

Market Share Analysis: Semiconductor Foundry Services, Worldwide, 2021

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Initiatives: [Technology Market Essentials](#)

Revenue for semiconductor foundry services jumped 31.3% in 2021 to \$100.2 billion. Raised wafer selling prices with long-term agreements and/or prepayments due to the chip shortage and the high demand were the main reasons for the great business.

Additional Perspectives

- [Invest Implications: Market Share Analysis: Semiconductor Foundry Services, Worldwide, 2021](#)
(16 May 2022)

Overview

Key Market Findings

- The 31.3% growth of foundry revenue to \$100.2 billion in 2021 (versus up 22.5% in 2020) was the combination of the 11.5% raised wafer overall ASP and the 17.8% wafer shipment increase.
- During the year, the fab utilization rate for the foundry industry stayed over 95%, with a particularly tight supply of 200 mm wafers for power management ICs (PMICs), driver ICs and fingerprint sensors.
- Reversing the declining pattern of the last few decades, wafer selling prices were raised in 2021 for all nodes, mature or advanced, some as high as 30%.
- Gaining confidence by having long-term agreements (LTAs) signed with customers accompanied by purchase prepayment, many foundries lifted capital expenditure (capex) to record highs in 2021 and extending further in 2022.

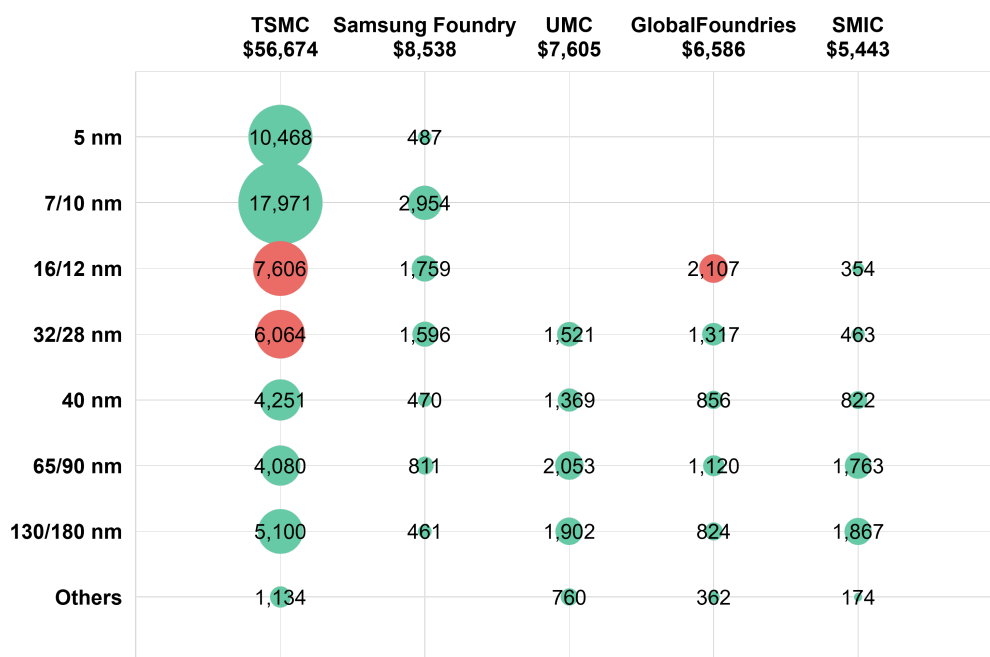
Vendor Performance Highlights

- The top 10 foundries received 93% of the total foundry revenue in 2021 as Taiwan-based foundries held 68.4% of the market share.
- TSMC maintained its leadership with 56.6% market share from the increased shipment of 7 nm and 5 nm nodes, serving Apple, AMD, MediaTek and others.
- Three foundries managed to increase their revenues by an astonishing 60% in 2021 – Samsung Foundry, PSMC and Shanghai Huahong Grace Semiconductor Manufacturing.

Market Share Data

Worldwide foundry business growth was fueled not only by advanced nodes but also by revenue on all legacy and mature nodes. Figure 1 shows the foundry supplier revenue by process nodes and rankings of the top 10 vendors.

