors. The nation relies on numerous overseas partners and suppliers for materials, equipment, EDA tools, IP, IC design, and niche semiconductors. However, the Korean government is actively working to address these weaknesses, striving for balanced industry growth, and the development of essential market-driven technologies. The recent government initiative, 'Semiconductor Mega Cluster Vision', aims to strengthen these weak links by focusing on materials, equipment, and fabless operations, while also supporting the development of new technologies for AI chips and compound semiconductors.

Despite these challenges, Korea's semiconductor industry is poised for continued growth, driven by commercial drivers such as AI chips for consumer and industrial electronics, electric and autonomous vehicles, 5G and 6G, and high-performance chips for data centres.

However, there is a growing concern about supply chain security due to the extensive outsourcing of supporting technologies in the fabrication process, including materials and equipment, such as EUV exposure process, and IC design and IP, such as next-generation high-performance and low-power graphics design. To address this, the Korean government is actively strengthening international cooperation, including with the UK through initiatives like the 'UK-Korea Semiconductor Cooperation Framework'.

Companies in the UK looking to enter the Korean market have several options to consider. An essential initial step is to comprehend the demands of the industry and the competitive environment. A trip to Korea may play a significant role in this learning curve. This can be arranged by a UK company acting independently or by taking part in an exhibition or networking event as part of a UK government trade mission. This can help create initial leads, establish discussions with stakeholders in the Korean semiconductor ecosystem, and offer more market information.

While it is feasible to conduct sales and drive conversations from the UK, we advise using a local agent or business development agency to handle customer support and sales in the local time zone. An additional strategy a UK business looking to enter the Korean market can consider is appointing a reseller or distributor. A UK company may think about forming a local corporation to aid in expansion after it starts drawing revenue from the market. The most popular strategy is for the head office to directly invest in a branch office. There is no one size fits all market entry approach, so the first market research phase is crucial.

## Market opportunities - Korea

### IP:

Expand into new emerging fabless companies and partner with Korean foundries' ecosystem programmes



### IC Design:

Expand into new emerging fabless companies and provide chips to Korea's strong electronics sector that cannot rely on domestic design



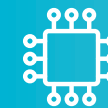
### EDA:

Emerging AI IC design companies are interested in niche tools



### Compound:

Partner with Korean foundries, design firms and others in the ecosystem to build-out low-cost mass production



### Advanced packaging:

Memory IC IDMs are interested in advanced packaging technology for HBM and chiplets



### Equipment:

Korean fabs are open to new equipment suppliers. UK companies with niche equipment can take advantage of this



## Taiwan

Taiwan is at the forefront of the world's semiconductor industry. It is the key industry for the island and as such the focus for its future growth. Taiwanese companies now account for approximately 78 percent of foundry revenue, 21 percent of IC design revenue, and 52 percent of assembly and test revenue globally. While Taiwan is strong in these mid-stream sectors, it relies on foreign partners for upstream technologies and downstream customers.

The main opportunities for UK companies are in compound semiconductors, silicon IP, and equipment.

Taiwan is strongest in the midstream of the semiconductor value chain, this includes IC design, IC fabrication, and test & packaging. Its IC design industry is in second place globally behind the USA at approximately 20 percent of global revenues. There are 262 IC design companies in Taiwan with a combined revenue of GBP 31.4bn in 2022, dropping to GBP 28bn in 2023. The UK is already successful at licensing semiconductor IP into Taiwan's fabless firms, and UK fabless design firms already use Taiwan's fabs for their designs.

Taiwan leads the world when it comes to semiconductor fabrication with TSMC alone making up 77.5 percent of Taiwan's entire foundry industry, and it commercialised its 3nm node in 2023. Other players such as UMC are strong in mature node fabrication.

Taiwan is weakest in upstream areas including, semiconductor IP, EDA tools, materials, and SME, so requires a lot of outside partners and suppliers. It has however built a nascent midstream compound semiconductor value chain, which includes epitaxy and substrate, foundries, design firms, and test & packaging.

Industry drivers for advanced chips like AI, 5G/6G, EV, and high-performance computing (HPC), will continue to fuel semiconductor industry growth in Taiwan. However, Taiwan faces some challenges. For example, possible unstable supplies of electricity and water threaten Taiwan's semiconductor manufacturing businesses. China's semiconductor supply chain is strong at mature nodes, so Taiwan's mature node fabs needs to provide more value-added products or services to avoid a price war. Finally, talent outflow to South Korea and China in search of higher wages is a concern.

UK companies seeking to enter the Taiwan market can explore several routes. Understanding the industry needs and competitive landscape is an important first step. A Taiwan visit can be a key part of this education process. This can be organised through participating in an exhibition or a networking event as part of a UK trade mission or independently by a UK company. As well as providing further market information this can also help generate initial leads and facilitate conversations with Taiwanese semiconductor ecosystem stakeholders.

It is possible to drive conversations and do sales directly from the UK, but we recommend using a local agent or a business development consultancy to provide local time-zone sales and customer support. Appointing a reseller or a distributor is another method a UK company seeking to enter the Taiwan market can explore. Once a UK company has generated initial revenue in the market, it can consider establishing a local entity to facilitate expansion. The most used approach is opening a branch office through foreign direct investment by the head office. Routes to market will likely differ for each company, so the initial market exploration stage is key.

**Taiwanese companies now account for approximately 78% of foundry revenue, 21% of IC design revenue, and 52% of assembly and test revenue globally. But while Taiwan is strong in these mid-stream sectors, it relies on foreign partners for upstream technologies and downstream customers.**

## Market opportunities - Taiwan

### IP:

Smaller British IP companies can build on the success of the UK's leading companies



### IC Design:

Compound design cooperation and sell chip designs into Taiwan's server and CE companies



### EDA:

New design methodologies and needs mean an opportunity for niche tools



### Compound:

Partner with Taiwan foundries to create low-cost mass production



### Equipment:

Grow with Taiwan's fabs but there are also opportunities in compound and R&D



### Materials:

Unique and customised materials for more advanced process nodes and bespoke applications



### Energy:

Offshore wind, energy storage, water treatment, and recycling technologies



### Talent:

R&D hubs for Taiwanese companies as well as university and design services cooperation



# Market overview - Japan

## Market size

According to Spherical Insights, the Japanese semiconductor market was valued at GBP 34.72bn in 2022 and is projected to grow at a CAGR of 9.64 percent from 2022 to 2032, to reach GBP 87.18bn by 2032. This growth is consistent with the Japanese government's strategic investments, such as the Advanced Semiconductor Fund, which aims to achieve ambitious growth targets for the industry over the next decade.

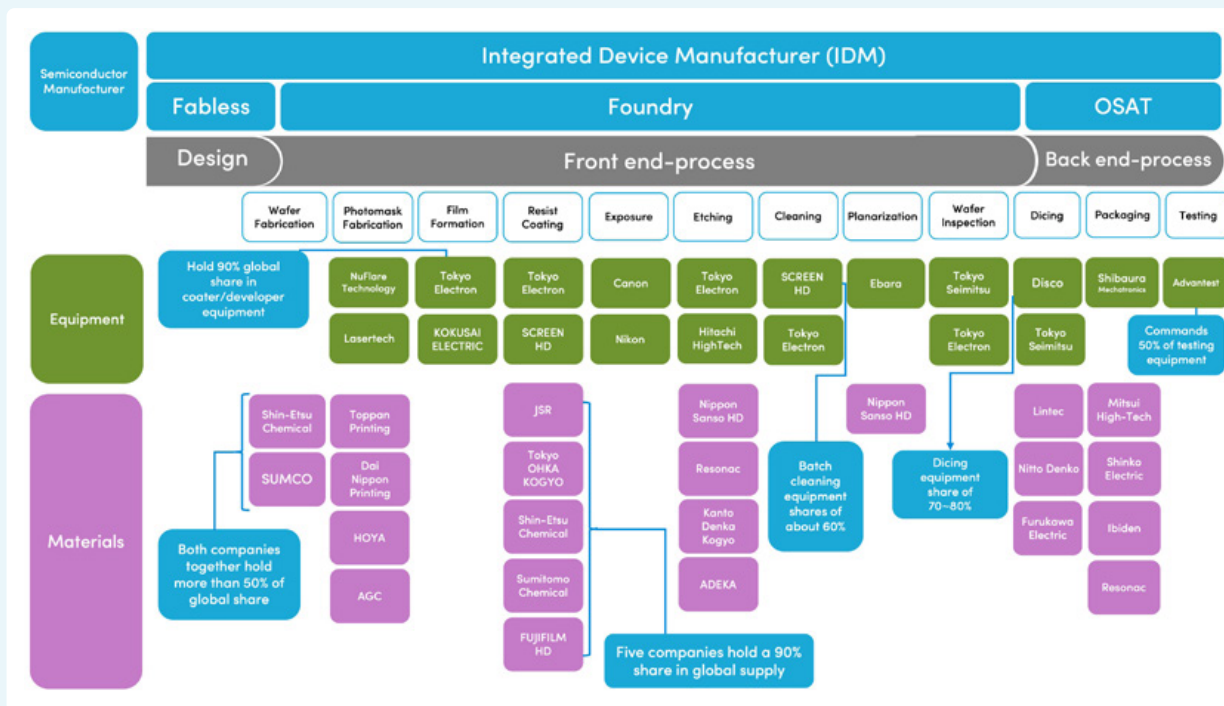
The Japanese semiconductor market remains pivotal globally despite a decline from over 51 percent of the global market in the late 1980s to 9 percent by 2022. This decline is due to factors such as the US-Japan Semiconductor Agreement, a shift from vertically integrated to fabless/foundry-based business models, and stiff competition from low-cost foreign manufacturers.



## Market segments

Japanese companies hold a significant global market share of 56 percent in semiconductor industry materials and 32 percent in semiconductor manufacturing equipment. Notable Japanese semiconductor companies are Tokyo Electron, Advantest, Shin-Etsu Chemical, Sumitomo Chemical, Mitsubishi Chemical, Renesas Electric, Rohm, and Screen Holdings, among many others have dominant market positions in specialised equipment and materials necessary for semiconductor manufacturing.

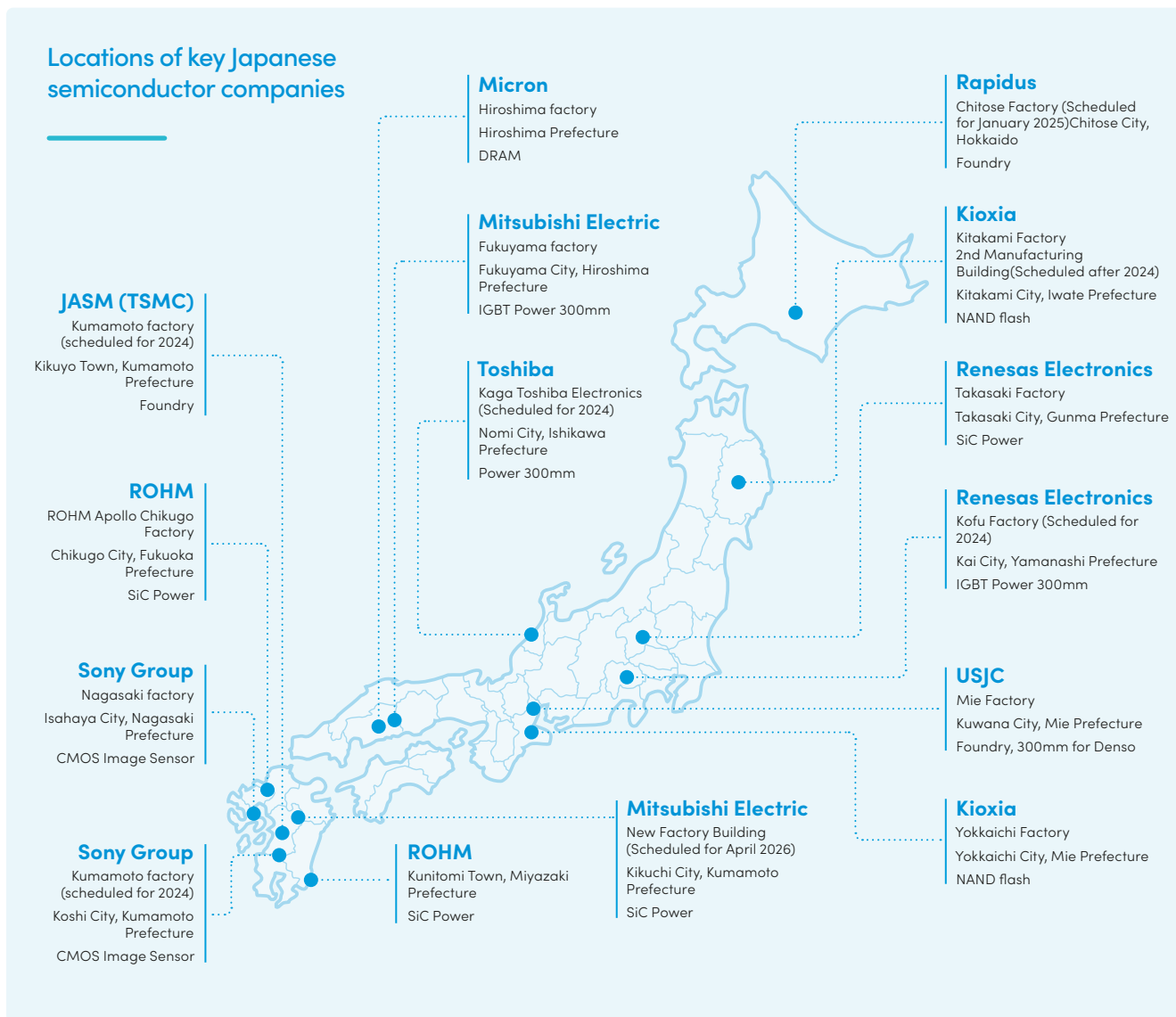
### Overview of Japanese semiconductor SME and material companies



Source: Intralink research

Traditionally, industrial clusters have been in the Kanto region near Tokyo and the Kansai region around Osaka. However, Japan's semiconductor industry is highly distributed, from Hokkaido in the north to Kyushu in the south. This broad distribution is a strategic measure to ensure resilience and diversification of production capabilities, thereby mitigating risks associated with disruptions such as natural disasters or localised economic downturns.

However, over the past five years, a significant portion of Japan's semiconductor industry has concentrated in the Kyushu region, often referred to as Japan's 'Silicon Valley'. This concentration is underscored by TSMC's recent completion of a plant in Kumamoto and Sony Group's long-standing presence in the area. Kyushu's ability to attract domestic and foreign investment, particularly in advanced process nodes, highlights its critical role in Japan's semiconductor sector.



## Key players

### Japanese semiconductor industry ecosystem



Source: Intralink research



## Materials

More than half of the 14 essential materials needed for chip manufacturing, such as photomasks, photoresists, and silicon wafers, are supplied by Japanese companies globally. This grants Japanese firms considerable influence in the industry, allowing them to play a crucial role in shaping market dynamics and technological advancements.

However, it is worth noting that despite Japanese companies' critical importance, many Japanese semiconductor material manufacturers are relatively small in scale. This makes them particularly vulnerable to acquisition by larger, more financially powerful foreign companies. These firms, recognising the strategic value of controlling such essential supply chain links, see an opportunity to strengthen their position globally by acquiring these Japanese companies.

Aware of such risks, the Japanese government has taken increasingly assertive steps to regain Japan's lead in advanced chip production and maintain its edge as a materials manufacturer. One recent strategic move involves the Japan Investment Corporation (JIC), which is overseen by the trade ministry, agreeing to buy semiconductor materials maker JSR – a leading supplier of photoresists - through a government-backed fund.

## Leading semiconductor materials companies in Japan

| Material                               | Company name(s)   | Comments  |
|--|---|---|
| <b>Silicon Wafers</b>                  | Shin-Etsu Chemical and SUMCO  | Together they hold over 60% of global market share  |
| <b>Polycrystalline Silicon</b>         | Tokuyama Corporation  | Holds 30% of global market share  |
| <b>Photomasks</b>                      | Toppan Printing, DNP, and Photronics  | Both companies together hold 50% of the global market share   |
| <b>Mask Blanks</b>                     | HOYA, AGC, and Shin-Etsu  | Hold a 70% global market share (EUV mask blanks)  |
| <b>Photoresists</b>                    | JSR, Tokyo Ohka Kogyo, Shin-Etsu Chemical, Sumitomo Chemical, and Fujifilm                    | Japanese companies dominate approximately holding 90% global market share   |
| <b>Etching Gas</b>                     | Kanto Denka Kogyo, Resonac, Central Glass, Daikin Industries, Taiyo Nippon Sanso, and ADEKA   | Kanto Denka Kogyo and Resonac together command over 50% of the global market for etching gas with other holdings minor share              |
| <b>Ultra-Pure Water (UPW)</b>          | Organo, Kurita Water, and Nomura Micro Science  | Japanese companies are leading providers in UPW production within Asia with Kurita Water and TSMC being partners                          |
| <b>CMP (Slurry, Dresser, and Pads)</b> | AGC, JSR, Fujifilm, Fujimi, and Resonac (Slurry); Showa Denko (DresserS); and FujiFilm (Pads) | Showa Denko Materials' CMP slurries, having the second largest global market share  |
| <b>Sputter Targets</b>                 | JX Nippon Mining & Metals   | Holds 60% global market share   |
| <b>Lead Frames</b>                     | Mitsui High-Tec and Shin-Etsu   | Mitsui High-Tec was the first company to make it possible to produce lead frames by punching using precision moulds                       |
| <b>Bonding Wires</b>                   | Sumitomo Metal Mining, Tanaka, and Tatsuta Electric Wire & Cable                              | Tanaka, Sumitomo Metal Mining, and MK Electron are the top four producers of bonding wires, holding approximately 29% of the market share |
| <b>Mold Resins</b>                     | Sumitomo Bakelite   | Holds 40% global market share   |
| <b>Substrates</b>                      | Ibiden and Shinko Electric Industries   | Both companies have a long track record in joint R&D with Intel   |

## Equipment

Japan is a key player in the semiconductor manufacturing equipment (SME) sector, hosting leading companies like Tokyo Electron, Advantest, Disco, and Screen Holdings, which provide critical technologies for semiconductor production. Tokyo Electron is Asia's largest and the world's third-largest supplier of semiconductor manufacturing tools after Applied Materials and ASML. This specialisation positions Japan as an indispensable part of the global supply chain in the tech industry, particularly in areas demanding high precision and advanced technological capabilities.

In 2023, Japan's imported approximately GBP 2.14bn worth of SME, a decrease of almost GBP 100m compared to the previous year. SME exports from Japan amounted to around GBP 12.68bn in 2023, decreasing by almost GBP 1.29bn compared to the previous year. This demonstrates a negative trend in Japan's semiconductor equipment market, both in terms of imports and exports.

The Semiconductor Equipment Association of Japan (SEAJ) forecasts a significant upturn in equipment sales in 2025 with investments from foundries, IDMs, and memory manufacturers. Fab investment is predicted to increase at a rate of 14 percent up until 2027, so expect renewed growth from H2 2024 onwards.

In 2023, sales declined by 23 percent, reaching GBP 15.89bn. This decline was attributed to changes in advanced factory plans driven by US export restrictions to China and reduced capital investments due to falling memory prices. In 2024, a recovery is anticipated, with sales expected to increase by 30 percent to GBP 20.66bn. This growth will be supported by a resurgence in memory investments and the logic/foundry sectors, aided by government support. By 2025, continued demand growth for SME is projected, leading to a further 10 percent increase in sales, reaching GBP 22.74bn.

This positive outlook is bolstered by Japan's Ministry of Economy, Trade, and Industry's (METI) strategic initiatives and favourable policies to assist factory construction and investments for fabrication development and 5G deployment.

### Wafer fabrication equipment

Tokyo Electron is renowned worldwide for being a leading SME supplier. It specialises in tools essential for various stages of chip manufacturing, including cleaning, etch, and deposition. Additionally, Hitachi-Hitech manufactures complementary etching, deposition, and metrology equipment. Screen Holdings and Kokusai Electric Corporation contributes with expertise in cleaning silicon wafers.

In 2022 Screen held approximately a 60 percent market share in wafer cleaning equipment, with Tokyo Electron holding 27 percent, meaning Japanese companies hold over 75 percent of global market share.

Nikon, Canon, Lasertec, and NuFlare Technology are also key companies globally. Nikon is renowned for its deep ultraviolet (DUV) lithography machines, crucial for creating the intricate circuitry in chips. Canon plays a pivotal role with its advanced semiconductor lithography equipment, which is essential for producing precise and high-quality semiconductor wafers. Lasertec holds a unique position as the sole manufacturer of semiconductor inspection equipment utilising extreme ultraviolet (EUV) mask lithography technology. Finally, NuFlare has made significant contributions to photolithography through the development of electron beam mask writers capable of projecting intensely precise light, necessary for creating circuit patterns on semiconductors.

### Assembly, test, and packaging equipment

Japan is the largest supplier of assembly equipment in APAC, boasting 43 percent of global market share. The country produces 66 percent of its domestic stock of assembly equipment and supplies considerable portions of other countries' demand, such as Taiwan (40 percent), the USA (24 percent), China (29 percent), and South Korea (29 percent).

Major Japanese producers include DISCO Corporation, Tokyo Electron, Screen, TOWA Corporation, and Accretech (Tokyo Seimitsu). Particularly, DISCO and Tokyo Seimitsu, which are acknowledged as key players in the dicing equipment market.

Japan's position is also strong in the test equipment market. China and Taiwan hold the bulk of the world's ATP/OSAT facilities, most of which are equipped with Japanese tools produced by Advantest, Tokyo Electron, and Accretech.

Japan produces 47 percent of Taiwan's total test equipment stock, 53 percent of China's, and 35 percent of South Korea's. Japan's leading company Advantest has 35 percent global market share, behind the USA's Tereadyne (47 percent).

Regarding packaging equipment providers, Towa has introduced significant innovations in the semiconductor moulding process, notably through its compression moulding system which effectively reduces resin waste. This technology is particularly relevant for the assembly and packaging of semiconductors designed for 5G applications. Towa's advancements have led to a 56.6 percent share of the global market in semiconductor moulding.

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## Foundry

Japan is home to a diverse array of semiconductor manufacturing facilities, with both domestic giants and international firms playing critical roles. Most semiconductor manufacturing in Japan is conducted by domestic IDMs such as Kioxia, Toshiba, Sony Semiconductor Solutions, Renesas Electronics, and Rohm. These companies have long established their presence, driving innovation and production within the country. Kioxia, in partnership with Western Digital, has been expanding its Yokkaichi memory foundry to anticipate future demand despite current market adjustments. Renesas's Kofu plant has been upgraded into a 300mm power semiconductor facility, highlighting a strategic shift towards cost competitiveness and technological advancement in power semiconductors.

Recognising the global chip shortage's impact, the Japanese government is placing great importance on actively bolstering domestic production and attracting foreign semiconductor manufacturers. International companies such as Micron Technology and UMC have invested in advanced DRAM manufacturing and UMC's presence through its Japanese subsidiary, USJC, shows how Japan is an attractive investment destination for foundry capacity expansion.

Most notably, TSMC's recent expansion into Kumamoto Prefecture in partnership with Sony Semiconductor Solutions and Denso, marks a significant milestone. This venture, named Japan Advanced Semiconductor Manufacturing (JASM), is set to initiate production in Kumamoto by the end of 2024, targeting an initial monthly output of 55,000 12-inch wafers. This will increase to 100,000 wafers per month when a second fab is completed on the same site in 2027. Both fabs will produce chips from 40nm, 28nm, 22nm, 16nm, 12nm, and even 7nm or 6nm. There is also an ambition to increase the local supply chain's contribution from 25 percent to 60 percent by 2030.

Additionally, Japanese government incentives such as the Post-5G Fund which encourage the development of emerging players like Rapidus through the provision of grants aiming to manufacture cutting-edge 2nm process semiconductors, and JS Foundry's acquisition of OnSemi's Niigata plant for power and analog semiconductor production, signal a robust future for foundry development in Japan. These initiatives reflect a strategic push towards securing Japan's position not just as a strong base for its traditional IDM companies, but also as an attractive destination for the world's pureplay foundries such as TSMC and UMC to expand production, and to boost its own pureplay foundry objectives with Rapidus.

Rapidus is collaborating with Canadian chip design company Tenstorrent to develop AI semiconductors, and it will send approximately 200 people to Tenstorrent HQ to be trained on AI semiconductors. Tenstorrent is partnering with other fabs as well though, in Korea it has partnered with Samsung Electronics as an AI chip foundry.

The future of foundry development in Japan is characterised by a strategic amalgamation of domestic innovation, international collaboration, and government support. With significant investments in advanced manufacturing technologies and strategic partnerships, Japan is placing domestic production of semiconductors as one of its economic engines going forward.

Furthermore, the establishment of JASM and Rapidus and the development of a 'Hokkaido Valley' reflect Japan's lofty aspirations to establish manufacturing bases for next generation chips. Large investment projects by the Japanese government showcases the nation's strategic efforts to reclaim a leading position in the industry.

## IC design

As semiconductor manufacturers worldwide pivot towards fabless and foundry models, historically, many Japanese firms persist with the IDM model and its dominance can be understood very clearly. It is often argued among experts in semiconductor manufacturing that Japan's decline in the semiconductor industry since the 1980's stems from its failure to effectively transition from IDM to fabless and pureplay foundry models. Remarkably, considering Japan's dominance in semiconductor equipment and materials, it lacks significant fabless or pureplay foundry companies with a commanding share of the global market.

The Japanese semiconductor IC design market consists of three leading IDM companies, Kioxia, Renesas, and Sony, holding more than 60 percent of the domestic market. Other well-renowned IDMs are Mitsubishi Electric and Toshiba. Among the top 10 firms, Socionext was formed by integrating the semiconductor divisions of Fujitsu and Panasonic. The company designs and develops system-on-chips (SoC) tailored to specific customers and products and stands as a significant fabless company. However, its revenues are low on a global level, especially against firms from the US and Taiwan. Although other fabless companies do exist, such as MegaChips (the first Japanese fabless company), QD Laser, Trex Semiconductor, and Axell, they exist within an ecosystem dominated by IDMs.

Thus, there is increasing concern regarding Japan's dependency on overseas companies not just for making chips, but also designing them. The industry recognises the need for Japan to develop its own fabless companies to revive its semiconductor sector.

## Other

### Compound

Compound is an emerging area in Japan and one which Japanese companies already have a foothold. Materials such as Gallium Arsenide (GaAs), Silicon Carbide (SiC), Gallium Nitride (GaN), and Indium Phosphide (InP), are critical for high-frequency and high-power devices in electric vehicles and 5G/6G technology.

Japanese companies are prominent players in this market, supplying these materials and using them to fabricate wafers with Sumitomo Electric Industries producing GaAs, SiC, and InP substrates and epitaxial wafers. Rohm Semiconductor specialises in GaN and SiC materials and devices. JX Nippon Mining & Metals is known for its production of InP substrates, and Showa Denko focuses on SiC materials.

### Semiconductor IP

The Japanese government recognises that semiconductor IP is becoming more important as chip designs become more complex and time-to-market pressures increase.

The demand for IP in Japan is driven by the growing investment in foundries and design companies, along with the increasing presence of FDI in semiconductor manufacturing plants, particularly in the Kyushu region. Additionally, Japan's IDMs require sophisticated semiconductor IP to maintain their competitive edge.

Regarding Japanese companies' presence within the semiconductor IP sector, Arm Ltd, now listed on NASDAQ, was previously owned by SoftBank Group. However, domestic competition among Japanese IP providers remains low. There are no large pureplay IP companies in Japan. Renesas, Fujitsu supply some semiconductor IP, and recently a pureplay IP company, NanoBridge Semiconductor (NBS) has emerged. Overall, there is still significant reliance on imported IP. NBS, a venture company established by NEC researchers, is a series-A startup that licenses its NanoBridge IP, a resistance-change type switch developed with NEC and the National Institute for Materials Science.

Renesas offers IP for the automotive market, with many products particularly suited for operation in high-temperature environments. For example, the 5V OTP IP developed in collaboration with eMemory using the 130nm BCD process enhances high-temperature resistance and data retention performance, meeting the demanding conditions of automotive applications. Additionally, their products for 5G communications and data centres incorporate technologies that improve energy efficiency.

## EDA tools

Japan has a limited presence in the design software sector, and like other countries, relies heavily on tools from the USA. There are a few companies like Zuken providing software solutions for PCB and IC design. Additionally, Agro Graphics' subsidiary company Jedat offers EDA products and services, however, it is not a significant global player.

The Japanese EDA tool market is expected to grow at a CAGR of 9.4 percent between 2022-2030. However, considering Japanese companies limited presence in the design software sector, it will continue to be an area where Japanese design companies rely on imported tools.

## Assembly, test & packaging (ATP)

Many ATP facilities (above 95 percent) are in Indo-Pacific countries, with a significant concentration of Outsourced Semiconductor Assembly and Test (OSAT) providers in Taiwan, China, and Southeast Asia, particularly in Singapore, Malaysia, Vietnam, and the Philippines.

Japan does not have its own OSAT companies; however, its IDMs typically handle packaging in-house.

Despite this, some Japanese IDMs and fabless companies still rely on foreign OSAT services for specialised packaging needs. Notable foreign OSAT providers such as Taiwan's ASE Technology and the USA's Amkor Technology play crucial roles in Japan, offering advanced packaging solutions that meet the stringent requirements of modern electronics.

A substantial number of Japanese semiconductor chips are sent to Taiwan, China, and Southeast Asia for packaging. It is common practice for chips to be manufactured in Korea or Taiwan, shipped to Southeast Asia or China for packaging, and then sent to another location for integration into devices.

This dependency on foreign OSAT services exposes Japan to strategic vulnerabilities, prompting initiatives from both the Japanese government and the private sector to bolster domestic capabilities in assembly, test, and packaging. These efforts aim to mitigate risks associated with supply chain disruptions and enhance Japan's resilience.



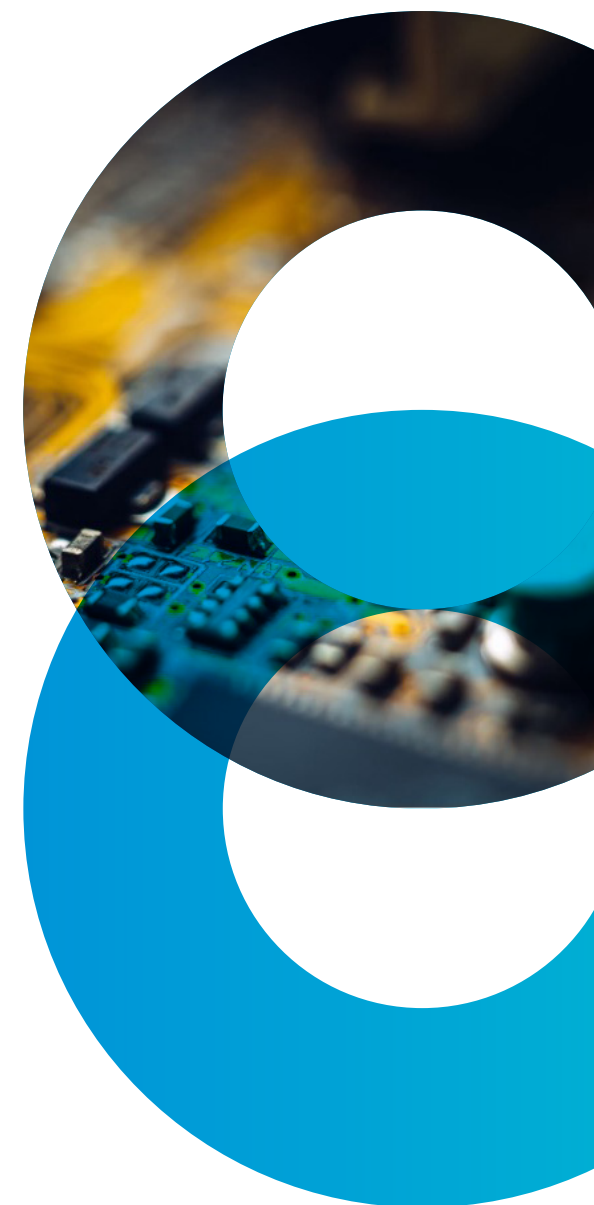
## Market trends

- The Japanese government has allocated JPY 2tn (approximately GBP 10bn) to enhance domestic production capabilities
- Japan is enhancing its role as a key player in the semiconductor supply chain, bolstered by government support, strong alliances (especially with the U.S.), and increasing incentives towards global semiconductor companies like TSMC and Samsung
- The surge in demand for advanced chips, driven by the growth in technologies such as 5G, AI, and electric vehicles, is making Japan even more of a key player in the global supply chain

Japan is concentrating on developing next-generation semiconductor technologies. The formation of Rapidus, a consortium of Japanese firms in collaboration with IBM and IMEC, aims to produce advanced 2-nm chips by 2027

## Challenges

- Talent acquisition and retention, compounded by an aging workforce and intense global competition for experts
- Lack of education and R&D capabilities. Japan needs to invest heavily in R&D to stay ahead
- Global supply chain vulnerabilities are a primary concern, such as Sino-US relations and the war in Ukraine, have highlighted the vulnerabilities in the global semiconductor supply chain
- The industry contends with the high costs of developing advanced semiconductor manufacturing facilities
- Meeting and maintaining ESG KPIs to continue attracting foreign investment
- Escalating competition. While Taiwan continues to lead, other nations such as Vietnam, Malaysia, Singapore, and Indonesia are intensifying their focus on the semiconductor industry



## Government initiatives

UK companies looking to offer their services or products in Japan can benefit from various government incentives. These incentives are part of Japan's efforts to boost its semiconductor industry and strengthen its economy against global competition and geopolitical challenges. Although foreign companies won't receive direct financial support, Japan's increased funding for its semiconductor manufacturing and related companies means there will be more opportunities for innovation and partnership projects.

The following are four main government initiatives driving the semiconductor industry in Japan:

- 1. Economic Security Fund:** GBP 3.03bn allocated for power semiconductors, semiconductor materials & equipment, electronic components, and computing resources
- 2. Advanced Semiconductor Fund:** GBP 4.03bn designated to support the mass production of advanced logic semiconductors
- 3. Post-5G Fund:** GBP 3.4bn allocated to support Rapidus, backend research and development, and design initiatives, emphasising the advancement and utilisation of cutting-edge semiconductors essential for next generation 5G technologies and beyond

- 4. Green Innovation Fund:** GBP 10.53bn aimed at achieving carbon neutrality by 2050, necessitating significant advancements in the energy and industrial sectors, alongside substantial investments in innovation managed by NEDO (New Energy and Development Organisation)

The Japanese government acknowledges its economic dependence on the automotive sector and is now heavily focused on developing its semiconductor industry as one of the world's leading ecosystems. A total of GBP 10.46bn (excluding the Green Innovation Fund) has been committed towards semiconductor production and technological advancement. Support for Rapidus in Hokkaido and TSMC's foundry in Kumamoto is also notable, with GBP 3.4bn and GBP 3.33bn allocated respectively, to aid in developing cutting-edge semiconductor technologies and the construction of foundries.

Japan is also encouraging collaborative research projects between domestic and international semiconductor players through initiatives such as the JOINT2. JOINT2 is a consortium initiated in 2021 by 12 companies, expanding to 13 in June 2023, targeting the semiconductor backend process and focuses on advancing next-generation semiconductor packaging and evaluation technologies, including 2.5D and 3D implementations.

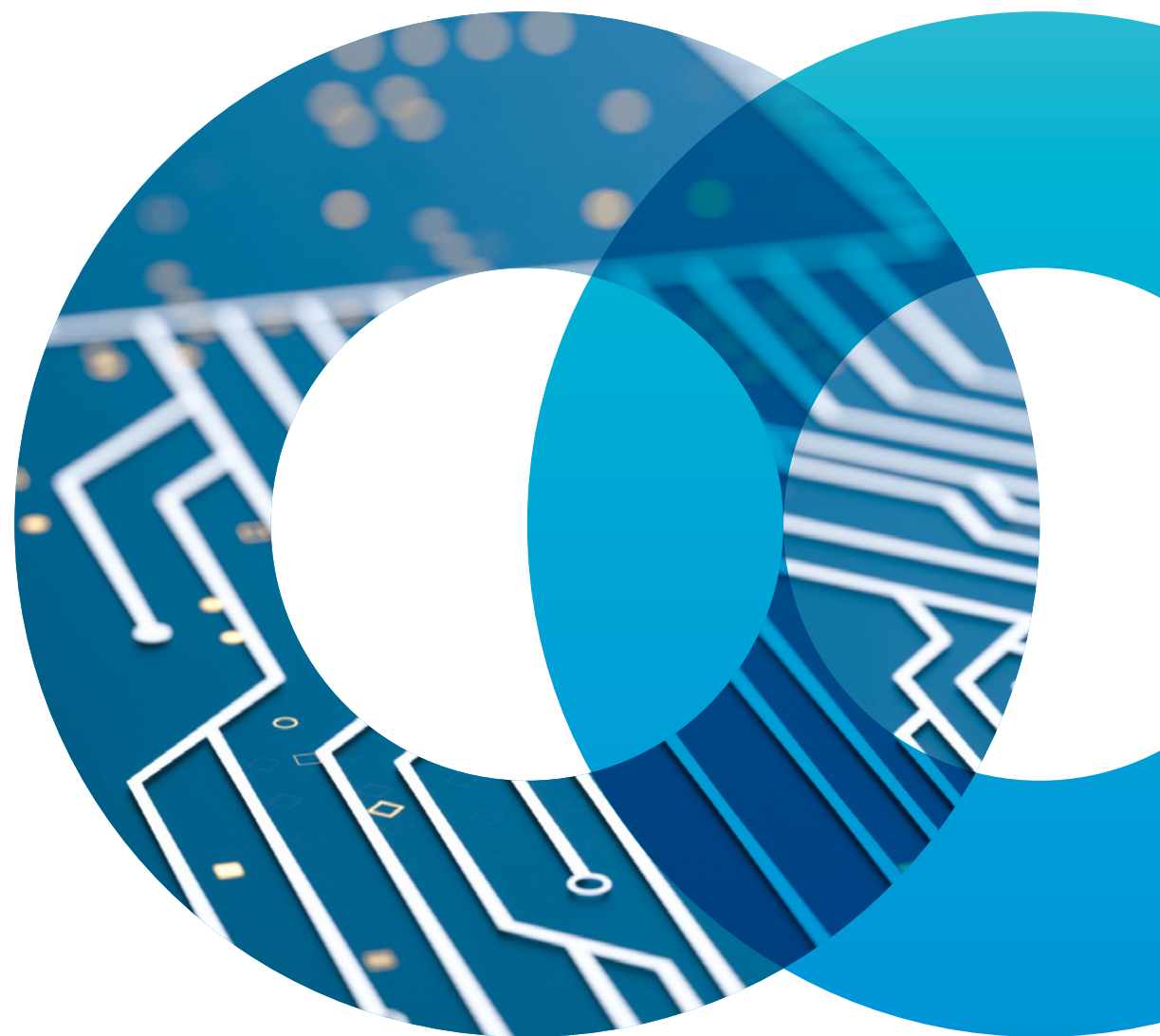
The Japanese government has launched a 10-year tax incentive for the semiconductor industry as part of a broader initiative to enhance production in strategic fields. This policy allows for up to a 20 percent reduction in corporate income tax, aiming to boost the competitiveness of Japanese semiconductor companies, stimulate investments in production and innovation, and attract R&D centres to Japan.

Japan's initiatives offer a gateway for UK companies aiming to sell or licence their services or products in the Japanese market. With financial incentives, support for innovation, and collaborative research opportunities, Japan is attempting to attract investment and lay the groundwork for sustainable growth and technological leadership in the semiconductor and digital industries.

# Opportunities for UK companies – Japan

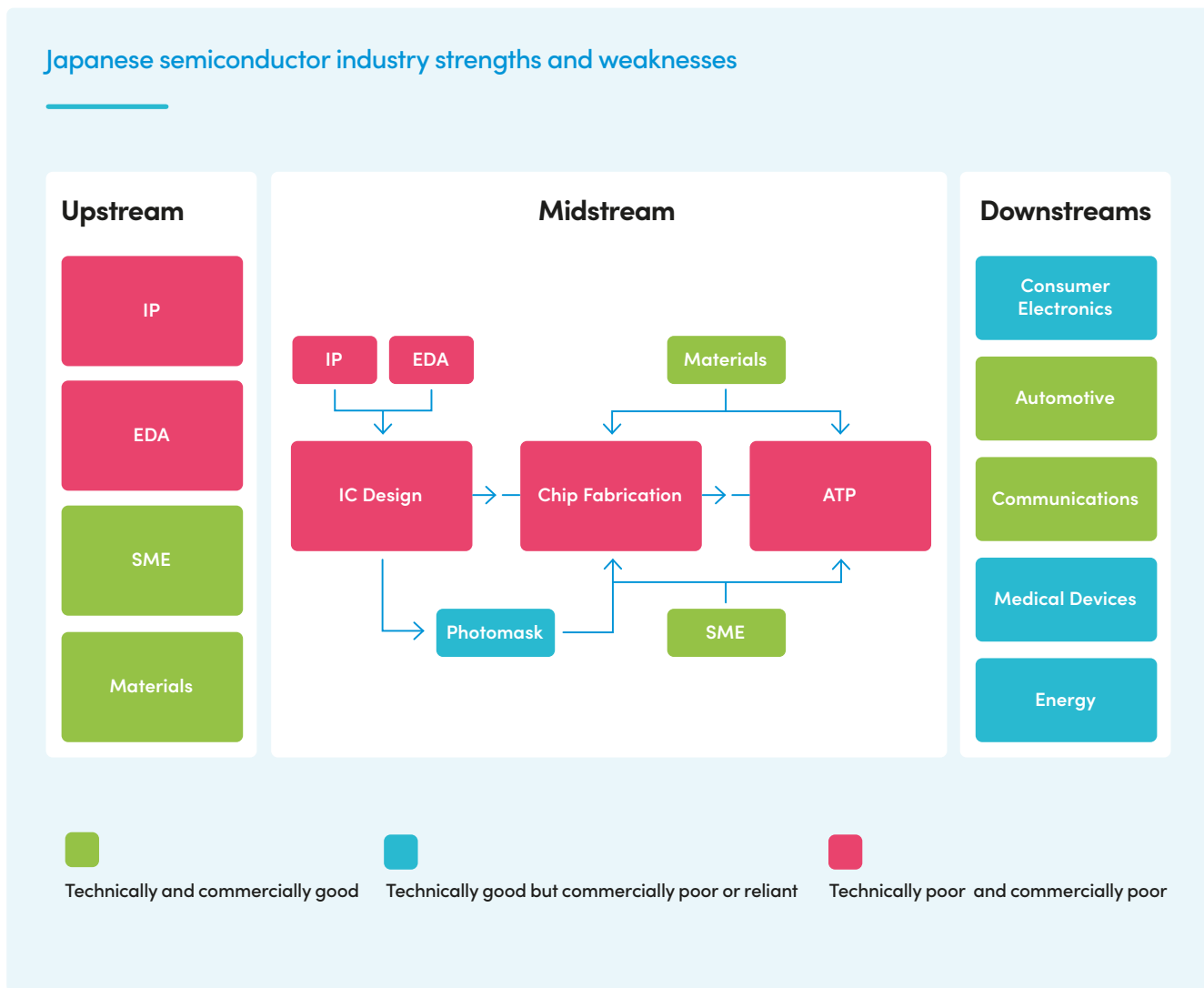
Japan is known for its strengths in SME and materials. However, the real opportunities for UK companies lie in providing technology which can further bolster areas such as ATP, chip fabrication, and IC design in the midstream sector, as well as the provision of advanced EDA tools and core IP in the upstream sector.