Figure 1: Top Five Semiconductor Foundry Providers' Revenue (Millions of U.S. Dollars) by Advanced Nodes, Worldwide, 2021



Source: Gartner (May 2022)

Note: The size of the bubble and value equal 2021 revenue (millions of U.S. dollars), and the color coding equals positive or negative year-over-year change. A green bubble represents positive change, and a red bubble represents negative change.

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Table 1: Top 10 Companies' Sales Revenue From Shipments of Foundry Wafers to External Customers, Worldwide, 2021 (Millions of U.S. Dollars)

(Enlarged table in Appendix)

2021 Rank	2020 Rank		2020	2020 Market Share (%)	2021	2021 Market Share (%)	Year-Over-Year Change
1	1	TSMC	45,562	59.7%	56,674	56.6%	24.4%
2	3	Samsung Foundry	5,150	6.8%	8,537	8.5%	65.8%
3	2	UMC	6,009	7.9%	7,606	7.6%	26.6%
4	4	GlobalFoundries	4,850	6.4%	6,585	6.6%	35.8%
5	5	SMIC	3,907	5.1%	5,443	5.4%	39.3%
6	6	PSMC	1,345	1.8%	2,340	2.3%	74.0%
7	9	Shanghai Huahong Grace Semiconductor Manufacturing	961	1.3%	1,631	1.6%	69.7%
8	8	VIS	1,126	1.5%	1,570	1.6%	39.4%
9	7	Tower Semiconductor	1,266	1.7%	1,508	1.5%	19.2%
10	10	Shanghai Huali Microelectronics (HLMC)	942	1.2%	1,298	1.3%	37.8%
		Top 10	71,117	93.2%	93,193	93.0%	31.0%
		Others	5,179	6.8%	7,001	7.0%	35.2%
		Total Market	76,296	100.0%	100,194	100.0%	31.3%

Source: Gartner (May 2021)

The following highlights help to understand the top vendor revenue changes.

The combined revenue of the top 10 foundries grew 31.0% in 2021 to reach \$93.2 billion, which accounted for 93% of the foundry business globally. The ranking of the top 10 foundries changed slightly in 2021 from previous years due to high growth by Samsung Foundry and Shanghai Huahong Grace Semiconductor.

- TSMC again maintained its revenue growth and market leader position, although its market share declined by 3% due to the less-aggressive wafer price hike than the second-tier foundries.
- Samsung Foundry manufactures wafers for both internal use and for the purpose of external foundry, which is estimated as \$8.5 billion in 2021 revenue. The revenue grew from many U.S. customers including Qualcomm, NVIDIA and Tesla on both 8 nm and 14 nm nodes.
- UMC, No. 3, was able to achieve 26.6% growth by delivering the optimum performance using 28 nm and other more-mature process nodes to meet customers' demand on cost and features.
- GlobalFoundries was IN the No. 4 position by serving FinFET, BCD, RF-SOI, SiGe and FD-SOI specialty technologies. Its sole sourcing strategy had successfully locked customers in.
- SMIC registered 39% growth by serving domestic Chinese customers for 14 nm and wider-geometry nodes.
- Powerchip Semiconductor Manufacturing Corp. (PSMC) jumped to No. 6 by being able to fully take advantage of the chip shortage by adjusting its wafer prices quarterly in 2021, serving the driver IC and low-density DRAM foundry market.
- Shanghai Huahong Grace Semiconductor, No. 7, achieved strong growth when 75% of its revenue was serving Chinese customers in MCUs, smart cards, super junction, power MOSFET and discrete.
- Vanguard International Semiconductor (VIS) has been the only foundry outside China that has been more aggressively expanding its 200 mm capacity to serve high-demand PMICs and display driver ICs.
- Tower Semiconductor fell to No. 9 but had a nice rebound in the second half of 2021. The company has agreed to be acquired by Intel, pending legal approval.
- No. 10, Shanghai Huali Microelectronics (HLMC) had an increase in revenue for serving the high-demand CMOS image sensor market for premium smartphones.