Japan's dominance in various industries, particularly automotive and communications, creates a high demand for semiconductors. The emergence and large demand of new technologies, such as AI, electric vehicles, and renewable energy, is driving the need for high-end chipsets and compound semiconductors. This presents a significant opportunity for UK companies to enter and thrive in the Japanese market.



For UK semiconductor companies entering the Japanese market, it is crucial to closely monitor the development of foundries within Japan and the growing incentives for the semiconductor industry promoted by the Japanese government. Any company with innovative equipment or other solutions could take advantage of investments into this industry. Of course, there are also opportunities arising from Japan's limited presence in semiconductor IP, EDA tools, and IC design which UK companies can capitalise on. Japan's strength in downstream industries means UK design companies have a source of customers for their chips, and a lack of local alternatives means IP and EDA companies can license into Japan's IDMs and fabless design companies.

Furthermore, Japan's initiative to revitalise its semiconductor industry through partnerships and the development of next-generation technologies provides an avenue for UK companies. The focus on sub-2-nm process nodes with Rapidus in Hokkaido, the development of beyond 5G mobile communication systems, and green technologies for the automobile and energy industries aligns with the expertise and innovative solutions offered by UK companies.



Source: Intralink research, TSIA, ISTI-ITRI

As shown in the table, it is essential for Japanese industries to form partnerships and collaborate with foreign technology companies to further innovate and explore cutting-edge technologies to sustain their foothold in the semiconductor industry. Especially worth noting is JSMC and Rapidus's aim to achieve 2nm chips in Hokkaido as early as 2027. Thus, leading technologies such as IP, ATP, and EDA tools are expected to be warmly embraced by the industry.

The weaknesses and opportunities in the Japanese market should be seen as opportunities for UK semiconductor companies. The UK semiconductor industry is renowned for its expertise in IC design, IP, compound, and advanced material semiconductors. UK firms should consider that the Japanese government is actively supporting investment and R&D initiatives aimed at bolstering the semiconductor value chain. This includes adopting technologies from outside Japan and developing domestic innovations. Specifically, Japan is particularly interested in partnering with companies in promising fields such as IC design, compound semiconductors, and advanced materials.

Some of these UK strengths align well with Japan's weaknesses. As the UK does not have an end-to-end semiconductor ecosystem, it benefits from partnering with and selling to other countries, such as IP sales to Japan's IDM firms. UK companies can build on this relationship and explore new areas in IP, equipment, and EDA, as well as energy and talent. Successful UK companies in Japan include Arm (IP), Oxford Instruments (equipment), Dialog (acquired by Renesas) (IC Design), and Imagination Technologies (IP).

## SWOT analysis for the Japanese semiconductor industry

### Strengths

- Strong heritage in manufacturing technology (advanced materials, equipment, and precision machinery)
- Well-established supply chain due to geographic location and trade agreements
- Well-established downstream industries
- Significant support in R&D by both the government and private sector

### Weaknesses

- Aging workforce and a shortage of young skilled professionals to replace retiring experts
- Demand and supply dependent on global markets, particularly the US, and China
- Underdeveloped fabless ecosystem with dominance from by legendary IDM's
- Dependence on downstream industries and large corporations

### Opportunities

- Forming strategic alliances and partnerships with foreign technology firms
- Regional collaboration between industry and academia in Kyushu, Hokkaido and greater Tokyo areas
- Strong pull demand from frontier technologies/industries and energy efficient technologies

### Threats

- Escalating competition from neighboring countries and ASEAN countries
- Increasing ESG KPIs to continue attracting foreign investment
- Fluctuation of the Japanese Yen
- High costs of developing advanced semiconductor manufacturing facilities

Source: Intralink Research

## Opportunities for UK companies

### IP:

Provision of new novel core IP to increase the global competitiveness of the existing strong IDM ecosystem and foundries.



### IC Design:

License to Japanese manufacturers to optimize chip designs for specific applications or to develop new chip architectures.



### EDA:

Utilizing increasing government and industry support for the development of next-gen chips for AI, Quantum, and Advanced Computing.



### Compound:

Partner with existing IDM's/foundries and suppliers to create and bolster low-cost mass production.



### Testing and Packaging:

Licensing of services to Japanese chipmakers, ensuring the quality and reliability of semiconductor products.



### Advanced Materials:

Specialized materials which can improve existing chip performance or durability.



### Energy:

Companies specializing in power semiconductors for solar inverters, energy storage systems, and smart grids can find a receptive market in Japan.



### Automotive:

Provision of services with expertise in power electronics, sensors, and chip design for automotive applications can find significant opportunities in this sector.



Source: Intralink Research

# Routes to market – Japan

The Japanese market is perceived as difficult to enter, and Japanese companies are often slow-moving. However, once developed, relationships with Japanese companies are long-lasting and robust. Japan values commitment and it is important to get it right the first time, as Japan is not usually forgiving to companies seeking to re-enter the market.

The steps to market entry are similar to any market expansion, however, there are some Japan-specific factors:

- Speed – the rule of thumb is to add 6 to 12 months to your usual sales cycle
- Extensive Q&A during technology validations – Japanese companies assess all possible risks and draw plans for response measures, including low-probability hypothetical scenarios
- Specific use cases – when being introduced a new technology, Japanese companies expect information about specific applications and the benefits they can expect when utilising the new technology, rather than figuring out how a new technology could potentially be leveraged
- Track record – Japanese companies tend to avoid being the first movers even if a solution is widely used overseas. Securing your first Japanese customer is crucial for success in the Japanese market
- Decision making process – Japan follows a consensus-based bottom-up decision-making process that involves gaining approvals from various stakeholders (‘ringi’). A top-down approach is often useful to gain initial traction, but you will likely be referred to a technical team to go through the evaluation
- Language – few people speak English, but reading ability is significantly higher than speaking. Because of this technical support in Japanese in the local time zone is often essential

## Market exploration

Before entering the Japan market, thorough market research is vital to identify opportunities. Understanding industry needs and the competitive landscape allows companies to tailor offerings, mitigate risks, and capitalise on trends. Being proactive enhances the chance of successful entry and sustained growth. Networking events and exhibitions such as SEMICON Japan are valuable mediums through which UK firms can gain initial leads and contacts.

### Semiconductor events in Japan

| Event   | Date      | Website  |
|---|-----------|--|
| <b>NEPCON JAPAN</b>   | January   | <a href="http://www.nepconjapan.jp">www.nepconjapan.jp</a>                                 |
| <b>JPCA Show</b>  | June      | <a href="http://www.jpccashow.com/show2024">www.jpccashow.com/show2024</a>                 |
| <b>Techno Frontier</b>  | July      | <a href="http://mente.jma.or.jp">mente.jma.or.jp</a>                                       |
| <b>JASIS (Japan Analytical &amp; Scientific Instruments Show)</b> | September | <a href="http://www.jasis.jp/special-project">www.jasis.jp/special-project</a>             |
| <b>Smart Energy Week</b>  | October   | <a href="http://www.wsew.jp/autumn/ja-jp.html">www.wsew.jp/autumn/ja-jp.html</a>           |
| <b>CEATEC</b>   | October   | <a href="http://www.ceatec.com/ja/application">www.ceatec.com/ja/application</a>           |
| <b>NexTech Week</b>   | November  | <a href="http://www.nextech-week.jp/hub/ja-jp.html">www.nextech-week.jp/hub/ja-jp.html</a> |
| <b>SEMICON Japan</b>  | December  | <a href="http://isestaiwan.com">isestaiwan.com</a>   |
| <b>APCS (Advanced Chiplet and Packaging Summit)</b>               | December  | <a href="http://www.computextaipei.com.tw">www.computextaipei.com.tw</a>                   |
| <b>Flex Japan</b>   | December  | <a href="http://www.semiconjapan.org/en/apcs">www.semiconjapan.org/en/apcs</a>             |

Source: Intralink Research

## Market research

A company seeking to enter the Japanese market will require a strong understanding of industry needs specific to its product and the competitive landscape. The UK-APAC Tech Growth Programme or information provided by Japanese government agency JETRO can be useful at this stage.

## Exploring opportunities

The next step is to visit Japan and validate the opportunity through direct conversations with Japanese companies. Japan has become a lot more open to online meetings since COVID-19, but a physical visit to Japan and face-to-face conversations with the stakeholders is necessary to gauge real interest and start building relationships. A Japan visit can be done as part of a mission organised by the UK Embassy (as a stand-alone event or in conjunction with a trade show), an independent self-organised visit, or a visit planned by a partner. Other options could include joining open innovation programs of Japanese companies, partnering with an accelerator, or attending a conference.

It is increasingly possible to conduct initial meetings in English, but business decision makers can rarely converse in English. It is best to have a Japanese speaker on the team or hire an interpreter for key meetings. Localising materials is helpful but not mandatory.

## Market entry strategies

A UK company can initially explore opportunities while overseas, but it is recommended to establish a local presence to effectively drive discussions with Japanese companies and show commitment to the market. Establishing a Japanese entity from the start can be risky and time consuming. It is more common to start by appointing a local partner while continuing visiting Japan to progress other discussions.

### Distributor

Distributors can provide access to a wide customer network; help manage relationships and provide technical support. It is important to invest time to identify the right partner, and then to train it.

It is important to validate that your potential partner's existing customer base includes your priority target customers, as Japanese distributors tend to focus on inside sales and are reluctant to use a cold approach. Ideally, your potential partner should also have experience selling similar products (hardware vs software), as Japanese companies struggle to apply their sales skills to a new type of product.

If your product is hardware, trading companies can be a good potential partner as they possess language capabilities, a wide customer network, and experience with import procedures. However, as they usually have low technical capabilities, this may not be the best option for everyone.

Trading companies can provide first-level support but are unlikely to drive pilots or commercial deployments.

System integrators are an important type of partner to consider. Japanese corporates rarely have in-house IT capabilities, turning to system integrators for consultations and deployment of new solutions. System integrators are a great partner if your product can augment their solution/service offering, but they are not the best primary distribution/reseller partner, since they are driven by customer needs and may work with multiple vendors. Nevertheless, having a large system integration as a partner is extremely beneficial for customer discussions and raising your profile in Japan.

Augmenting your channel strategy by engaging a sales agent or hiring an initial direct employee can be transformative in increasing the effectiveness of distribution partners.

### Joint venture

A joint venture can be an efficient market entry strategy, but it may take a long time to select the right partner, determine the structure of the joint venture and negotiate the terms.

## Licencing

Direct licencing and franchising can be the most straightforward market entry strategy as it can be accomplished without a local partner or establishing a Japanese entity. However, a UK company will often require Japanese-speaking staff (or a bilingual person in Japan) and in-country technical resource to facilitate the conversations with potential partners.

## Agent

Appointing a local sales agent – an individual or an organisation – to carry out business development activities and negotiations on your behalf will provide an advantage of having in-country support and a way to effectively manage relationships and business discussions with Japanese companies. This strategy allows you to augment or replace them by hiring local staff. This strategy is particularly suitable for companies with complex solutions that require extensive communication with the overseas teams.

## Investor

Seeking investment from a Japanese VC or corporate and leveraging its connections to secure initial deals is another strategy a company seeking to enter the Japanese market could explore.

| VC Firm   | Areas of interest   | Website  |
|---|---|--|
| <b>TEL Venture Capital (Tokyo Electron Limited)</b> | Semiconductor technology, digital transformation, advanced materials, AI, and data science. | <a href="http://www.tel.co.jp/rd/telvc">www.tel.co.jp/rd/telvc</a>                                       |
| <b>Hitachi Ventures</b>                             | Industry 4.0, energy, smart cities, healthcare, robotics, AI, and mobility.                 | <a href="http://www.hitachi.co.jp/corporateventuring">www.hitachi.co.jp/corporateventuring</a>           |
| <b>Sony Innovation Fund</b>                         | AI, robotics, mobility, fintech, healthcare, entertainment technologies, and gaming.        | <a href="http://www.sonyinnovationfund.com">www.sonyinnovationfund.com</a>                               |
| <b>Panasonic Kurashi Visionary Fund</b>             | Autonomous driving, IoT, AI, robotics, and energy solutions                                 | <a href="http://www.panasonic.com/global/about/cvc.html">www.panasonic.com/global/about/cvc.html</a>     |
| <b>DENSO Ventures</b>                               | Automotive technology, semiconductors, AI, and energy solutions                             | <a href="http://densocvc.com">densocvc.com</a>   |
| <b>Woven Capital</b>                                | Autonomous driving, AI, robotics, and smart cities  | <a href="http://woven.vc">woven.vc</a>   |
| <b>SoftBank Vision Fund</b>                         | AI, robotics, IoT, mobility, and other frontier technologies.                               | <a href="http://visionfund.com">visionfund.com</a>   |
| <b>KDDI Innovation Fund</b>                         | Telecommunications, AI, IoT, 5G, media, and fintech.  | <a href="http://www.kddi.com/open-innovation-program/koif">www.kddi.com/open-innovation-program/koif</a> |
| <b>NTT DOCOMO Ventures</b>                          | 5G, IoT, fintech, AI, smart cities, healthcare, mobility, and robotics.                     | <a href="http://www.nttdocomo-v.com/en">www.nttdocomo-v.com/en</a>                                       |
| <b>Mitsubishi UFJ Capital</b>                       | Frontier technology, healthcare, and fintech.   | <a href="http://www.mucap.co.jp/english">www.mucap.co.jp/english</a>                                     |
| <b>SMBC Venture Capital</b>                         | Mobility, fintech, AI, and green technologies   | <a href="http://www.smbc-vc.co.jp">www.smbc-vc.co.jp</a>   |

## Setting up local entity

Japanese companies value a local presence, so it is recommended to establish an entity in Japan once initial business and relationships have been established. The main types of entity a UK company can choose from are a representative office and a subsidiary.

### Representative office

Representative office is the most basic form of in-country representation and a good option for the initial stage of market entry. It can engage in market research, information gathering, purchasing, and advertising, but cannot perform sales activities. No formal registration is required but it will need support from the main office or the local representative to open bank accounts or rent property.

**UK companies looking to enter the Japanese market can start with a representative office for market research and advertising, which requires no formal registration but has limited activities. For hiring local staff and deeper market integration, setting up a subsidiary such as a joint-stock corporation or limited liability company is recommended.**

### Subsidiary

Japanese employees prefer to be hired by a Japanese entity; therefore, it is recommended to set one up when hiring local staff. A foreign company will typically choose between a joint-stock corporation (Kabushiki-Kaisha (K.K.)) or a limited liability company (Godo-Kaisha (G.K.)). There are service providers that assist with the registration – the process usually takes six to eight weeks and costs GBP 7,000 - 8,000.



# Market overview - Korea

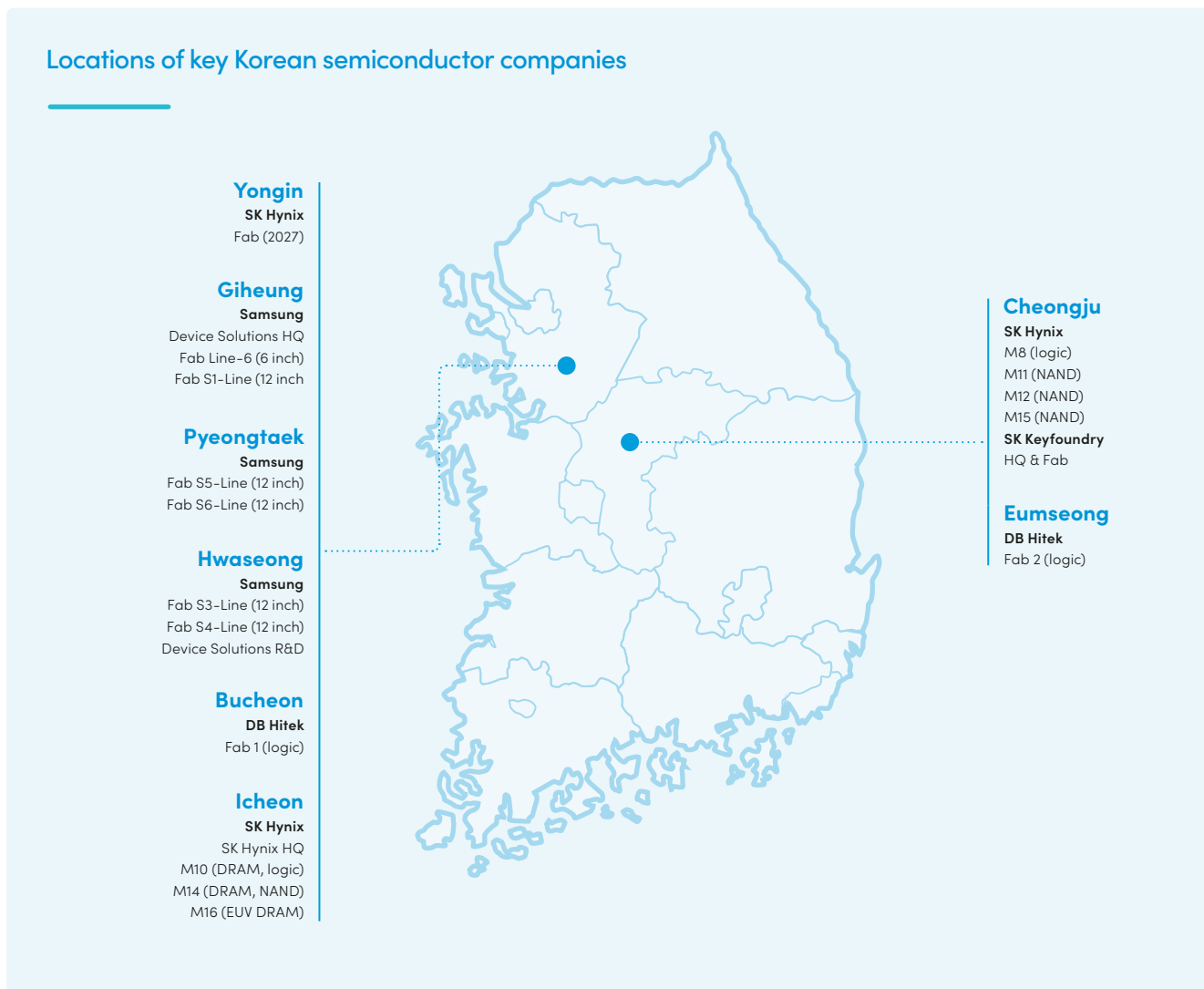
## Market size

Korean companies held a 13.2 percent share of global semiconductor chip sales in 2023, ranking second globally behind the USA. This figure does not include foundries such as TSMC or semiconductor equipment companies such as ASML. For the global market share including listed companies, in terms of sales, Korea accounted for 9.7 percent in 2023. As its leading export good, the share of Korea's semiconductor exports made up 20.7 percent, amounting to GBP 104.6bn in 2023. Meanwhile, semiconductor imports amounted to GBP 84.6bn, creating a trade surplus of GBP 19.9bn. Korea's internal semiconductor market revenue is expected to reach around GBP 15bn by 2024. It is estimated that by 2027, the market volume will have grown to GBP 16.8bn. In the following sections, we will analyse Korea's strengths, its needs, and identify business opportunities for UK companies.



## Market segments

Korea leads the memory IC market globally, but also has a vibrant ecosystem across its local semiconductor value chain that includes foundries, fabless IC design, materials, components, equipment makers, and OSATs. Korea's semiconductor manufacturing facilities are all located in two provinces, Gyeonggi Province and North Chungcheong Province (Chungbuk).



Source: Intralink research

## Key players

### Korean semiconductor industry ecosystem



Source: Intralink research

## Integrated Device Manufacturer (IDM)

Korea is the home of two of the world's leading IDMs and dedicated memory semiconductor manufacturers, Samsung Electronics and SK hynix. These two companies design, manufacture, and sell IC products. Together they held 51 percent of the global NAND flash market and 73 percent of the global DRAM market in 2023. Overall, Korea accounts for 17.3 percent of the global foundry market and 60.5 percent of the global memory chip market. More specifically, memory chips contributed for 57.46 percent, or GBP 57.5bn, of Korea's whole semiconductor export value in 2022, with 2023 likely to be a similar percentage.

Memory semiconductors are typically divided into two categories, DRAM and NAND flash products. In the third quarter of 2023, Samsung had a 38.9 percent global market share in DRAM, while SK hynix had a 34.3 percent market share. Samsung ranked first among manufacturers in the third quarter of 2023 for NAND flash goods, generating revenues from product sales of GBP 2.3bn worldwide, a decline of GBP 1.1bn from the same quarter in 2022. SK hynix ranked second, with NAND flash product sales bringing in GBP 1.5bn.

Samsung Electronics and SK hynix have recently focused on developing advanced packaging for high-performance DRAM, such as High Bandwidth Memory (HBM) and DDR5, to meet the growing market for generative AI and HPC. As HBM is embedded within GPUs, which are key to the growing AI industry, the product is expected to see increased demand from 2024 onwards. To maintain its advantage over Samsung with regard to HBM, SK hynix recently partnered with TSMC to create next generation HBM. Samsung announced its HBM3e memory in 2024 and has been testing samples with Nvidia.

For NAND flash memory, both companies are competing on stacking technologies and the mass production of 300+ layer NAND chips. In August 2023, SK hynix made public that it had developed 321-layer NAND memory for the first time and plans for mass production in 2025. However, in October the same year, Samsung Electronics announced that it would advance the production timeline of 300-layer NAND memory to early 2024, making it the first company to mass produce such memory. With regard to stacking methodology, SK hynix has adopted a triple-stack method by creating three separate chips and then assembling them vertically, whereas Samsung Electronics applies a double-stack method that only involves two stacks with a higher number of layers internally.



## IDM's logic IC businesses

Acknowledging the larger market potential of logic semiconductors, Samsung Electronics', and SK hynix's IDM operations are also involved in logic IC design and production as the next growth engine alongside their primary memory focus. In 2019, Samsung Electronics announced its 'Logic Semiconductor Vision 2030', outlining its ambition to lead the global logic semiconductor sector in design and foundry services by investing a total of GBP 77.7bn by 2030. In 2021, this investment commitment was further boosted to GBP 100bn.

Samsung Electronics' System LSI Business Division designs logic IC products. Products include mobile application processors (AP) that go into Samsung's smartphones, tablets, and smart watches, automotive processors, CMOS image sensors embedded in cameras, and display driver integrated circuits (DDIC) installed into operating display panels. A large part of the division's revenue comes from Samsung itself. Clients include Samsung Display, Samsung Electronics' MX Division for consumer electronics products, and Samsung Electronics' VD Division for display products. However, the division also supplies other companies, for example, Xiaomi for image sensors (CMOS, CIS) and Volkswagen, Audi, and Hyundai Motor Company for automotive processors (infotainment processors).

The division uses Samsung's Foundry Business Division for production, but also outsources to UMC and GlobalFoundries. In 2023, Samsung Electronics announced an expanded strategic partnership with AMD in next-generation high-performance, low-power graphic design assets. This aims to enhance graphic module functionalities for Samsung's Exynos mobile AP. Most Samsung's logic designs use IP from Arm.

Keyfoundry's areas of expertise used to include Bipolar-CMOS-DMOS (BCD) and high voltage products, while SK hynix System IC specialises in CMOS Image Sensors (CIS), display driver ICs (DDI), and Power Management Integrated Circuits (PMIC). Both SK subsidiaries recently focused on fabricating DDIC, and 8-inch wafer based automotive and industrial power semiconductors such as Micro Controller Units (MCUs), Engine Control Units (ECUs), and PMICs. SK keyfoundry recorded sales of GBP 300m, and SK hynix System IC's sales was GBP 18m in 2023.



## Foundries

Samsung is the second largest foundry globally behind TSMC. Both TSMC and Samsung Electronics mass produce 3nm process nodes using the GAA (Gate-All-Around) process. However, there is a significant market share gap between TSMC and Samsung on all other processes. Samsung Electronics held an 11.7 percent market share in the worldwide semiconductor foundry market in the second quarter of 2023, while TSMC had a 56.4 percent market share in terms of revenue. SK keyfoundry and SK hynix System IC come next to Samsung Foundry, making revenues of approximately GBP 300m and GBP 18m, respectively. DB Hitek is Korea's only pure-play foundry and accounts for around 1 percent of global market share, ranking approximately tenth.

Samsung started offering foundry services in 2005, and in 2017 the Foundry Business Division was spun out, offering foundry services to fabless companies.

The division's revenue is primarily from Qualcomm and Samsung's own System LSI Business Division for 40 percent, and Nvidia for 10 percent. Other large clients like Intel, Tesla, Sony, NXP, and STMicro have partially outsourced to Samsung Foundry, and many smaller Korean fabless firms like ADTechnology have recently started using Samsung for its 3nm process. The foundry business revenue is estimated to be worth around GBP 11bn in 2023 and now has over 150 customers, compared to TSMC's more than 1000.

On the other hand, SK hynix operates two subsidiaries dedicated to logic IC, SK keyfoundry, and SK hynix System IC, while the mother company maintains its memory business. SK keyfoundry concentrates on the Korean, European, and US markets, and SK hynix system IC operates its lines solely in China, based on its strategy to focus exclusively on Chinese fabless companies. SK Hynix plans to sell half its stake in its China operation.

DB Hitek was the second-largest foundry in Korea prior to SK hynix acquiring Keyfoundry in 2022, which used to be another pureplay foundry in Korea. DB Hitek's revenue was GBP 669m in 2023 and was the 10th largest logic IC foundry globally in 2023. Its main business comes from analog, mixed-signal, high voltage products, and MEMS. Recently, it began developing 8-inch wafer-based next-generation power semiconductors such as GaN and SiC by partnering with A-Pro Semicon, a GaN epitaxial wafer manufacturer that used to be a GaN IC design company recently equipped with MOCVD equipment.

Korea's IDMs and foundries experienced significant revenue reduction in 2023 but are expected to return to growth from 2024 onwards.

### Korea's IDM and foundry companies, 2023

| 2023 Ranking | 2022 Ranking | Company                               | Segment          | 2022 Revenue (~GBP bn) | 2023 Revenue (~GBP bn) | Growth (%) |
|--------------|--------------|---------------------------------------|------------------|------------------------|------------------------|------------|
| 1            | 1            | Samsung Electronics                   | IDM-Foundry      | 50.1                   | 31.3                   | -37.5%     |
| -            | -            | Samsung Electronics' Foundry Division | IDM-Foundry      | 16.7                   | 10.7                   | -35.93%    |
| 2            | 2            | SK hynix                              | IDM-Foundry      | 26.3                   | 17.9                   | -32.1%     |
| -            | -            | SK keyfoundry                         | IDM-Foundry      | 0.486                  | 0.3                    | -38.04%    |
| -            | -            | SK hynix System IC                    | IDM-Foundry      | 0.1                    | 0.018                  | -82%       |
| 3            | 3            | DB HiTek                              | Pureplay Foundry | 1.0                    | 0.6                    | -30.9%     |

Source: Intralink research

## IC design (fabless)

Korea accounted for around 3.3 percent of market share with a revenue of GBP 11.8bn and ranked 6th in the global logic IC design market in 2022, behind the US, Europe, Taiwan, Japan, and China, according to the Korea Institute for Industrial Economics and Trade (KIET). Korean companies' logic IC revenue stream has mostly relied upon the Korean conglomerates' stable sales channels that serve popular demands for chips that go into final goods such as smartphones and TVs. Most Korean fabless companies are primarily small- and medium- sized businesses that have significant gaps in their technological competitiveness in comparison to major global fabless firms.

Leading local fabless business LX Semicon, which was the only Korean fabless ranked in the top 50 worldwide as of 2022, reported a revenue of over GBP 1.2bn in 2022, representing an increase of almost 10.5 percent from the year before. LX Semicon's two primary design domains are PMIC (specifically mobile AP power management semiconductors) and DDIs, which include display panel driver ICs for LCD and OLED. Other Korean fabless firms are much smaller than LX Semicon.

There are now about 150 fabless companies in Korea, down from roughly 300 in the 1990s. They have suffered from a vicious cycle of lack of talent, lack of initial R&D investment, and lack of commercial strategies and channels to connect supply and demand. Korea has managed to maintain competitiveness in DDIs and CIS.

Recently though there has been a wave of new Korean fabless startups designing memory and AI chips. For example, Jeju Semiconductor designs multi-chip package (MCP) memory ICs and The-AiO designs NAND flash controllers. Rebellion, Furiosa AI, and SAPEON are new AI focused firms. Rebellion is valued at GBP 519m and outperformed equivalent Nvidia and Qualcomm chips on the MLPerf benchmark. Rebellion and SAPEON develop chips that target data centres, and Furiosa AI develops chips for computer vision applications. These three companies closely collaborate with Samsung Electronics and SK hynix, receiving support from major online platform companies like Naver and Kakao, as well as telecommunications giants SK Telecom and KT.

### Top nine fabless companies in Korea, 2023

| 2023 Ranking | 2022 Ranking | Company             | 2022 Revenue (~GBP bn) | 2023 Revenue (~GBP bn) | Growth (%) |
|--------------|--------------|---------------------|------------------------|------------------------|------------|
| 1            | 1            | LX Semicon          | 1.23                   | 1.11                   | -10.3%     |
| 2            | 2            | Silicon Mitus       | 0.18                   | 0.17                   | -7.67%     |
| 3            | 3            | Above Semiconductor | 0.14                   | 0.13                   | -4.2%      |
| 4            | 5            | Telechips           | 0.08                   | 0.11                   | 27.06%     |
| 5            | 4            | Jeju Semiconductor  | 0.09                   | 0.08                   | -7.8%      |
| 6            | 7            | Dongwoon Anatech    | 0.02                   | 0.06                   | 122.4%     |
| 7            | 8            | Gaon Chips          | 0.02                   | 0.037                  | 46.8%      |
| 8            | 6            | AD Technology       | 0.08                   | 0.035                  | -55.6%     |
| 9            | 9            | DeepX               | 0.45 (mn)              | 0.03 (mn)              | - 93.7%    |

Source: Intralink research

## Materials, components, and equipment

Together with Taiwan and China, Korea is one of the world's leading investors in semiconductor facilities. This results in a sizable market for semiconductor materials and equipment. As of 2022, Korea's share of the global market for semiconductor equipment and materials is 24.4 percent and 18.3 percent, respectively. According to a recent SEMI survey, Korean businesses bought GBP 16bn worth of semiconductor equipment in 2023 and GBP 17.4bn in 2022, accounting for 18.7 percent of global sales, and it also relies heavily on Japan and the USA for the supply of semiconductor materials.

In particular, exposure equipment is 100 percent dependent on Dutch imports, and ion implanters are 70.8 percent and 25.5 percent dependent on US and Japanese imports, respectively. For semiconductor etching equipment 53.7 percent was imported from the USA and 35.5 percent from Japan, and 61 percent of deposition equipment was imported from Singapore.

Korea's semiconductor ecosystem revolves around a handful of large conglomerates, which numerous domestic small- and-medium-sized businesses supplying materials, components, and equipment have established themselves by coexisting around. Most Korean equipment companies are dependent on Samsung Electronics and SK hynix for their sales.

Foreign market leaders in materials, components, and equipment have localised their R&D centres, commercial operations, and production operations to meet the high demands coming from Samsung Electronics and SK hynix. For instance, as there are no Korean photolithography companies, so Samsung and ASML agreed to invest approximately GBP 577m together to build an EUV-based next-generation semiconductor manufacturing technology research facility in Korea. SK hynix and ASML agreed to have a joint development of hydrogen gas recycling technology for EUV. In the case of photoresist, Dongjin Semichem produces photoresist and has been developing EUV photoresist with IMEC in Belgium.

### Top ten materials, components and equipment companies in Korea, 2023

| 2023 Ranking | 2022 Ranking | Company          | 2022 Revenue (~GBP bn) | 2023 Revenue (~GBP bn) | Growth (%) |
|--------------|--------------|------------------|------------------------|------------------------|------------|
| 1            | 1            | SEMES            | 1.69                   | 1.46                   | -13.17%    |
| 2            | 2            | SK siltron       | 1.37                   | 1.18                   | -13.98%    |
| 3            | 4            | Dongjin Semichem | 0.61                   | 0.56                   | -7.9%      |
| 4            | 5            | Solbrain         | 0.63                   | 0.49                   | -22.6%     |
| 5            | 6            | Wonik IPS        | 0.59                   | 0.40                   | -31.8%     |
| 6            | 7            | SK Specialty     | 0.49                   | 0.39                   | -19.07%    |
| 7            | 3            | SFA Semicon      | 0.40                   | 0.25                   | -37.44%    |
| 8            | 8            | Wonik Materials  | 0.34                   | 0.22                   | -32.06%    |
| 9            | 10           | TES              | 0.02                   | 0.08                   | 143.7%     |
| 10           | 9            | PSK              | 0.04                   | 0.05                   | 30.1%      |

Source: Intralink research

SEMES is a subsidiary of Samsung Electronics, specialising in cleaning, coating, and etching equipment. It is ranked 6th among global front-end semiconductor equipment companies and is known to offer competitive etching process equipment. It also produces semiconductor post-processing equipment.

SK siltron is Korea's only silicon wafer manufacturing company. Its primary clients are SK hynix and Samsung Electronics, and exports account for about 50 percent. It is speeding up its next-generation wafer business after acquiring DuPont's silicon carbide wafer division in the United States in 2021.

### Korean semiconductor materials, components and equipment ecosystem

| Category               | Equipment                              | Material  | Parts                              |
|------------------------|--|---|------------------------------------|
| Lithography            | SEMES, DONGJIN, PSIC                   | ne:es, ENF, PKL, SK siltron                     | S&S TECH, FST                      |
| Etching                | SEMES, ZEUS, GigaLane, Adaptive Plasma | soubrain, ENF, WONIK MATERIALS                  | MiCo, MCP, Totvacuum, SK materials |
| Deposition             | WONIK IPS, TES, ZUCONTEC, AP Systems   | SK materials, soubrain, WONIK MATERIALS, EDSION | MICARD, MiCo, WONIK QnC, UP POWER  |
| Diffusion              | AP Systems, RFPT                       | WONIK QnC, UP POWER                             | SKC solmics, KKG                   |
| Metallization          | TOP TECHNOLOGY, AP Systems, JUSUNG     | soubrain, GO Element                            | MiCo, MCP                          |
| Polishing & Cleaning   | ZEUS, PSIC, KCTECH, TES                | SK materials, OCI, soubrain, ENF, MUJIN         | SYNOPEX, MCP, SET                  |
| Metrology & Inspection | AURUS, NEXTIN, SFA, E-SOL              | Park SYSTEMS                                    | XAVIS                              |
| Packaging & Testing    | UniTest, EXICON, 한미반도체                 | SEMES, NEON, EP EOTECHNICS, DONGJIN             | MiCo, LEENO, ISC                   |

Source: Invest Korea

## Other

Korea relies heavily on conglomerates or foreign partners when it comes to compound semiconductors, semiconductor IP, and EDA tools.

## Compound

Korea has heavily relied upon imports of compound power semiconductors due to lack of technological capabilities and patents being dominated by European, American, Chinese, and Japanese players. Korean firms only account for 1 to 2 percent of global compound semiconductor sales. However, there is an initiative from Korean government agencies to provide incentives and funding activities for R&D, this is discussed in detail in the Government Initiative section.

Korea's position as one of the major players in the global automotive and battery manufacturing industry drives the development of power management ICs for use in electric vehicles. SK siltron, a silicon carbide (SiC) bare and epitaxial wafer supplier, acquired Dupont's SiC Wafer division in 2020, and established a subsidiary called SK siltron CSS in the US in 2022, which produces 6-inch SiC wafers. SK Group pursues inorganic growth by buying 95.8 percent share of Yes Power Technix (rebranded itself as SK powertech after acquisition), the first Korean SiC power semiconductor IDM, and is reviewing establishing a joint venture with RFHIC, a Korean manufacturer of gallium nitride (GaN) on SiC devices, and gallium arsenide (GaAs) MMICs.

Foundries such as Samsung Electronics, DB Hitek, and SK keyfoundry have expanded into producing compound semiconductors. Samsung announced that GaN power semiconductor foundry services will be launched by 2025, aiming for consumer electronics, data centres, and automotive applications. DB Hitek and SK keyfoundry have developed 8-inch GaN foundry processes. LX Semicon, the largest Korean fabless company, moved into the automotive power semiconductor sector by acquiring LG Innotek's SiC wafer production patents and equipment in 2021. Wavice is Korea's only GaN IDM that vertically integrates GaN RF semiconductor, package, and module technologies. It designs and develops compound semiconductors and modules that are applied to radio frequency (RF) used in aerospace and defence systems, 5G communication, and frequencies for ISM (Industries, Medical, and Science). There are also small equipment companies such as Supreme Thermal Instrument (STI) which provides equipment for manufacturing high purity SiC powder.

## Outsourced Semiconductor Assembly and Test (OSAT)

Korean OSAT vendors account for 6 percent of the global ATP industry's revenue. Several Korean OSAT vendors are in the global top 25. These are Hana Micron, SFA Semicon, and Nepes. These major Korean players and the Korean government alike have invested in diversifying and growing the back-end ecosystem in recent years.

Hana Micron and SFA Semicon are the largest OSATs in Korea. In 2023, Hana Micron reported GBP 603m in revenue, going beyond the KRW 1 trillion (GBP 590m) threshold for the first time, while SFA Semicon reported GBP 258m. They mainly provide memory IC packaging services. Hana Micron offers total turnkey solutions covering bumping, packaging (wire bonding, flip chip, wafer level packaging), and testing. Samsung Electronics, SK hynix, and other Korean and overseas fabless companies are its main customers, it has also diversified its business into the logic IC space as well. SFA Semicon offers a batch production system of Large-Scale Integration (LSI) and memory products from bump to testing to mainly Samsung and SK.

In addition to Samsung and SK hynix investments in back-end expansion, recently, the Doosan Group, has reviewed the acquisition of SFA Semicon to expand its own backend business. In 2021, it acquired Tesna, a leading Korean testing company that previously supplied System on Chip (SoC), CIS, and AP to Samsung, it was rebranded as Doosan Tesna. In February 2024, it was reported that Doosan Tesna had completed the acquisition process of EngiOn, an OSAT offering a wide range of products, including CIS, DDI, and SiC power semiconductors, aiming to expand its value chain.

## Semiconductor IP

Korea relies upon well-known foreign IP suppliers, such as Arm and Synopsys, and lags behind global leaders. Compared to Arm, one of the global market leaders, Chips and Media, the largest Korean IP firm developing multimedia video signal processing IP, is significantly smaller. Chips and Media's 2023 revenue was only GBP 16.2m and it employed 85 people, whereas Arm made GBP 2.3bn and employed 5,963 people. Approximately 80 percent of IP used by Korean fabless companies is imported. IP imports are projected to reach between GBP 118m to GBP 177m annually.

However, due to the latest growth of AI technologies and the miniaturisation of semiconductor processes, a couple of Korean IP unicorns focusing on AI technologies have stood out and listed on KOSDAQ. Openedges Technology provides IP portfolios including on-device AI and next-generation memory interfaces such as Compute Express Link (CXL), making GBP 11m in revenue in 2023. Qualitas Semiconductor offers PHY IP technologies and made GBP 6m in revenue in 2022. Both IP firms are included in Samsung's foundry ecosystem platform, SAFE IP.

## EDA tools

Korea mostly uses EDA tools from, Synopsys, Cadence, and Siemens EDA.

However, there are other suppliers, Samsung Electronics' Foundry Business Division, for example, has reportedly partnered with 23 foreign EDA companies, of which 12 are American, 8 are Chinese, and 3 are European firms. There are also some small local companies, such as Polliwog, Baum, and Alsemy. Baum offers EDA software that allows efficient analysis of power consumption over the semiconductor design process to overseas and domestic fabless design houses, including LX Semicon and Korean fabless startups, Fadu and Furiosa AI.