Overall Market Segment Performance Analysis

As the global economy bounced back in 2021, shortages appeared throughout the semiconductor supply chain. Initially, the chip shortage started with devices fabricated on legacy nodes at 200 mm fabs and foundries, which are capacity-constrained. This shortage particularly affected the automotive market, which saw considerably reduced demand in 2020 but found capacity booked out when demand rebounded in 2021. Devices facing severe shortages included power management integrated circuits (PMICs), microcontroller units (MCUs), metal-oxide semiconductor field-effect transistors (MOSFETs), display driver integrated circuits (DDICs), discrete and analog. The situation has then extended to other parts of the semiconductor supply chain, including capacity constraints and shortages for substrates, wire bonding, passives, materials, and testing. These are highly commoditized industries with minimal flexibility/capacity to invest aggressively at short notice.

A series of events led to the current chip shortage situation that has impacted OEMs across the globe.

These include:

- The U.S.-China trade war in mid-2018 that led to Huawei being placed on the U.S. Entity List, which caused OEMs to pile up inventory
- The arrival of the 5G era, which required more semiconductor content in smartphones
- The COVID-19 pandemic, which created an unexpected demand for consumer electronics with higher semiconductor content and the expansion of data centers as hyperscale players stepped up investments in response to online activity in lieu of face-to-face interaction

Additionally, the following events worsened the supply-demand balance of chips and stressed the chip supply chain at various points:

- Huawei was banned from receiving wafers from all key foundries in September 2020.
- The leading foundry in China, SMIC, was placed on the Entity List in December 2020.
- A Texas winter storm in the U.S. in March 2021 caused several factory shutdowns, including the fab of Samsung Foundry.

- The earthquake and fab fires, including Renesas, occurred in Japan. .

A combination of strong demand and logistics/raw material price increases drove semiconductor ASPs higher, helping to contribute to the revenue growth of semiconductor chip and foundry business in 2021.

Market share data by Gartner shows that worldwide semiconductor revenue increased 26.3% in 2021 to \$595.0 billion with revenue increasing \$124.1 billion over 2020. The nonmemory semiconductor segment was \$429.2 billion in revenue at \$23.9% growth in 2021. The foundry industry follows closely the growth pattern of the nonmemory semiconductor market as most logic application chips were designed by fabless customers and manufactured by foundries. As fabless customers, such as AMD, Novatek Microelectronics and MediaTek, were 2021's fastest growers among the top vendors, foundries benefited greatly from their success.

Foundries' capex in 2021 reached a historic high at \$51.0 billion, 49.1% higher than the previous year, mostly due to the continuously upward adjusted spending in expanding 300 mm fab capacity and new fab projects. Foundries gained confidence in future business when LTAs were signed with prepaid purchase by customers. However, the 200 mm capacity expansion by foundries has been insufficient due to the lack of used fab equipment, and the tight supply of legacy chips served by 200 mm fabs could last for a long time.

Top Vendors Analyzed

TSMC

TSMC maintained its continuous revenue growth in 2021 with very aggressive capex to increase fab capacity, including some overseas new fabs announced.

The highlights of TSMC in 2021 include the following:

1. A strong adoption of its 5 nm and 7 nm technologies by customers in high-performance computing, 5G smartphones and the IoT occurred. In 2021, TSMC is estimated to have a higher than 90% market share in both the foundry 5 nm and 7 nm technology nodes.
2. Fast ramping of its services to the automotive market in an effort to ease the chip shortage resulted in a nearly 70% increase of the automotive revenue to \$2.3 billion.

3. TSMC maintained highly utilized 200 mm and 300 mm fabs on all nodes from 770 thousand wafers per month (kwpm) 200 mm wafer capacity and 847 kwpm 300 mm wafer capacity in 2021, according to Gartner estimates.
4. TSMC made super aggressive capex: \$30 billion in 2021, versus \$17 billion in 2020, to bring more capacity online in 2024 and 2025.
5. TSMC continued to invest in advanced packaging technology which has contributed more than \$4.1 billion revenue in 2021.
6. TSMC broke the ground for a new fab in Arizona and jointly announced a new 300 mm fab with specialty technology of 22/28 nm and 12/16 nm processes in Japan with Sony and Denso for manufacturing CIS and automotive chips.
7. Wafers produced by TSMC contributed to more than a quarter of the worldwide output value of semiconductors excluding memory in 2021.

The company's 5 nm wafers have generated a sizable \$10.5 billion of revenue, combined with \$17.9 billion generated by 7 nm. These two bleeding-edge nodes accounted for 50% of the company revenue, while 16/12 nm had \$7.6 billion. A higher mixture of advanced-node shipments and good yield lifted the company's gross profit margin to 52.7% in the fourth quarter of 2021. TSMC has benefited from the lack of competition from other foundries and the high demand from major applications for AP, CPUs, GPUs and FPGAs. Although never disclosed by TSMC, the top customers on the advanced wafers are believed to include Apple, AMD, MediaTek, NVIDIA, Qualcomm, Broadcom, Marvell, Xilinx and Will Semiconductor.

In advanced packaging technologies, TSMC's 3DFabric family offers Integrated Fan Out (InFO), Chip on Wafer on Substrate (CoWoS) and TSMC-SolC solutions. For high-performance computing applications, TSMC offers larger reticle size by InFO-oS and CoWoS enabling larger floor plans for chiplets and high-bandwidth memory integration. The chip-on-wafer version of SolC has been qualified for 7 nm-on-7 nm with production targeted in 2022.

The most outstanding news of TSMC in 2021 was the success in attracting more new business from Intel, while being able to maintain great relationships with existing customers such as AMD, Qualcomm and Apple. With its 3 nm N3 entering volume production later in 2022 with good yield and 2 nm N2 development being on track for volume production in 2025, TSMC is expected to continue its technology leadership to support its customer innovation and growth. Thanks to the demand of bleeding-edge technologies, TSMC's foundry leadership position seems to have become even more concrete in recent years.

Samsung Foundry

Samsung's foundry serving third-party customers is separate from its semiconductor revenue, according to Gartner's definition. This is different from Samsung's own definition of Samsung Foundry, which includes business from the captive use of logic fabs for manufacturing internally on CIS, OLED driver ICs and PMICs. Samsung's nonmemory revenue included business from Samsung Foundry and Samsung System LSI Division, two different entities totaling more than \$18 billion. Their foundry business serving third-party customers was \$8.537 billion in 2021 revenue.

Three large U.S. customers of Samsung's foundry business more than doubled their business in 2021. Qualcomm moved from a TSMC N7P process to Samsung 5LPE node for its Snapdragon 888/888 Plus, and the 5G modem and Qualcomm's transceivers were manufactured by Samsung's 14 nm. NVIDIA's consumer Ampere GPUs, or GeForce the RTX 3000 series, have been manufactured by Samsung's 8 nm technology while the volume continued to increase in 2021. Tesla has increased the purchase of self-driving chips in its hardware 3.0 computer manufactured by Samsung's 14 nm wafers for the purpose of normal production use as well as for the large quantity of automobile recalls happening in 2021. Tesla's new-generation chips for autonomous driving did not get produced until 4Q21 by Samsung's 5 nm technology. During the Austin fab shutdown caused by Texas snow in 1Q21, Samsung's wafer delivery to Qualcomm and Tesla were both affected. In addition, Samsung seems to do well in attracting new customers, it has also been reported that STMicroelectronics would use Samsung Foundry's 14 nm process for MCU production in 4Q21. The chips will be used for Apple's next-generation iPhone models. Until 2021, STMicroelectronics produced the MCU in its own fabs. Also reported is that a Microsoft ASIC may use Samsung for wafer outsourcing.

Due to the chip shortage and after TSMC's 4Q21 wafer price increase, Samsung Foundry has followed suit to do the same. Samsung's wafer selling prices were raised as much as 20% late last year. As the company reported, the foundry business set a new revenue high for 4Q21 when it increased sales for large-scale HPC customers and secured new orders in HPC applications.

Samsung System LSI Division has increased the outsourcing to external foundry services because of the lack of production capacity in its own fab at Samsung Foundry. In our estimate, Samsung 300 mm logic capacity excluding CIS fab in 2021 was 215 kwpm for both internal System LSI Division and foundry purposes. Samsung began to outsource the OLED driver IC manufacturing by UMC and LCD driver IC by Nexchip 55 nm in China, which caused both companies to aggressively expand their fab capacity. Also noticeable is that Samsung has been on the key customers list in the GlobalFoundries IPO disclosure.

UMC

The 26.6% revenue growth of UMC was a combination of a 10.6% increase in wafer shipments and a 14.4% increase in wafer selling prices. The improved cost structure from the high loading of fabs and the low depreciation cost from the conservative capex of the past few years allowed the gross profit margin of the company to rise, approaching 40% versus 19% of the previous years.