## Market trends

- Next-generation memory semiconductor development, such as High Bandwidth Memory (HBM)
- Development of 2nm process in foundries
- Investment in compound semiconductor development aiming at meeting rising demands in automotive, data centre, and power electronics applications
- Collaborative R&D between startups and conglomerates for AI chips such as GPU and NPU
- Significant interest in semiconductors for quantum computing applications according to the first national strategy for quantum technologies
- Applications in communications, such as advancing from 5G to 6G for future mobility (e.g., Drones)

## Challenges

Korea's semiconductor industry faces several challenges:

- Relatively weak IC design compared to its global dominance in memory chip design and fabrication
- Fabless companies face challenges in establishing commercial pipelines, seizing opportunities for new product development, advancing technological capabilities, attracting talent, and securing investment
- Heavy reliance on imported materials, equipment, and foreign semiconductor IP
- Limited access to materials, components, and equipment's feasibility testbed platforms for mass production
- Geopolitical sensitivities of the interplay between the US and China. Complicated landscape due to the US's reshoring strategy while China is a significant customer for Korean firms
- Lack of semiconductor R&D talent

## Government initiatives

### Semiconductor Mega Cluster Vision

In January 2024 the Korean government announced the creation of high-tech industry clusters for five key industries (semiconductors, secondary batteries, bio, future mobility, and hydrogen). The Semiconductor Mega Cluster is one of its plans. Relative ministries will support the establishment of the Semiconductor Mega Cluster from 2024 to 2027. Tax incentives include a deduction for facility investments and R&D expenses for enabling semiconductor technologies, ending by December 2024. Crucially, both domestic and foreign-invested companies can enjoy these incentives.

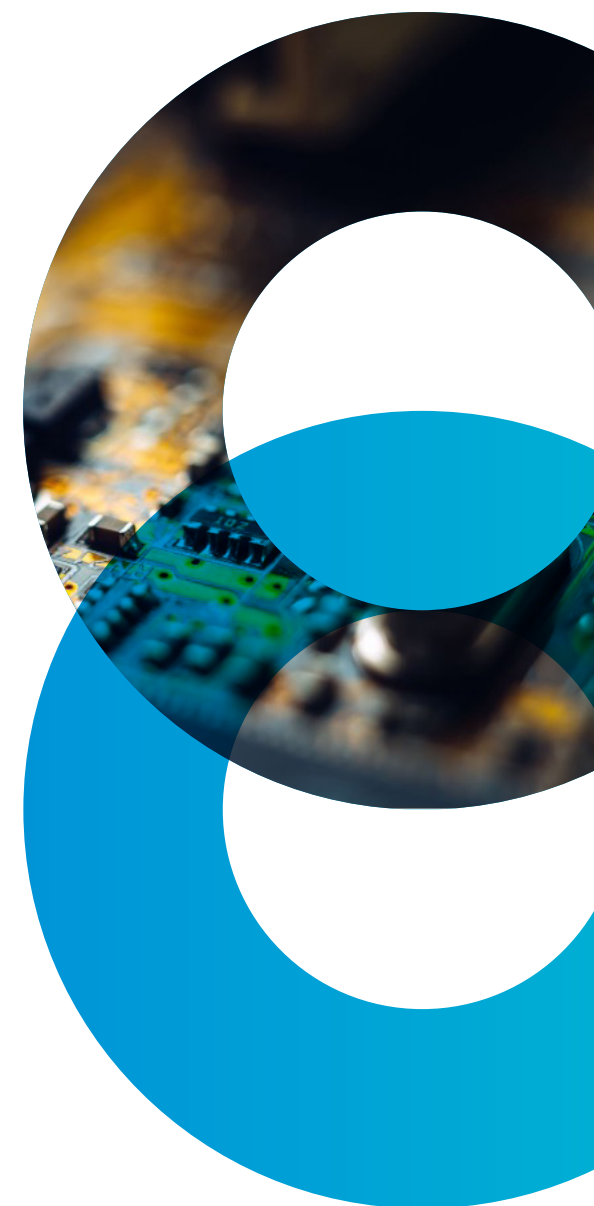
The semiconductor mega cluster will accommodate companies across six segments, fabless, memory manufacturing and foundries, materials, components, equipment, and advanced R&D. In terms of memory production, both in area and production volume, it will become the largest fabrication base in the world, taking up an area of 21.02 million m<sup>2</sup>, and is expected to produce an unbelievable 7.7 million wafers per month by 2030. The government plans to foster and encourage cumulative private sector players' investments up to GBP 359bn by 2047 for establishing 16 more new fabrication lines.

The vision's milestones include initiatives designed to attract foreign companies, particularly those aligned with Korea's technology requirements.

These strategies are geared towards welcoming foreign firms to bolster Korea's semiconductor ecosystem, focusing on areas such as fabless technology, materials, components, and equipment.

Additionally, efforts are directed at stabilising the global semiconductor supply chain through the establishment of support networks with key diplomatic partners: the US, Japan, the UK, and the EU (especially the Netherlands). The details of the status of semiconductor collaboration agreements are as follows:

- The UK and the EU: design and technologies cooperation
- Netherlands: stable supply of advanced equipment
- The US: technologies and supply chain cooperation
- Japan: restored as a whitelisted export country

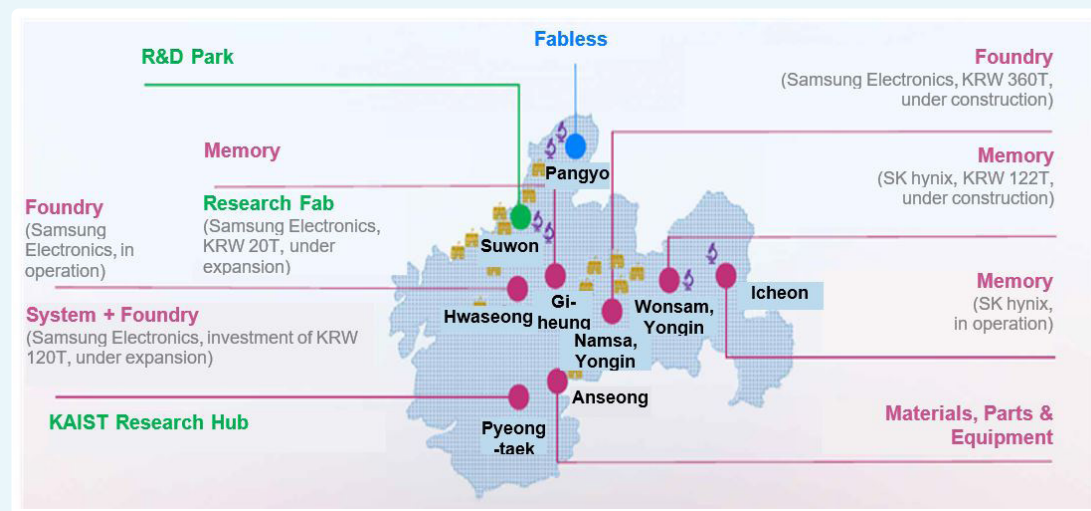


## Materials, components, and equipment

In pursuit of the goals of establishing a resilient semiconductor ecosystem within the overarching Mega Cluster Vision, the Ministry of Trade, Industry, and Energy (MOTIE) and the Ministry of Science and ICT (MSIT) aim to cultivate global competitiveness in materials, components, and equipment. Their primary focus is on mitigating risks associated with the global semiconductor supply chain by fostering strong ties with key global players. To accomplish this, they have the following strategies:

- Establish R&D systems and testing environments to expedite the transition of materials, components, and equipment from development stages to commercialisation and mass production
- Attract the top 10 global equipment companies specialising in inspection, cleaning, and etching to establish R&D centres by expanding financial support for foreign investment from GBP 29.4m in 2023 to GBP 117.6m in 2024
- Improve supply chain independence by up to 50 percent by 2030, currently it is 30 percent
- Nurture 10 Korean companies generating revenue over GBP 588m, with the current count standing at four

### Korean Semiconductor Mega Cluster Vision



Source: MOTIE, MSIT, Kim & Chang

## Fabless scale-up projects

MOTIE and the MSIT aim to boost Korea's global fabless market share to 10 percent by 2030 by leveraging Korea's strengths in foundries to reinforce a robust semiconductor value chain.

Additionally, they seek to nurture 10 fabless companies capable of ranking among the top 50 globally in terms of revenue. To achieve these aims, they have outlined the following strategies:

- Strengthen the commercial pipeline for fabless companies
  - Establish an open technology exchange platform and networking opportunities to facilitate connections with foundries
- Develop a support system for the entire product development lifecycle, from design and feasibility to commercialisation
  - Double the national funding allocated for prototype production costs
- Offer financial support
  - Extend a financing policy offering preferential support for loans, guarantees, and interest rates

## AI semiconductors

To secure cutting-edge semiconductor technology that will lead the AI era, Pangyo in Gyeonggi Province will serve as a hub for advancing domestic AI semiconductors and nurturing the local cloud technology ecosystem.

The plans are:

- Advance and develop low-power, high-performance Korean AI semiconductors through fabless support (NPU low-power Processing in Memory (PIM) ultra-low-power Processing in Memory (PIM))
- Reach global competitiveness through the 'K-Cloud project', including building a cloud data centre based on Korea-produced AI semiconductors and perfecting the HW/SW technology ecosystem

**"The Korean government has invested in overall logic semiconductor capabilities since 2019, aiming to nurture AI semiconductor technologies. Technology development is likely to be directed towards edge devices that can conduct inference calculations rather than traditional CPU and GPU calculations."**

KISTEP (Korea Institute of S&T Evaluation and Planning) – Associate Research Fellow of Centre for Growth Engine R&D Coordination

## Compound semiconductor R&D

Suwon in Gyeonggi Province will become a hub for collaboration between industry, academia, and research institutes. The Korean government plans to support the entire process of compound semiconductor R&D, verification, and analysis, based on collaboration among industry, academia, and research institutes in the Gyeonggi province region.

- Compound semiconductors will be promoted through organic collaboration with regional hubs such as communications, photonics, and power semiconductors
- Special emphasis will be placed on fostering four specialised fields in compound semiconductors (space/defence, next-generation communication, power, and sensors).
- Prior to the announcement of the Mega Cluster Vision, MOTIE earmarked GBP 81m for a national research and development initiative aimed at advancing compound semiconductor technology. This funding is designated to enhance the competitiveness of power & compound semiconductors such as SiC and GaN, particularly in applications for electric vehicles, renewable energy, and the Internet of Things (IoT). The project, which successfully passed a preliminary feasibility study in 2023, is scheduled to span five years, from 2024 to 2028. Key areas of the initiative include:

- Power conversion modules for Korea's electric vehicles, energy, and industrial sectors
- Drive circuit (power IC) technology
- Power semiconductor materials

## Advanced packaging and devices

Pyeongtaek in Gyeonggi Province will become a hub for next-generation components and advanced packaging technologies, as well as talent development. Two research centres focusing on next-generation semiconductors, such as advanced devices (ferroelectric, magnetic materials), advanced packaging (vertical stacking, heterojunction), and new concept designs (neuromorphic, PIM) will be established.

## UK – Korea Semiconductor Cooperation Framework

In November 2023, the UK Prime Minister and the Korean President agreed to be global strategic partners as part of the Downing Street Accord to celebrate the 140th year of diplomatic relations during Korea's Presidential visit to the UK. This was launched to deepen bilateral cooperation across shared science and technology priorities, in particular semiconductors.

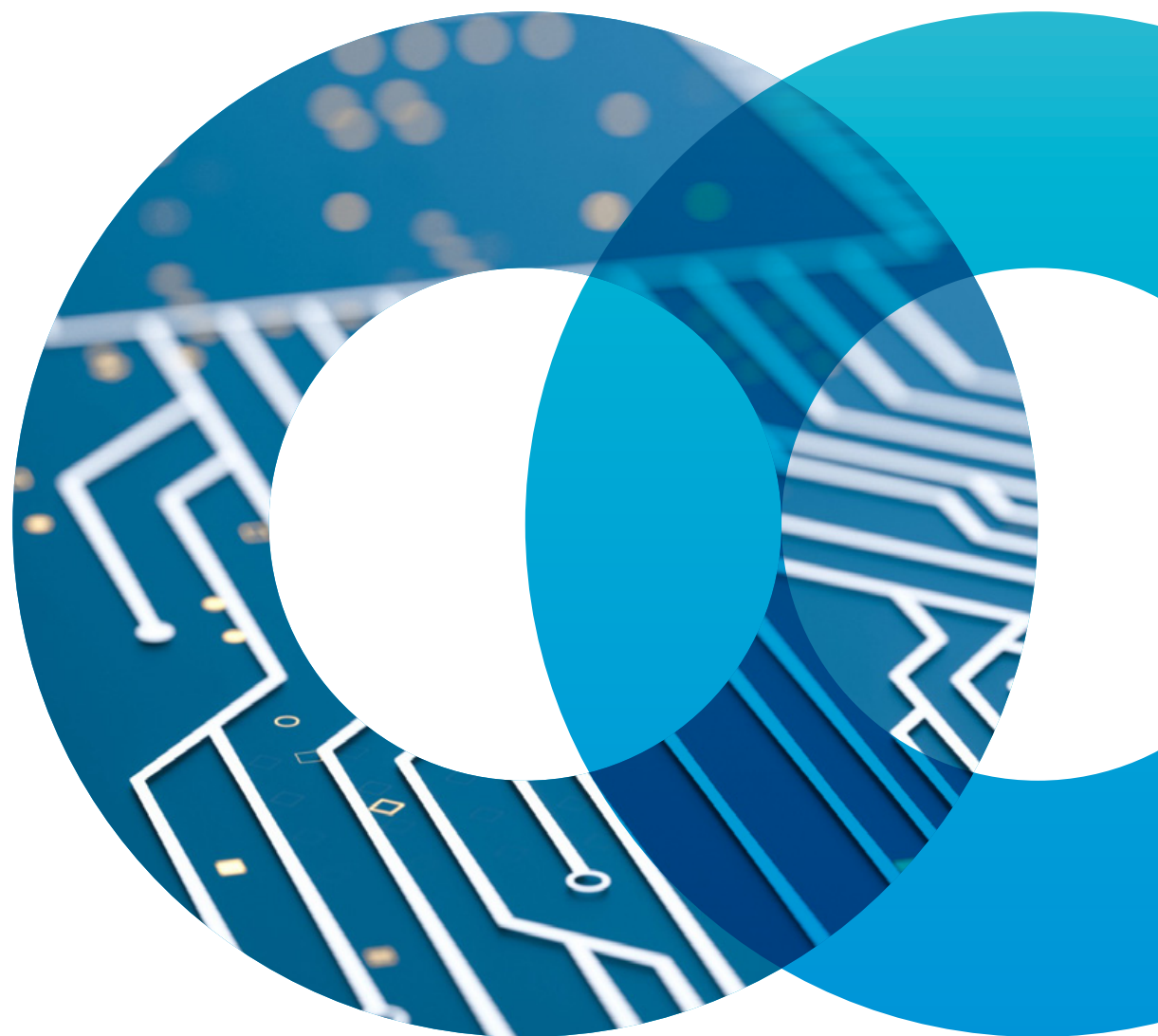
The joint statement of the UK – Korea Framework for Semiconductor Cooperation was signed as part of the Accord between the MOTIE, and the UK Government's Department for Science, Innovation and Technology (DSIT). The following commitments have been reflected in the Framework:

- Deepen collaboration in the development of advanced semiconductor skills on both countries' respective strengths
- Support collaborative research and development projects, including by strengthening links between academic and research institutions
- Enhance bilateral and multilateral cooperation on semiconductor supply chain resilience
- Identify and facilitate exciting new research and industry collaborations

These commitments indicate that with regard to UK firms' strengths in design capabilities, IP, and compound semiconductors, both parties have agreed to work collaboratively in commercial and academic technology development, human resource training, securing supply chains, and sharing industry trends and policies.

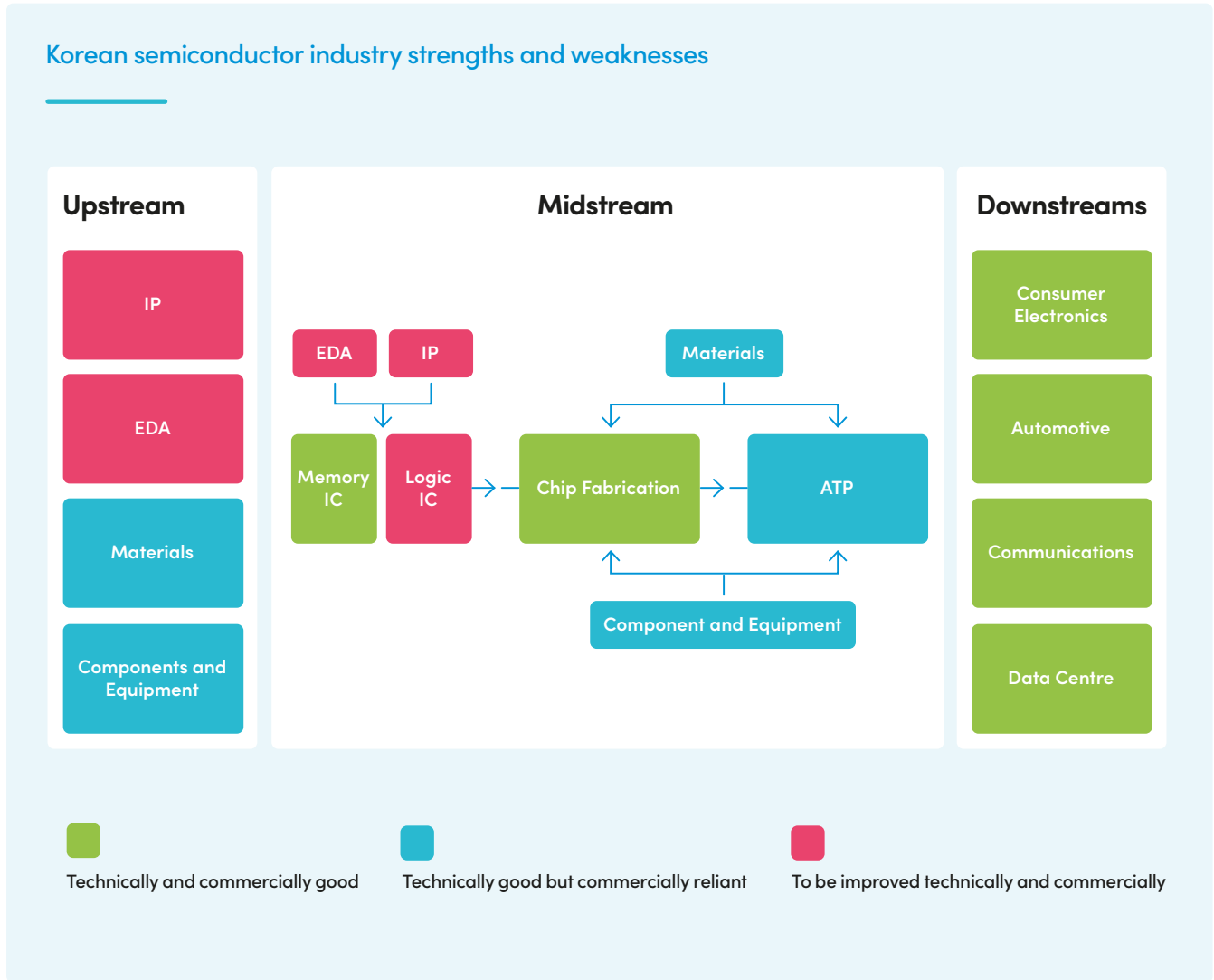
# Opportunities for UK companies - Korea

UK semiconductor companies armed with enabling technologies are encouraged to keep an eye on the progress of the cluster's establishment, especially for securing research or operations facilities on the ground.



Korea excels in memory production and foundries and has strong downstream capabilities in consumer electronics, automotive, communications, and data centres, which offer market opportunities and drive innovation in the market. However, Korea heavily depends on foreign technologies for various aspects of its semiconductor industry, including semiconductor IP, EDA tools, materials, components, equipment, and IC design.

When it comes to memory IC, Korea possesses world leading design and fabrication capabilities. The surge in AI-powered high-performance chipsets and applications such as ChatGPT is propelling the demand for high-performance memory. This necessitates Korea to maintain its pace in memory IC production while strategically investing in and enhancing less competitive areas like logic IC design, advanced packaging, materials, and equipment.



Source: Intralink Research

As shown in the table, Korean industries are keen to explore cutting-edge technologies to sustain their foothold in the memory market. Areas such as IP, packaging, and equipment for manufacturing high-performance chips are expected to be warmly embraced by the industry.

The challenges that Korea faces can be seen as opportunities for UK semiconductor companies to address the Korean market. The UK semiconductor industry is renowned for IC design, IP, compound, and advanced material semiconductors. UK companies should consider that the Korean government is actively supporting investment and R&D initiatives aimed at bolstering the semiconductor value chain. This includes adopting technologies from outside Korea and developing domestic innovations. Specifically, Korea is particularly interested in partnering with companies in promising fields such as IC design, compound semiconductors, and advanced materials.