The decision in earlier years to drop off 7 nm development in the race to Moore's Law seems to have paid off. UMC was successful to deliver the sweet-spot technologies using the optimum process nodes. UMC was the first Taiwan-based foundry to have successfully developed a 28 nm high-voltage process in AMOLED panel driver IC production and further advanced to 22 nm process capabilities. This enabled the company to have won new outsourcing business from Samsung on ISP and AMOLED driver products. The success of 28 nm technology became well-served to applications in WiFi 6 for the IoT, ISP, RF switch, SSD, OLED drivers and some 5G transceivers, while 28 nm capacity was expanded by 20% in 2021 with another 20% increase planned in 2022.

Challenged by the conventional practice, UMC was among the first few foundries to have informed customers in early 2021 on the raised wafer prices. Actually, UMC continued to raise prices a few times during the year for being able to meet customers' demand on cost and performance. Its blended ASP was adjusted quarterly to have increased by 1.0%, 5.6%, 7.5% and 4.0% quarter over quarter. Exiting the year, the ASP reached \$834 per 200 mm wafer.

During this chip shortage year, both UMC's 300 mm and 200 mm fabs were fully utilized with reported utilization rate higher than 100% throughout 2021, allowing the annual wafer shipments to approach 10 million 200 mm equivalent wafers. UMC was also among the first few foundries to have signed an LTA in 2021 with customers. Such agreements have been accompanied by some types of financial commitment by customers, such as a wafer prepayment, a deposit or an interest-free loan. In 2Q21, with the prepayment for a few thousand monthly wafers by at least six customers, UMC became more comfortable to expand new fab capacity. Its Tainan Fab 12A Phase 5 was extended by 10 kwpm from 90 kwpm to 100 kwpm in 2021, while the next phase will be increased by 27.5 kwpm. The P6 expansion is scheduled for production in the later part of 2023, with total investment for the project at NT\$100 billion (US\$3.5 billion). In 2021, the actual capex spent by the company was \$1.8 billion. However, UMC in 2022 budgets for even higher \$3 billion capex, reflecting management's long-term view on a better business outlook which can be served only by a higher capacity.

In 2021, UMC had a share exchange to establish a long-term partnership with Chipbond Technology, a back-end company in Taiwan. Chipbond focuses on panel driver IC assembly and testing, flip chip bumping, and wafer-level chip scale packages (WLCSP) plus fan-out system-in-package (FOSiP) and flip-chip system packaging (FCSiP) technologies. Chipbond also has packaging technologies serving wide-bandgap materials, such as GaN, SiC and RF, matching well with the development strategies of UMC.

GlobalFoundries

In October 2021, GlobalFoundries and its investor Mubadala Investment successfully raised \$2.6 billion in IPO as the third biggest listing on the U.S. exchange of this year. GlobalFoundries was appealing to the public-market investor as interest in semiconductor manufacturing is at an all-time high in the severe chip shortage environment.

The revenue of GlobalFoundries increased significantly due to a 16% increase of wafer selling prices and a 17% increase of wafer shipments estimated to have reached 2.4 million wafers. The company had a great execution plan in mixing up the 300 mm fabs in Malta and Dresden on FinFET and FD-SOI, while 200 mm facilities in Burlington and Singapore offered customers differentiated single-source SOI, SiGe and BCD technologies.

The company has also been aggressive in the automotive market, which generated 5% of the company revenue in 4Q21, double that from a year ago. GlobalFoundries in 2021 also made key partnerships with Ford, BMW and Bosch.

A long list of customers, including Samsung, Broadcom, NXP, Qorvo, Skyworks and others, was disclosed in the filing to the U.S. Securities and Exchange Commission for the initial public offering (IPO) ([Form F-1 Registration Statement GLOBALFOUNDRIES Inc](#)).