## SWOT analysis for the Korean semiconductor industry

### Strengths

- Strong in memory IC fabrication
- World leading foundries
- World leading talent
- Strong downstream industry for electronics
- Well-equipped IT infrastructure
- Stable energy supply such as water and electricity

### Weaknesses

- Relatively weak in the fabless market
- Heavy reliance on imported materials, equipment, and foreign IP
- Limited access to materials, components, and equipment feasibility testbed platforms for mass production
- Reliant on two large corporations

### Opportunities

- Growing importance of memory IC fabrication and foundry capabilities as the global market evolves into customised production that merges memory and logic products
- High-end applications such as AI, HPC, EV, and autonomous driving grow demand for advanced chips, compound semiconductors, and advanced packaging
- Strong support from the government to build semiconductor value chain

### Threats

- Geopolitical sensitivities and supply chain insecurity due to the interplay between the US and China. Complicated landscape due to the US's reshoring strategy while China is a significant customer for Korean firms
- Lack of semiconductor R7D talent
- Growing competition among tech giants for foundry business
- Environmental regulations in terms of energy sources for manufacturing lines e.g., RE100
- Price fluctuation of raw materials e.g., copper

Source: Intralink research

## IP

In terms of opportunities in IP it can be extremely helpful to first make sure one's IP is compatible with Korean foundries' processes. This can be assured through partnering up with Samsung Foundry's SAFE programme or working with other Korean foundries. This will be essential if one is to licence IP into Samsung's design teams as they virtually always use Samsung foundry, but also to target Korea's wider fabless ecosystem of 150 companies. While not all Korean fabless companies use Samsung or other Korean foundries, many do, and it may be one of the first questions asked.

Korea's overall upstream semiconductor sector is developing. Local fabless companies and design services are looking to create ever complex designs, requiring better IP. UK companies can directly sell or license their IP to Korean IDMs, fabless companies, and design services.

Memory IDMs Samsung and SK hynix will also be interested in new memory related technologies, including IP, which they can bring into new designs.

## EDA

UK firms making niche EDA tools have opportunities to licence into Korean fabless and design services companies looking, as Korea has a low profile in IC design compared to global leaders but is eager to grow. This is the same for licencing tools into Korean IDMs. While it is possible for UK firms to licence directly into IDMs' design arms with niche tools, becoming part of Samsung Foundry's EDA Alliance as a partner can also be beneficial. This helps to secure potential deals with local IC design companies as many Korean companies use Samsung Foundry.

Compound semiconductor EDA tools can be an example of a niche EDA tool. Keysight Technologies, an American equipment and software company, recently initiated a joint operation of Keysight ADS East Asia Education Centre with CSRC (Compound Semiconductor Research Center) of Mokpo National University in January 2024 and donated GBP 21m worth of EDA software. This is to foster the compound industry and talent in Korea. While this is a case of an American company, as the UK has exhibited a strong international presence of compound technology, it is worth reviewing to expand its research and commercial collaboration in Korea.



## IC design

To give a clear view on UK players' opportunities, IC design can be broken down into two parts: fabless companies and design services.

UK's fabless companies can sell chips into downstream industries in Korea. Korea has strong downstream industries, such as automotive (Hyundai Motor Company, KIA Motors), consumer electronics (Samsung Electronics, LG Electronics), and communication (SK Telecom, LG Uplus, KT Telecom). As Korean fabless companies are not strong enough yet to meet the needs of Korean downstream industries, Korean downstream players are also looking for overseas chip vendors.

UK fabless companies can also promote their design capabilities to Korean electronics companies. This can be either to provide existing chips that meet the market's needs or to understand the electronics companies' commercial and technological roadmap to inform future chip design plans or to jointly develop application specific designs. The UK's experience in RF and advanced mixed signal designs is also attractive to Korean companies.

On the other hand, UK design service companies can collaborate with Korean fabless companies who are looking to improve their chip design capabilities and competitiveness to sell into local electronics companies.

When it comes to collaboration with Korean foundries, UK fabless and design service companies can utilise foundries' partner ecosystems. Samsung Foundry's SAFE programme includes a Design Solution Partner Alliance that offers partnerships open to foreign fabless companies to cooperate within its ASIC design service and supply chain management. Like other foundries globally Samsung Foundry can allow access to advanced process technologies and design services. SK hynix runs its Open Research Platform (ORP) that allows technical partnership opportunities to foster innovative development roadmaps up to commercialisation under its Revolutionary Technology Centre (RTC) established in 2021. This can help fabless start-ups bring their designs to market faster and more cost-effectively.

## Equipment

EUV is currently the most in demand semiconductor equipment technology in Korea, with demand mainly coming from Samsung Electronics and SK hynix. However, there is demand for other equipment in Korea and there are some examples of successful UK companies in this sector.

Oxford Instruments' wafer inspection solutions have received strong interest from Korean semiconductor companies, and Infinitesima secured strategic investment for expanding its production of inline wafer metrology systems from Wonik Investment Partners, a subsidiary of Wonik, one of the largest Korean semiconductor materials and equipment companies in 2022.

Wonik Investment Partners say the strategic partnership was made to face increasing demands and requirements in the field of advanced semiconductor process control, particularly high-resolution 3D metrology.

**Korean downstream players are looking for overseas chip vendors as Korean fabless companies are not strong enough yet to meet their needs, while UK design service companies can collaborate with Korean fabless companies to sell into local electronics companies.**

## Advanced packaging

UK IC design companies can leverage Korea's advanced packaging capabilities for next-gen chip designs, also UK expertise in compound semiconductors may require advanced packaging capabilities. UK firms in this space could use Korea's advanced packaging facilities for their compound semiconductor designs, or potentially work with both countries to attract Korean advanced packaging investment into the UK. Korean firms are also highly interested in any equipment or other technology that could improve their packaging capabilities.

## Compound semiconductors

Korea is placing more emphasis on compound semiconductor manufacturing technologies as it is pushed by the growing demand in high-end applications such as AI, HPC, EV, and autonomous driving. Both public and private players in Korea have shown high interest of developing compound power semiconductors. The Korea Evaluation Institute of Industrial Technology (KEIT) said that it will invest approximately GBP 78m by 2028 to develop advanced compound power semiconductor technologies.

Moreover, Samsung Electronics and SK hynix are reportedly reviewing future GaN semiconductor commercialisation projects. Samsung is planning for GaN compound power semiconductor foundry services by 2025, and SK hynix reported publicly that it has been developing GaN semiconductors starting from 2022, aiming for mass production by 2025.

The UK has strong, world leading compound semiconductor companies working on SiC, GaN, and other advanced material semiconductors in South Wales and the Northeast. The UK's well-established companies and startups armed with advanced compound semiconductor technology will find room Korean companies open to licensing technologies or production collaboration.



## Opportunities for UK companies in Korea

### IP:

Expand into new emerging fabless companies

Partner with Korean foundries' ecosystem programmes



### Advanced packaging:

Memory IC IDMs are interested in advanced packaging technology for HBM and chiplets



### Equipment:

Korean fabs are open to new equipment suppliers. UK companies with niche equipment can take advantage of this



### IC design:

Expand into new emerging fabless companies Provide chips to Korea's strong electronics sector that cannot rely on domestic design



### Compound

Partner with Korean foundries, design firms and others in the ecosystem to build-out low-cost mass production



### EDA

Emerging AI IC design companies are interested in niche tools



**"Identifying and facilitating opportunities that are mutually beneficial to both Korea and the UK is important for enhancing the resilience of the semiconductor supply chain from a long-term perspective. While Korea leads in semiconductor manufacturing and cutting-edge memory, it lags behind in chip design. Korean fabless firms will welcome the opportunity to deepen collaboration in chip design, IP, and software, where the UK holds globally competitive strengths."**

KSIA (Korea Semiconductor Industry Association) – Director of Industrial Support Division

Source: Intralink research

# Routes to market - Korea

## Market exploration

For those enabling technology companies looking to expand their business to East Asia, Korea is a technologically agile testbed and a commercially mature market to grow a business. Situated between Japan and China, Korea provides an evenly developed industrial ecosystem across conglomerates, SMEs, startups, and scaleups with CVC, and VC firms, while allowing a technologically safe environment for UK firms to collaborate in terms of intellectual property. Any UK company looking to enter the Korean market should first confirm there is a technical and commercial fit. Through this one can narrow down targets and decide on what to prioritise.

Market reports, which usually provide quantitative information about the industry size, key players, how the ecosystem and value chain work, and market trends, can be utilised to gain a basic understanding of the market for a certain technology and its total addressable market. However, once this is understood, it is critical to visit Korea in-person to get a deeper understanding. Trade shows in Korea can be an opportunity to meet industry players and further understand the opportunity before going all in.

## Selection of semiconductor events in Korea

| Event  | Date      | Website   |
|--|-----------|---|
| <b>Korean Conference on Semiconductors</b>   | January   | <a href="http://kcs.cosar.or.kr/2025/">http://kcs.cosar.or.kr/2025/</a> |
| <b>Semicon Korea</b>   | February  | <a href="http://www.semiconkorea.org">www.semiconkorea.org</a>          |
| <b>System Semiconductor Start-up IR</b>  | April     | <a href="http://www.ksia.or.kr">www.ksia.or.kr</a>                      |
| <b>International Symposium on the Physics of Semiconductors and Applications (ISPSA)</b> | June      | <a href="http://www.ispsa.or.kr">www.ispsa.or.kr</a>                    |
| <b>Advanced Semiconductor Packaging &amp; Chiplet Show (ASPC)</b>                        | August    | <a href="http://www.semipkgshow.com">www.semipkgshow.com</a>            |
| <b>International Electronic Circuits and Packaging Show (KPCA)</b>                       | September | <a href="http://www.kpcashow.com">www.kpcashow.com</a>                  |
| <b>SEDEX</b>   | October   | <a href="http://www.sedex.org">www.sedex.org</a>                        |

Source: Intralink Research

## Market entry strategies

### Direct sales: operations from the UK without a local presence

Companies that give a relatively low commercial priority to Korea may choose to simply sell directly from the UK, investing the lightest number of resources. There is a tendency for software solution providers to take this option when entering the market. They generate leads and respond directly to technical support queries via engineers based at HQ.

Many western companies though tend to select Singapore as a greater Asia regional headquarter, in part due to the familiar and strong international arbitration laws there. If such an office exists commercial and technical decision-makers can be based in Singapore to manage Korea as one of the Asian countries that the regional headquarters look after. Depending on the Singaporean-based commercial team's size and Korea's strategic importance, it may make sense for the regional HQ to hire Korean speakers.

When it comes to understanding the Korean market, for example how products and technologies are received and where potential collaborative opportunities lie, direct sales have some drawbacks:

- Speaking the local language
- Navigating local customers' organisational dynamics and politics

- Earning insider information circulating in the local value chain
- Representing your product and technology with continuous support after closing deals that reassures local accounts

### Sales agents and business development consultancies

Sales agents are often local industry veterans who have built up connections and relationships over their careers and now use these to help firms navigate the Korean market. They can be very good for initial market exploration but often do not like to explore outside of their relationship circle, so can be less useful in the medium-to-long term.

Services that business development consultancies offer vary. They allow access to targeted industries and segments but also adjacent fields and relevant contacts to widen the conversation and navigate further into Korean companies to drive commercial deals and collaborative technology PoC projects.

### Partnership with local distributors

Companies choose to partner up with local distributors that play key roles in the local industry ecosystem or value chain. They can complement a product within the value chain and help navigate the legal environment as it has experience in the target sector. Local press releases and representation supported by renowned local businesses can help UK companies streamline business development efforts. Factors to consider when seeking a distributor include:

- Does the distributor already serve the type of customer that we do? Does it offer a similar or complementary solution?
- Does the distributor have a good understanding of the market in general and my particular application?
- Is the distributor focused on short-term wins or will they be able to drive our business in the long run?
- Does the distributor have specific experience with public sector projects (if relevant)?
- Are we comfortable communicating with the distributor and are they transparent with us?
- Will the distributor proactively promote and sell, or will my product simply be one among a catalogue of products?
- Do we need a sales agent or consultancy to help us manage the distributor?

If a local partner works on an account-based sales basis that continuously introduces new technologies and solutions into existing key account relationships, there may be less chance for a UK company to push its own technology individually, as it could be merged into and utilised for the local partner's or investor's interest in creating a bigger story for their own business, borrowing the foreign technology as a piece of a larger solution. The UK company must be able to operate partner management and account management to reflect its interests, for it to make sense.

## Establishing a local presence

Locally employed FAEs or Korean-speaking support staff sent from HQ are required once sales reach a certain size. This is needed to fully support local customers and accounts in the same time zone and with no language barriers.

Once technical and production-related collaboration shows tangible progress, larger commercial teams will be required on the ground, this is when a local sales office or subsidiary is required.

There are broadly three ways of establishing a local presence: (1) a liaison office, (2) a branch office, (3) a local corporate (subsidiary) through foreign direct investment (FDI) or (4) a joint venture.

Establishing a liaison office takes the smallest effort; completing a Korean liaison office registration takes about 5 business days after handing over documents. However, a liaison office does not receive a business registration that has legal authority, it is simply assigned a certificate number, as it is only allowed to manage tasks that do not generate revenues, such as market research, R&D, after-service, and promotions.

A branch office is not granted status as a separate legal entity but can create revenues in Korea, and profits generated can be directly remitted to the parent company. This option is usually used by smaller overseas companies or companies that want to test the business environment in the short term. However, they cannot receive various tax deductions and are subject to additional branch taxes.

Since the capital required to establish a corporation or subsidiary is large and many people are hired, the Korean government strongly encourages new investment by providing various tax benefits, and from a foreign companies' perspective, the purpose is to lay the foundation for long-term business operations. Profits within a local corporate cannot be directly remitted to the parent company, only dividends can be remitted.

Joint ventures are a good option if the JV partner can bring technical or commercial benefits to help win business that may otherwise be difficult. Technological capabilities to reduce the risk when entering the market. Because it is a joint venture between a UK company and a Korean, its financial structure is relatively safe, and the risk of withdrawal is low.

Market-specific factors to consider when establishing a local presence in Korea include:

- Is our business receiving enough traction in Korea to consider a local presence?
- Is Korea a strategic market for us, either in terms of securing use cases or further funding?
- Will we transfer staff from our HQ or hire local staff?
- What location shall we pick for our local presence?

# Market overview - Taiwan

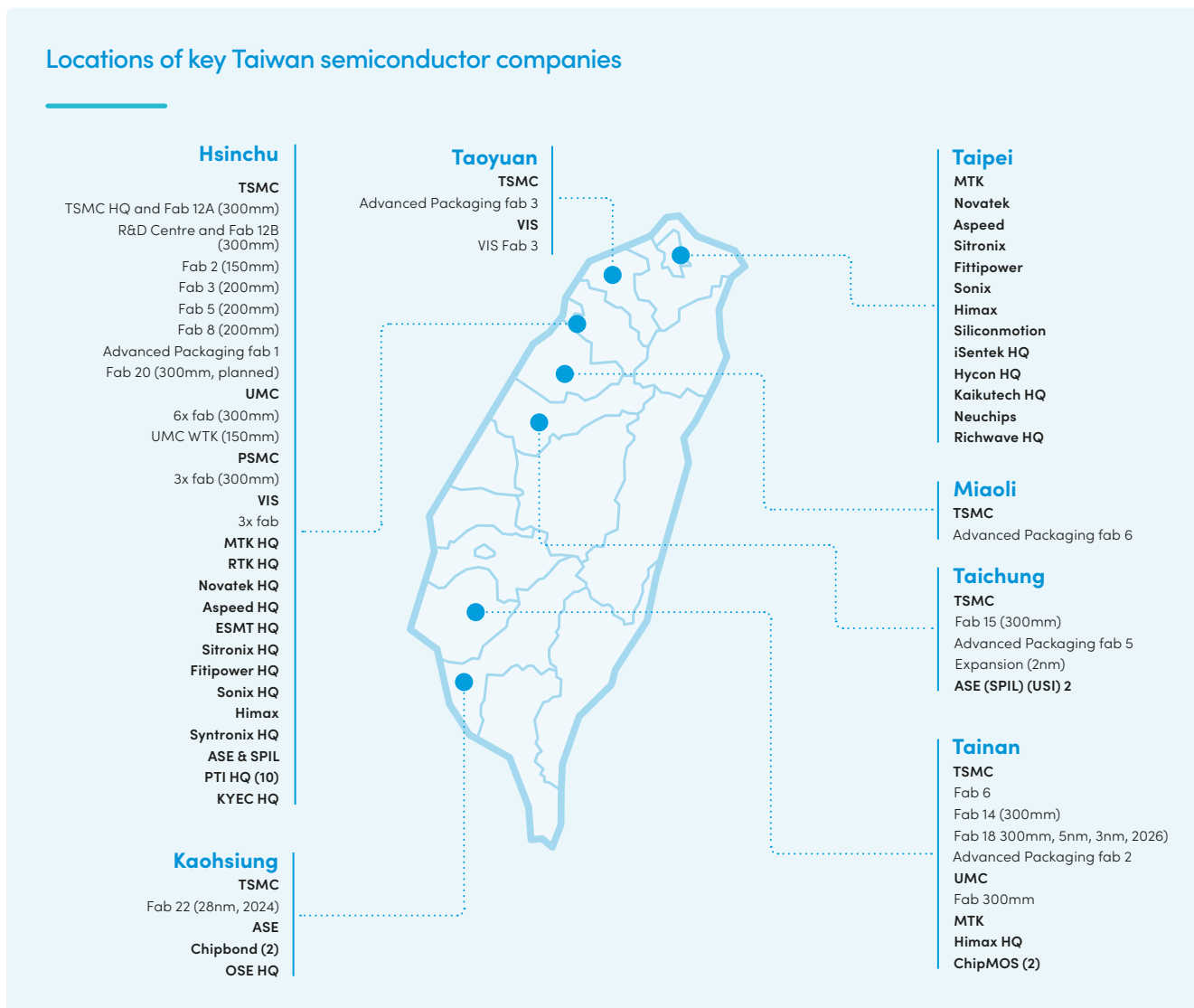
## Market size

According to the Taiwan Semiconductor Industry Association (TSIA), the semiconductor industry makes up approximately 12 percent of Taiwan's GDP - GBP 74.7bn - with the overall electronics industry accounting for one-third. It employs approximately 320,000 people. Semiconductor product exports exceeded GBP 146.7bn in 2022, accounting for 39 percent of Taiwan's total export value. Taiwan's IC industry was worth approximately GBP 110.7bn in 2023, a 10.2 percent decrease from 2022. Taiwanese companies account for approximately 78 percent of foundry revenue, 21 percent of IC design revenue, and 52 percent of assembly and test revenue globally. In the following sections, we will analyse Taiwan's strengths, its needs, and identify business opportunities for UK companies.



## Market segments

Taiwan boasts world leading companies across the semiconductor value chain, especially foundries, fabless IC design, and OSATs. Taiwan's semiconductor industry is traditionally almost exclusively located in the Northwest. This is the most developed part of Taiwan where logistics and infrastructure are modern, natural disasters are less common, and where there is a history of strong talent development through universities and research institutes. Most fabs, OSATs, and design firms are in Hsinchu. Design firms generally have sales offices in Taipei as well. Other regions have a scattering of fabs and OSATs.

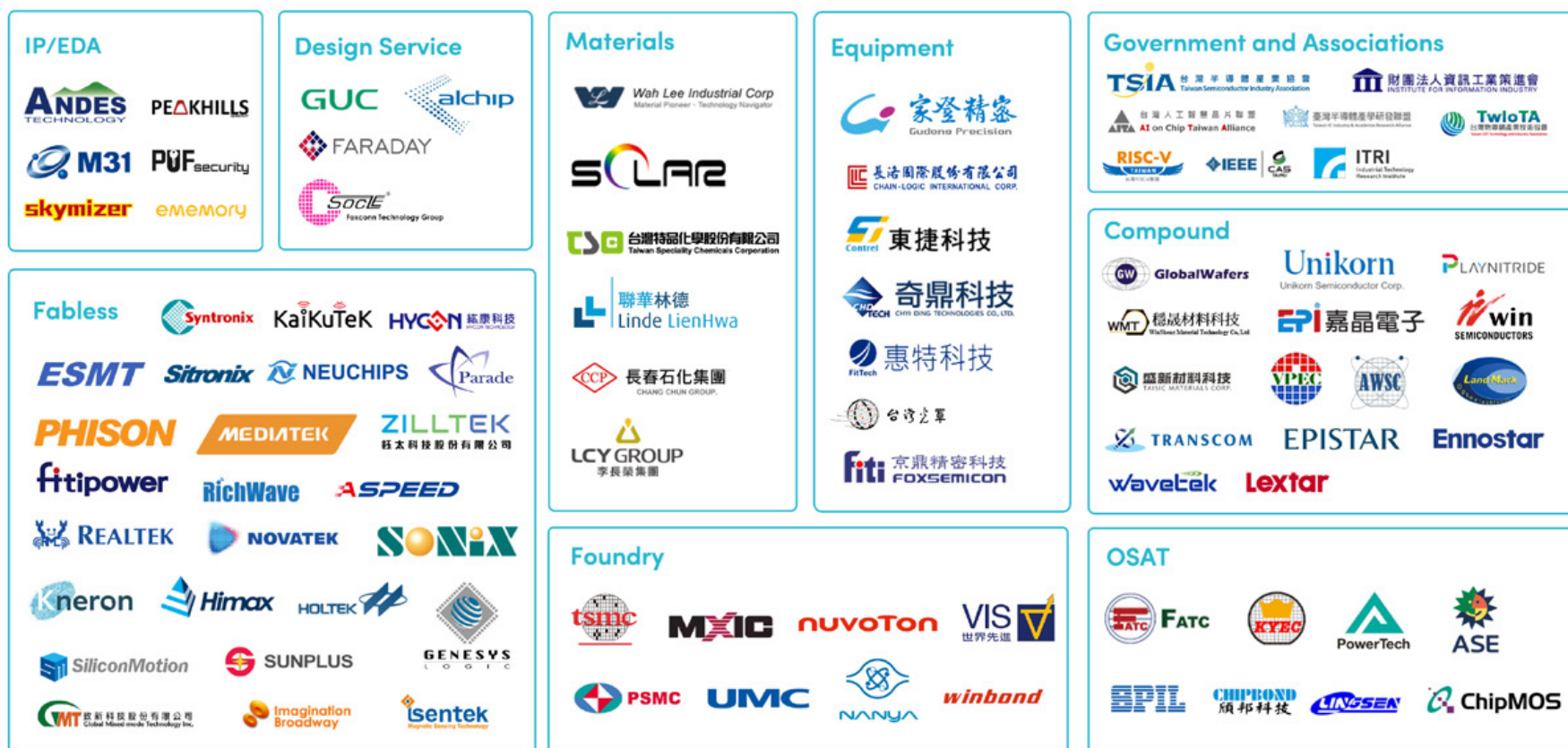


Source: Intralink research, TSIA, ISTI-ITRI

## Key players

Taiwan is strongest in the fabless IC design, foundry, and OSAT sectors, but also has many companies in other parts of the semiconductor value chain.

### Taiwanese semiconductor industry ecosystem



Source: Intralink research

## Foundries

There are 15 IC wafer fabrication companies in Taiwan. These are TSMC, UMC, PSMC, Vanguard, Episil, Mosel, AMPI, Win Semiconductors, Nuvoton, AWSC, Unikorn, and HYS, as well as memory manufacturers such as Winbond, MXIC, and Nanya Technology. Taiwan's IC industry was worth approximately GBP 110.7bn in 2023, of which foundry revenues (including memory) made up GBP 67.8bn, or 61 percent. Taiwanese foundries accounted for roughly 77.6 percent of global foundry revenues in 2022, with 2023 likely to be a similar percentage.

New technology applications such as AI and HPC, which require advanced chipsets, mean demand for advanced manufacturing processes (below 7nm) is still rising. Currently, Taiwan has nearly 90 percent of  $\leq 10\text{nm}$  production capacity in the world, and approximately 28 percent of the 10-22nm IC production capacity.

UMC is Taiwan's second largest foundry, but it focuses on mature process nodes. It is facing competition from other mature process vendors including GlobalFoundries and SMIC, which is the largest foundry in China. UMC recently partnered with Intel to work on 12nm process node, a step towards more advanced nodes for the company.

It achieved GBP 5.7bn revenue in 2023, a decrease of 20 percent.

In addition to TSMC and UMC there are several smaller foundries in Taiwan. Of these, Winbond ranks third. It specialises in memory IC fabrication, and its product lines include DRAM, NOR, and NAND Flash. It earned GBP 2bn revenue in 2023, a 16 percent decrease from 2022. due to sluggish demand in memory markets. Its product applications can be divided into four main areas including communication (23 percent), computer (25 percent), automotive and industrial (27 percent), and consumer (25 percent).

## Top ten fabrication companies in Taiwan, 2022

| 2022 Ranking | 2021 Ranking | Company  | 2021 Revenue (~GBP bn) | 2022 Revenue (~GBP bn) | Growth (%) |
|--------------|--------------|----------|------------------------|------------------------|------------|
| 1            | 1            | TSMC     | 40.47                  | 57.72                  | 42.6%      |
| 2            | 2            | UMC      | 5.43                   | 7.1                    | 30.8%      |
| 3            | 3            | Winbond  | 2.54                   | 2.4                    | -5.1%      |
| 4            | 5            | PSMC     | 1.67                   | 1.94                   | 15.9%      |
| 5            | 4            | Nanya    | 2.18                   | 1.45                   | -33.5%     |
| 6            | 7            | Vanguard | 1.12                   | 1.32                   | 17.6%      |
| 7            | 6            | MXIC     | 1.29                   | 1.11                   | -14%       |
| 8            | 8            | Nuvoton  | 1.05                   | 1.07                   | 1%         |
| 9            | 9            | Win Semi | 0.66                   | 0.46                   | -29.8%     |
| 10           | 10           | Episil   | 0.19                   | 0.23                   | 22.2%      |

Source: Intralink research

## IC design

Most of Taiwan's fabless firms are based in Taipei and Hsinchu where it is easier to source talent and conduct business development. IC design is R&D intensive, so a high proportion of revenue goes into R&D costs.

There are 262 IC design companies in Taiwan. These companies had a combined revenue of GBP 28bn in 2023, an 11 percent decrease from 2022. This still means Taiwan's IC design industry represents approximately 21 percent of global design revenues, in second place, behind the USA. Key IC design sectors in Taiwan include wireless communication chipsets such as 5G and Wi-Fi, display drivers, memory controllers, power management ICs, and high-speed data communication controllers such as USB-C controllers.

According to the TSIA, in terms of revenue, 79 percent of Taiwan's IC designs were digital, 11 percent analogue, and 9 percent were memory or sensor designs in 2022.

The Taiwanese IC design industry has experienced volatile growth from 2019 to 2022, swinging from 1.4 percent to 42.4 percent. This trend continued in 2023 due to global economic slowdown and stagnant downstream demand but will return to growth in 2024. There is also rising competition from China where many fabless design start-ups formed in recent years.

MediaTek is by far the largest IC design firm in Taiwan and the fifth largest globally in terms of revenue. Its 2022 revenue reached GBP 13,99bn, which accounted for 44.5 percent of Taiwanese IC design companies' revenues but dropped to GBP 11bn in 2023.

These are expected to grow again in 2024. Its main products are smartphone and TV SoCs, 5G, application processors, Wi-Fi, and custom ASICs. Customers include smartphone and TV companies including Xiaomi and Huawei. Novatek is now the second largest IC design firm in Taiwan, with a revenue of GBP 2.8bn in 2023, more or less the same as 2022. Its main products are display driver ICs, and multimedia SoCs. Realtek dropped to third place in 2023, having a revenue of GBP 2.5bn, dropping from GBP 2.85bn in 2022. Its products are mostly connected media ICs, communication network ICs, computer peripheral ICs, and multimedia ICs.

While revenues are down, many IC design firms actually achieved higher profits and expect revenues to recover in 2024.

### Top ten fabless companies in Taiwan, 2022

| 2022 Ranking | 2021 Ranking | Company        | 2021 Revenue (~GBP bn) | 2022 Revenue (~GBP bn) | Growth (%) |
|--------------|--------------|----------------|------------------------|------------------------|------------|
| 1            | 1            | MediaTek       | 12.58                  | 13.99                  | 11.2%      |
| 2            | 3            | Realtek        | 2.69                   | 2.85                   | 6%         |
| 3            | 2            | Novatek        | 3.45                   | 2.8                    | -18.8%     |
| 4            | 4            | Phison         | 1.6                    | 1.54                   | -3.7%      |
| 5            | 5            | Himax          | 1.1                    | 0.91                   | -17.3%     |
| 6            | 6            | Silicon Motion | 0.66                   | 0.74                   | 12.8%      |
| 7            | 13           | GUC            | 0.39                   | 0.61                   | 59.1%      |
| 8            | 7            | Raydium        | 0.63                   | 0.58                   | -8.1%      |
| 9            | 9            | Fitipower      | 0.58                   | 0.5                    | -13.9%     |
| 10           | 10           | Sitronix       | 0.57                   | 0.46                   | -19%       |

Source: Intralink research

## Assembly, test & packaging (ATP)

ATP vendors provide third-party IC-packaging and test services and are also often referred to as Outsourced semiconductor assembly and test (OSAT). There are currently 37 ATP companies in Taiwan. In 2023 their combined revenue reached GBP 14.9bn, a decrease of 17 percent from 2022. This is in line with forecasts made in early 2023, as part of the semiconductor down cycle having grown significantly in previous years. Estimates are ATP will have a moderate return in 2024 due to economic recovery and reduced overstock issues in the industry. Taiwan remains leading ATP industry globally, accounting for roughly 54 percent of the world's revenues.

Revenue per worker continues to drop year-on-year as the added value of OSAT services is decreasing. Advanced chipsets for AI and HPC applications are becoming smaller or three dimensional (3D), and they require advanced IC packaging such as CoWoS (Chip on Wafer on Substrate) and InFO (Integrated Fan-Out), which TSMC and other leading foundries have internalised. Also, competition from China is fierce as China is also a leading ATP service provider and is developing its own advanced packaging solutions. This has caused pressure on Taiwanese companies' pricing.

ASE is the largest OSAT in the world. Its revenue was GBP 9.5bn in 2022.

The main packaging types it offers are Bumping, Flip chips, Wafer Level Packaging (WLP), System in Package (SiP), and Wire Bonding. It has expanded overseas and established plants in the USA, China, South Korea, Japan, and Singapore. The second largest OSAT provider in Taiwan is PTI with a revenue of GBP 2.14bn in 2022. It also provides WLP, Flip Chip, Wire Bond BGA, and SiP. In terms of product revenue, 37 percent came from logic ICs, and 54 percent from memory (NAND and DRAM). KYEC ranked third in Taiwan's OSAT industry. Its main packaging service is BGA for different chip dimensions. OSATs are mostly based in Hsinchu but are present in small numbers in other locations around Taiwan.

### Top ten ATP companies in Taiwan, 2022

| 2022 Ranking | 2021 Ranking | Company    | 2021 Revenue (~GBP bn) | 2022 Revenue (~GBP bn) | Growth (%) |
|--------------|--------------|------------|------------------------|------------------------|------------|
| 1            | 1            | ASE        | 8.22                   | 9.5                    | 15.5%      |
| 2            | 2            | PTI        | 2.14                   | 2.14                   | 0.1%       |
| 3            | 3            | KYEC       | 0.86                   | 0.94                   | 8.9%       |
| 4            | 5            | Chipbond   | 0.69                   | 0.61                   | -11.4%     |
| 5            | 4            | Chipmos    | 0.7                    | 0.6                    | -14.2%     |
| 6            | 6            | Signore    | 0.43                   | 0.48                   | 12%        |
| 7            | 7            | OSE        | 0.4                    | 0.4                    | -2.5%      |
| 8            | 9            | Ardentec   | 0.3                    | 0.37                   | 21.8%      |
| 9            | 8            | Tong Hsing | 0.35                   | 0.36                   | 1.4%       |
| 10           | 10           | FATC       | 0.25                   | 0.26                   | 5.1%       |

Source: Company statement, TSIA, ISTI-ITRI

## Other

Taiwan is strong in the segments discussed above but relies much more heavily on foreign partners when it comes to compound semiconductors, semiconductor IP, SME, EDA tools, and materials.

## Compound

Like its silicon industry, for compound semiconductors, Taiwan's strength is in fabrication. Major players include TSMC, UMC (Wavetech), Vanguard, Winfoundry, and ASWC. Aside from Winfoundry and ASWC, which specialise as GaAs foundries, these companies still make most their revenue from silicon-based chips with only a small portion coming from compound products. The market for compound will continue to rise though due to growth in AI, 5G/6G, and automotive applications. Some upstream wafer companies such as Globalwafers, Epi, VPEC, and Taisic Materials also invested in substrate and epitaxy. As for IC design, due to compound technologies' ability to deal with high-power throughput, most designs in Taiwan using compound materials are for power management ICs (PMICs) for automotive and industrial applications as well as power amplifiers using GaAs. Market feedback indicates there are approximately ten compound semiconductor fabless design companies in Taiwan.

With regard to GaN and SiC, feedback indicates Taiwan's industrial chain is less developed than GaAs. This is an area in which we have identified Taiwanese companies are interested in collaborating with UK firms. UK companies in these areas can provide the technologies that Taiwan needs while Taiwan provides the ability to mass produce such technologies at low-cost.

## Semiconductor IP

Although in recent years Taiwan has developed some standout pureplay IP firms such as Andes for RISC-V core IP, M31 for USB, and eMemory for memory and security IP, it still lags global leaders. These three are the only Taiwanese pureplay semiconductor IP firms to IPO. eMemory is the standout among them having moved into the global top ten pureplay semiconductor IP firms based on revenue in the past few years. Taiwan's IC design service companies such as Faraday and GUC also license self-developed IP as part of their design work.

Overall, Taiwan does not have many IP firms and relies heavily on imports. With 262 IC design firms including industry leaders such as MediaTek and Realtek, the market is one of several key markets around the world for UK headquartered semiconductor IP firms such as Arm, Imagination Technologies, and Alphawave.



## Equipment

Despite its semiconductor manufacturing prowess, Taiwan relies on foreign firms for its manufacturing equipment. This mainly comes from the USA (LAM Research, AMAT), Japan (Tokyo Electron, DISCO), and Europe (ASML). Even Chinese suppliers such as SMEE, AMEC, and Naura claim to have Taiwanese customers.

According to SEMI, the Taiwanese semiconductor equipment market size in 2022 was GBP 21.2bn, ranking second behind China at GBP 22.33bn, and ahead of South Korea at GBP 17.1bn. Together these three accounted for 71 percent of the global market, or GBP 60.52bn.

There are some local players though, such as Foxsemicon Integrated Technology Inc. (FITI Group, a division of Hon Hai) and All-Ring Tech (ART), Gudeng, and CHD Tech.

In general, Taiwanese vendors are capable of supplying equipment for conventional packaging processes and components for wafer production equipment. Local industrial policy is encouraging the domestic supply chain to collaborate with international upstream equipment vendors in two areas, advanced packaging equipment and equipment for 12-inch wafer fabrication:

- Front-end fabrication equipment. Deposition technology, dry etching technology, DUV and EUV exposure technology, photoresist coating and photoresist developing technology, and chemical-mechanical polishing technology
- Advanced packaging process equipment. Exposure technology, copper-plating technology, deposition technology, and dry etching technology

## EDA tools

Taiwan does not have a strong domestic EDA industry. IC design companies large or small rely on industry stalwarts such as Cadence, Synopsys, and Siemens EDA to design their ICs, along with other smaller foreign EDA companies. Small domestic players do exist though, such as Skymizer, which has a compiler tool for IC design houses, particularly vendors of AI SoCs, that can help improve functionality, performance, and reliability. Other start-ups in this space, such as MediaTek-championed Maxeda Technology, offer a range of production-validated AI-assisted EDA solutions. Like other markets most the market is dominated by the big three firms, but in a similar way to IP, there is room for smaller EDA providers to get some market share in niche application areas with Taiwan's 262 design firms.

"There is no need to re-invent the wheel when it comes to EDA in Taiwan."

Skymizer- CEO

## Materials

The materials market for semiconductors in Taiwan continues to rely heavily on imports, or increasingly local production of foreign companies, and this trend will continue. The Japanese company Shin-Etsu Chemical provides an illustrative example for UK companies to engage the Taiwanese supply chain. If UK semiconductor material companies are already exporting to Taiwan, they could also consider local production. Despite this, Taiwan has developed some local companies like Shiny Chemical, Taiwan Specialty Chemicals Corporation (TSCC), and Solar Applied Materials.

Industry led initiatives (mostly spearheaded by TSMC) not only help encourage photoresist suppliers to establish local production facilities in Taiwan but also actively strengthens the technical R&D capabilities of domestic suppliers, reduces costs, and shortens lead times. In 2021, the first EUV photoresist plant in Taiwan was established by Shin-Etsu Chemical, a Japanese company that supplies semiconductor silicon and photomask substrates. To support domestic and foreign suppliers in Taiwan, TSMC will lease EUV exposure machine to photoresist suppliers so that they do not need to purchase additional machines to verify the quality of the photoresist. This has been very beneficial to companies such as Everlight Chemical, a domestic photoresist manufacturer and provider of electronic chemicals.

## Market trends

- AI, HPC, EV driving the demand for high-end chips
- Lower process nodes getting more difficult is driving need for new technologies such as new lithography processes, new compound materials, chiplets, photonics, and advanced packaging
- Chinese expansion of mature node capacity is a threat to prices
- Energy limitations and geopolitics resulting in Taiwanese companies going to SEA, Japan, Europe, and the USA
- Increased use of AI in the chip design and manufacturing processes

## Challenges

Taiwan's semiconductor industry faces several challenges:

- Lack of control over IP, advanced production materials, and equipment
- Dependent on downstream electronic product demand overseas
- Reliant on energy imports, energy costs increasing
- China is building its own supply chain and offers some similar products and services at lower prices
- Potential power shortages
- Geopolitics are one factor in TSMC and others to diversify manufacturing facilities overseas
- Low wages can cause some talent outflow

## Government initiatives

### Taiwanese chip act

Officially the ‘Statute of Industrial Innovation’ but referred to as the ‘Taiwanese Chip Act’. Applications opened on the 1st February 2024 and were open until 31st May. Tax incentives include a 25 percent deduction for R&D expenses and a five percent deduction for expenditures on acquiring new equipment for advanced processes. These can be deducted from the current year’s corporate income tax.

Eligibility criteria include companies with R&D expenses of at least NTD 6bn, an R&D density of 6 percent, and expenditures of NTD 10bn for the purchase of equipment for advanced processes. There are no restrictions on industry category. A review panel assesses whether applying companies meet the criteria for a critical position in the international supply chain and other qualification requirements.

When applying companies are required to provide explanatory documents and supporting evidence, for example, product data, global market share, rankings, import-export trade, and other statistics.

Such data helps assess the level of technological innovation and market position.

Taiwanese companies such as TSMC, MediaTek, Realtek, Novatek, Delta Electronics, Nanya Technology, Phison, and Winbond, meet the R&D requirements for these incentives.

### A+ Industrial innovative R&D program

In 2014, the Department of Industrial Technology (DoIT) kick-started the A+ Industrial Innovative R&D Program (the A+ Program). This is a continuation of the Industrial Technology Development Program (ITDP). The A+ Program aims to encourage and guide businesses to invest in high value-adding cutting-edge industrial technologies and to facilitate multidisciplinary integration, to help perfect Taiwan’s industrial development. It provides subsidies to businesses to help them get involved in innovation, development, and research programs; and encourages them to establish onshore R&D centres, develop global R&D partnerships, and initiate similar programs. Some UK semiconductor companies are already taking advantage of this program in Taiwan.

### The Taiwan chip-based industrial innovation program (TCIIP)

Enacted by the Executive Yuan, the TCIIP has set funding of NTD 300bn for its implementation between 2024 and 2033. The first five years of the TCIIP will focus on leveraging Taiwan’s leading global position in front-end and back-end chip manufacturing to develop innovative new applications through integrating silicon chips with critical technologies such as generative AI.

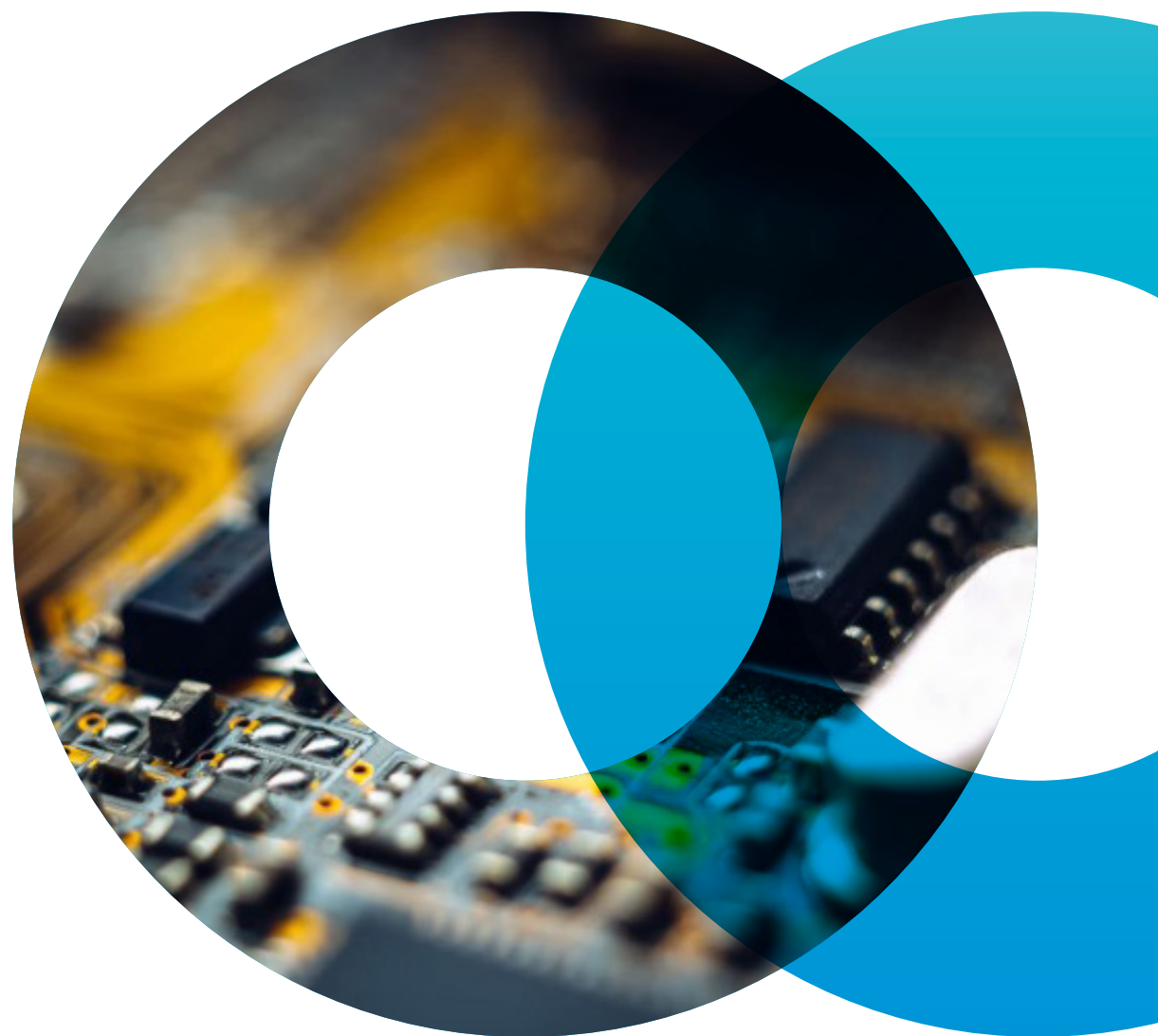
The TCIIP has four main strategies:

- Integrate generative AI with silicon chips to drive innovation
- Improve domestic talent cultivation and attract global R&D professionals
- Accelerate adoption of heterogenous integration and other advanced innovation technologies
- Harness Taiwan’s ‘silicon island’ strengths to attract international startups and investment

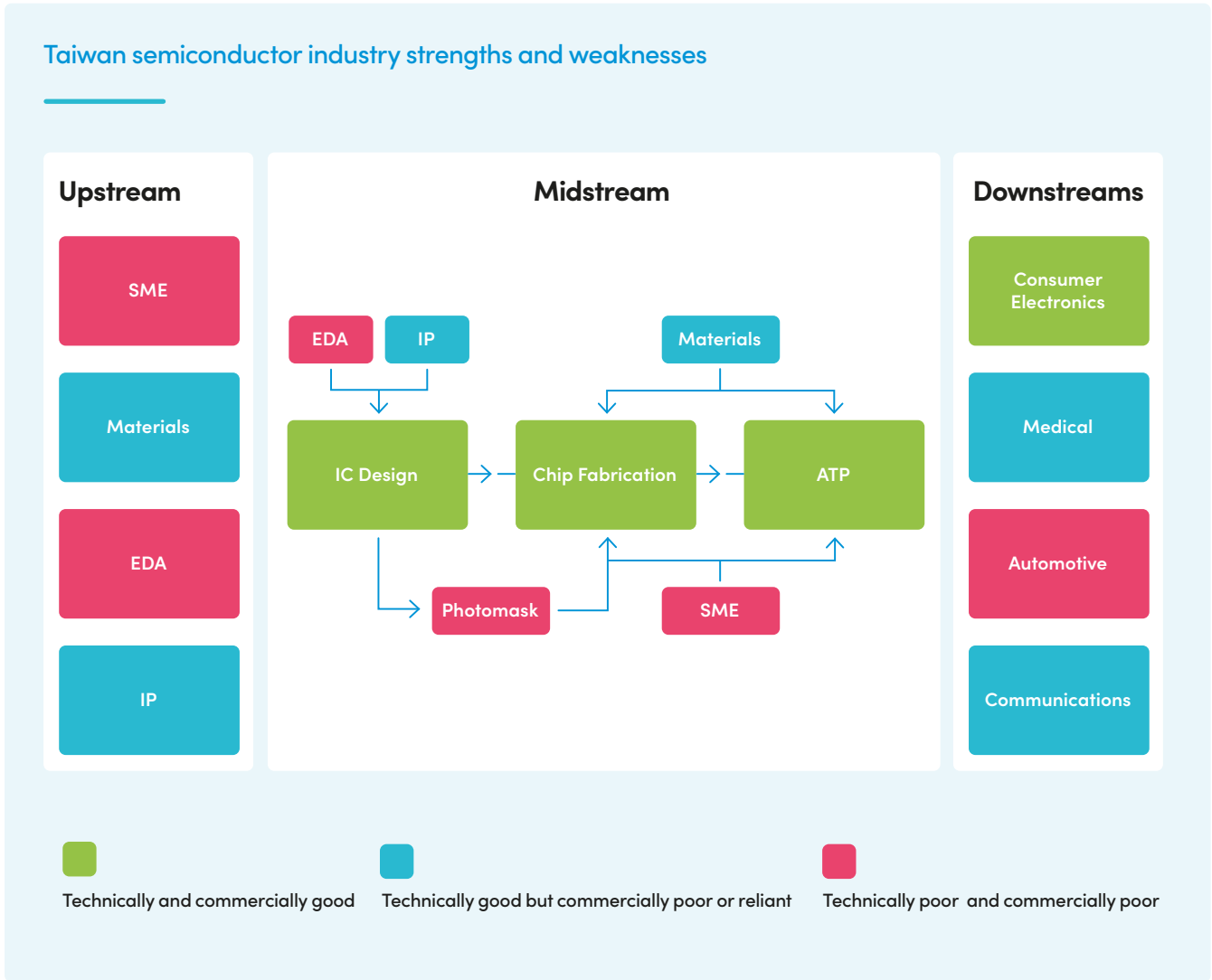
# Opportunities for UK companies - Taiwan

**Taiwan's strengths are in IC design, chip fabrication, and ATP, but Taiwan relies on foreign upstream materials, SME, EDA tools, and IP.**

New technologies such as AI, high performance computing (HPC), and electric vehicles (EV) have helped drive more demand for high-end chipsets and compound semiconductors, and although Taiwan is well-equipped to benefit from these industry trends, we see that Taiwan relies on foreign partners for key materials, core IPs, EDA tools, and advanced semiconductor manufacturing equipment (SME) such as EUV.



We can look at Taiwan's opportunities and threats to get a full picture. Competition from China and South Korea makes Taiwan in need of advanced foreign technologies. Mature-node manufacturing capacity at lower prices from China also puts pressure on Taiwan's mature-node fabs, and even industry leaders like TSMC feel the pressure of constantly having to keep ahead of competitors. This is becoming harder and harder at the bleeding edge so new techniques such as chiplets and advanced packaging are being used and are needed to stay ahead of the competition, as it becomes ever more difficult to keep up with Moore's Law.



Source: Intralink research

## SWOT analysis for the Taiwan semiconductor industry

### Strengths

- Strong in IC design
- World leading foundries
- World leading ATP/OSAT companies
- Close industry clusters and strong supply chain advantage
- World leading talent

### Weaknesses

- Lack of control over IP, advanced production materials, and equipment
- Dependent on downstream electronic product demand overseas
- Reliant on energy imports

### Opportunities

- High end applications such as AI, HPC, EV, and autonomous driving grow demand for advanced chips and compound semiconductors
- Increased mass media awareness of the importance of semiconductors has made Taiwan more strategic and increased its bargaining power

### Threats









- China is building its own supply chain and offers similar products and services at lower prices
- Potential power shortages
- Geopolitics are one factor in TSMC and others to diversify manufacturing facilities overseas
- Low wages can cause some talent outflow

The UK semiconductor industry is famous for IP, IC design, and compound and advanced material semiconductors. Its key industry clusters are in Cambridge, Bristol, South Wales, Scotland, and the Northeast. Some of these UK strengths fit well with Taiwan's weaknesses. As the UK does not have an end-to-end semiconductor ecosystem, it benefits from partnering and selling to other countries, e.g., with Taiwan for the mass production of UK designed chips, and for IP sales into Taiwan's IC design firms. UK companies can build on this relationship and explore new areas in IP, compound semiconductor materials, equipment, and EDA, as well as energy and talent. Also, Taiwanese companies are exploring photonics, AI, and quantum technologies, in which the UK has early investments and advantages.

Successful UK companies in Taiwan include Arm (IP), Porotech (compound), IQE (compound), Edwards Vacuum (equipment), Oxford Instruments (equipment), SPTS (equipment), Dialog (IC Design), and Cambridge GaN Devices (IC design).

Source: Intralink research

## Opportunities for UK companies in Taiwan

|  |  |
|--|--|
| <p><b>IP:</b></p> <p>Smaller British IP companies can build on the success of the UK's leading companies</p>      | <p><b>Materials:</b></p> <p>Unique and customised materials for more advanced process nodes and bespoke applications</p>  |
| <p><b>Compound:</b></p> <p>Partner with Taiwan foundries to create low-cost mass production</p>                   | <p><b>IC Design:</b></p> <p>Compound design cooperation and sell chip designs into Taiwan's server and CE companies</p>   |
| <p><b>Equipment:</b></p> <p>Grow with Taiwan's fabs but there are also opportunities in compound and R&amp;D</p>  | <p><b>Talent:</b></p> <p>R&amp;D hubs for Taiwanese companies as well as university and design services cooperation</p>   |
| <p><b>EDA:</b></p> <p>New design methodologies and needs mean an opportunity for niche tools</p>                | <p><b>Energy:</b></p> <p>Offshore wind, energy storage, water treatment, and recycling technologies</p>                 |

**"Taiwan's midstream strengths match with the UK's leading IP design and compound semiconductor capabilities, setting the stage for exciting collaboration opportunities in SME, compound, materials, EDA tools, and IP!"**

ITRI - General Director of Electronic and Optoelectronic Systems

Source: Intralink research

# Routes to market - Taiwan

## Market exploration

Before entering the Taiwan market, thorough market research is vital to identify opportunities. Understanding industry needs and the competitive landscape allows companies to tailor offerings, mitigate risks, and capitalise on trends. Being proactive enhances the chance of successful entry and sustained growth. Networking events and exhibitions such as Semicon Taiwan are valuable mediums through which UK firms can gain initial leads and contacts.

## Selection of semiconductor events in Taiwan

| Event  | Date      | Website  |
|--|-----------|--|
| <b>International VLSI Symposium on Technology, Systems and Applications (VLSI TSA)</b> | April     | <a href="http://www.expo.itri.org.tw">www.expo.itri.org.tw</a>   |
| <b>International Compound Semiconductors Conference</b>                                | April     | <a href="http://www.touchtaiwan.com">www.touchtaiwan.com</a>   |
| <b>Electronic Equipment Exhibition</b>   | April     | <a href="http://www.e-equipment.com.tw">www.e-equipment.com.tw</a>   |
| <b>Smart Manufacturing</b>   | April     | <a href="http://www.monitech.com.tw">www.monitech.com.tw</a>   |
| <b>Touch Taiwan</b>  | April     | <a href="http://www.touchtaiwan.com">www.touchtaiwan.com</a>   |
| <b>ISES Taiwan</b>   | May       | <a href="http://isestaiwan.com">isestaiwan.com</a>   |
| <b>Computex</b>  | June      | <a href="http://www.computextaipei.com.tw">www.computextaipei.com.tw</a>                                   |
| <b>Semicon Taiwan</b>  | September | <a href="http://www.semicontaiwan.org">www.semicontaiwan.org</a>   |
| <b>DV-Con Taiwan</b>   | September | <a href="http://www.dvcontaiwan.org">www.dvcontaiwan.org</a>   |
| <b>RISC-V Taipei Day</b>   | September | <a href="http://www.riscv.org/event/2023-risc-v-taipei-day">www.riscv.org/event/2023-risc-v-taipei-day</a> |
| <b>Taitronics</b>  | October   | <a href="http://www.taitronics.tw">www.taitronics.tw</a>   |
| <b>TSIA Annual Convention</b>  | October   | <a href="http://www.tsia.org.tw">www.tsia.org.tw</a>   |

Source: Intralink Research

## Market entry strategies

Entering the Taiwanese market holds immense strategic value for a UK semiconductor company, primarily driven by Taiwan's status as a global technology hub. The island's well-established semiconductor industry, integrated supply chain, and proximity to key Asian markets present compelling opportunities. Collaborating with local suppliers and manufacturers can optimise production processes, reduce costs, and enhance supply chain efficiency. Moreover, Taiwan's robust research and development ecosystem, policy support, and a growing demand for semiconductors across various industries make it an ideal market for innovation and business expansion. Strategic partnerships within the collaborative Taiwanese semiconductor ecosystem further underscore the potential benefits for a UK company looking to establish a presence in this dynamic market.

### Direct sales from the UK

This is the simplest option. The main downside is the lack of local time-zone customer support. This can be mitigated by using a local agent or business development consultancy, capable of bridging time-zone, language, and cultural gaps without the long-term commitment of local incorporation and hiring. Factors to consider include:

- Do we have a strong differentiator – something that sets us apart from our competitors in the market?

- Do we have a strong track record in other major markets?
- Are we willing to localise the product for the market and/or local regulations, if necessary?
- Are we ready to provide a Proof of Concept (PoC) at little or no cost to the customer? Taiwanese public sector-led initiatives, for example Taipei Smart City, do not pay suppliers for PoCs
- How do we provide after-sales support?
- Do we understand the local regulations, particularly in relation to data and compliance to US led export controls?
- Do we need to adjust our business model to adapt?

### Agents and business development consultancies

These can help answer the above questions and provide sales channels on their own or with a local distributor. Sales agents are usually local industry veterans that have built up connections and relationships over their career and now use these to help firms navigate the Taiwan market. These can be relatively cost-effective ways to hit the ground running but have some drawbacks. For instance, there is no set way to find such a person, they often do not have a website, so it is usually a case of being introduced through industry connections or meeting at an exhibition. These agents usually rely entirely on the connections they already have, once these are extinguished, they may struggle to create new leads as they prefer to stick to their relationship circle.

This makes them cost-effective in the beginning but can create limitations down the line, which often results in bringing in distributors, or a business development consultancy.

There are a wide range of business development consultancies, and it is important you find the right one for your technology and business needs. Services between firms vary widely – from initial market research assessments, market entry strategy initiatives, to others that may also provide a sales and/or business development team for your product in Taiwan. Such a team will act as your sales team on the ground and provide you with a local office address overnight. They can be found through online search, but it is important you use one that has experience with the semiconductor industry and make sure the team that is appointed to your account also has this experience. Such consultancies often deal with many different industries, so it is important to appoint one with experience in semiconductors.

## Appointing a reseller or distributor

Another approach to the market is to seek a partnership with an established local company that complements your product, has experience in the target sector, and can help navigate the legal environment. A local channel partner can provide services such as certification, registration, pre-sales, sales, consulting, installation, technical training, service maintenance and technical support. Factors to consider when seeking a partner include:

- Does the partner already serve the type of customer that we do? Does it offer a similar or complementary solution?
- Does the partner have a good understanding of the market in general and my particular application?
- Is the partner focused on short-term wins or will they be able to drive our business in the long run?
- Does the partner have specific experience with public sector projects (if relevant)?
- Are we comfortable communicating with the local partner and are they transparent with us?
- Will the partner proactively promote and sell my product, or will my product simply be one among a catalogue of products?
- Do we need a sales agent or consultancy to help us manage the distribution partner?

Like anywhere else in the world, it is important to find distributor that understands your product, has experience with similar technologies, and is proactive in promoting your product. Large global distribution companies such as Digikey or Avnet are all active in Taiwan so if you are using these elsewhere in the world, this can be easily replicated. However, for smaller fabless firms, or for those in other parts of the value chain, more specialised distributors are required.

There is no one distributor that ‘fits all’. It is important to find one that suits you, and to appoint the correct partners from the outset. For example, the size of partner can be important. A small semiconductor firm partnering with a large distributor may find salespeople focus on large brand partners that make up most of their revenue. A smaller firm may work hard but might not have the connections or experience in your part of the industry value chain.

## Establishing a local presence

There are broadly three ways of establishing a local presence: (1) a liaison office, (2) a branch office or (3) a local corporation through foreign direct investment (FDI). Setting up a liaison office is a simple process, but a liaison office can only perform non-profit generating activities in Taiwan such as market surveys, research and development, and quality assurance.

Setting up a branch office can be a complicated process that requires translating documents, but it allows for sales activities and the exchange of revenues with the head office. The most common process for a foreign firm to open a branch office in Taiwan is through FDI, where an initial investment is made by the head office, which in return owns stock in the branch. The local corporation leads independent activities and is authorised to perform direct transactions.

Market-specific factors to consider when establishing a local presence in Taiwan include:

- Is our business generating enough revenue in Taiwan to consider a local presence? Businesses usually consider establishing a local presence after several years of sales (either direct or through a partner)
- Is Taiwan a strategic market for us, either in terms of securing use-cases or securing further funding?
- Do we need to engage in profit generating activities?
- Will we transfer staff from our head office or hire local staff?
- What location shall we pick for our local presence? Scouting, negotiating, and conclusion of contracts are time-intensive processes that often are hard to conclude without local support.

There are many service companies that can assist you in setting up a local presence in Taiwan. Such companies can often also help with legal, HR, accounting, and payroll as well once the local company is established. In some cases, this could be the consultancy you may have used in your initial market entry or a specialised legal firm or consultancy that only provides this specific service. Many such companies can be found online. Make sure you speak to several companies to find the best one for you, but also ask third parties, especially others who have set up in Taiwan for their recommendations. The British Chamber in Taipei has a short guide here on how to set up business operations in Taiwan.

# About this report

This report is prepared as part of the UK-APAC Tech Growth Programme by Intralink Limited.

## Exchange rates used in the report

GBP 1 = JPY 190

GBP 1 = KRW 1700

GBP 1 = NTD 39.22

## About Intralink

The UK-APAC Tech Growth Programme is a government-backed initiative to support the UK's most innovative tech companies' expansion in the Asia Pacific region.

It spans eleven territories: Japan, Korea, Taiwan, Singapore, Vietnam, Malaysia, the Philippines, Thailand, Indonesia, Australia, and New Zealand.

Any UK-headquartered technology startups and scaleups keen to develop opportunities in APAC are eligible for the programme. The goal is to set the companies up for APAC success by helping them:

- Understand if there is an opportunity – and learn how to approach the region

- Validate which potential customers and partners will be interested in their technology – and get the customers' eyes on their product
- Accelerate in-market opportunities, secure partnerships and lay the foundations for commercial success in the target market(s)

Depending on the participants' readiness level, they can be selected for a wide range of free or subsidised activities – from business matching with major corporates to overseas missions, pitch events, and bespoke in-market business development initiatives.

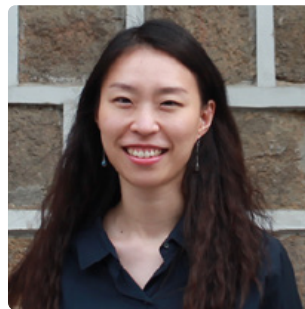
The programme is a joint initiative led by the Department for Business and Trade, the Department for Science, Innovation and Technology and Intralink.



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## Glossary

|        |  |
|--------|--|
| AI     | Artificial Intelligence                    |
| ATP    | Assembly, Test and Packaging               |
| BGA    | Ball Grid Array                            |
| CMOS   | Complementary Metal Oxide Semiconductor    |
| CoWoS  | Chip on Wafer on Substrate                 |
| CPU    | Central Processing Unit                    |
| DRAM   | Dynamic Random-Access Memory               |
| DUV    | Deep Ultraviolet                           |
| EDA    | Electronic Design Automation               |
| EUV    | Extreme Ultraviolet                        |
| FD-SOI | Fully Depleted Silicon on Insulator        |
| FinFET | Fin Field Effect Transistor                |
| GAA    | Gate-All-Around                            |
| GaAs   | Gallium Arsenide                           |
| GaN    | Gallium Nitride                            |
| GPU    | Graphics Processing Unit                   |
| HBM    | High Bandwidth Memory                      |
| HPC    | High-Performance Computing                 |
| IC     | Integrated Circuit                         |
| IDM    | Integrated Device Manufacturer             |
| InFO   | Integrated Fan-Out                         |
| InP    | Indium Phosphide                           |
| NAND   | Not-And                                    |
| OSAT   | Outsourced Semiconductor Assembly and Test |
| SME    | Semiconductor Manufacturing Equipment      |
| SiC    | Silicon Carbide                            |
| SiP    | Silicon in Package                         |
| SoC    | System on Chip                             |
| TSIA   | Taiwan Semiconductor Industry Association  |
| WLP    | Wafer Level Packaging                      |



# Northeast Asia's semiconductor market - opportunities for UK companies

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The information contained herein has been obtained from sources believed to be reliable, but is not guaranteed as to its accuracy or completeness. An effort has been made to go beyond simple data collection in this report: responses have been interpreted to elucidate the underlying processes, motives and relationships involved in the dynamics of the situations under investigation.

All references to factual data and properties should be recognised as respondents' perceptions of reality unless otherwise stated.

This report is not intended for, and should not be used as, an investment recommendation.