It is impressive that revenue from the U.S. customers still accounted for two-thirds of the company's revenue. One key customer, AMD, has moved some wafer purchases from GlobalFoundries' 14/12 nm to use TSMC's 7 nm technology, but then in 4Q21 the company announced an extension of its supply agreement with AMD to supply wafers through 2025. Many of GlobalFoundries' customers have signed agreements secured through some financial commitment to wafer purchase. The company claimed to have secured \$30 billion worth of business by having signed LTAs with 30 customers, committing more than \$3.2 billion toward the continued expansion of its global manufacturing footprint. With the increased confidence over future business, GlobalFoundries will increase its capex from \$1.8 billion in 2021 to \$4.5 billion in 2022. In June 2021, the company started the construction of a new 300 mm fab at its Singapore campus with an investment of over \$4 billion. At the completion targeted by 2023, GlobalFoundries expects to add a production capacity of 450,000 wafers per year to its manufacturing lines.

SMIC

As the most advanced manufacturer of logic process technology in China, SMIC is the Chinese iconic semiconductor manufacturer, headquartered in Shanghai, offering CMOS planar to FinFET technology manufacturing services. With the successful management and operation, SMIC was able sustainably to maintain the No. 5 position in the foundry ranking in 2021 with \$5.44 billion dollars in revenue.

SMIC's management team operated the whole company under the high stress of the Entity List, supply chain restrictions from the U.S. Department of Commerce (especially for critical process equipment applied in advanced technology nodes lower than 10 nm), and the uncertainty of the COVID-19 pandemic. Still, SMIC maintained great revenue growth from mature technology nodes of 150/180/60/40/55/28 nm and 14 nm FinFET platform, driven by applications in consumer electronics, smartphones and smart home. Revenue contribution was the highest from Chinese customers at 63.8% or \$3.5 billion, an increase of 40% from a year ago, while the revenue from North American customers was 22.7% or \$1.3 billion, a 36% YoY increase. For the entire year in 2021, SMIC's 39.3% revenue growth was the result of a 15.4% of wafer price increase and an 18.4% increase in wafers shipped. Due to the serious capacity shortage globally, like most other competitors, SMIC was able to raise the wafer ASP, which reached \$830 per 200 mm equivalent wafer by 4Q21 when the gross profit margin jumped to 35.0%.

By having spent \$4.5 billion capex in 2021, the company expanded the fab capacity by 18% through the adding of 45k wpm of 200 mm capacity to reach 302k wpm; and 10k wpm of the 300 mm capacity to reach 120k wpm, SMIC was able to increase the wafer shipment in 2021 by 19% reaching 6.7 million 200 mm equivalent wafers to satisfy the market demand. SMIC plans to spend another \$5.0 billion capex in 2022 to further increase 200 mm fab capacity and 300 mm fab capacity by 40 kwpm each. With three new 300 mm fabs under construction at Shenzhen, Lingang and Beijing, SMIC intends to triple its 300 mm capacity output over the next few years.

In the technology offerings, SMIC's 22 nm low-power-consumption platform became ready for customer engagement for applications in IoT, digital TV, portable and consumer devices. The 28 nm HPC+ Platform came to the customer engagement phase, for applications in smart home, internet model, Wi-Fi, mobile and microwave devices. SMIC completed 40 nm eFlash development and achieved 65 nm and 55 nm NOR flash process set up for applications in Bluetooth and TV set-top boxes. In 2021, SMIC also completed the NAND flash SSD products qualification, took 38 nm NAND flash products to mass production, and made a 24 nm SLC production start in a low-volume phase.

Powerchip Semiconductor Manufacturing Corp. (PSMC)

Renamed from the merger of Maxchip Electronics and Powerchip Technology, PSMC had a successful IPO in December 2021 with its smooth transition to the foundry business after retreating from commodity DRAM. Today PSMC is the only foundry company offering DRAM specialty technologies to benefit from the tighter supply of low-density consumer, auto and IoT for legacy DDR2/DDR3 standards. While still producing 55 nm to 75 nm DRAM for Taiwanese fabless customers such as AP Memory and Etron, the company has benefited from the lack of competition in these mature-node memory technologies to have won more than 50% of the low-density DRAM market. Starting in 2021, we have classified all its DRAM sales as foundry revenue.

With the strategy not to compete with TSMC on advanced nodes, but to offer solutions to customers seeking alternatives to UMC and VIS in Taiwan, PSMC has developed its logic technologies for foundry business in both its 300 mm and 200 mm fabs addressing PMICs, CISs, driver ICs and MCUs. The company has declared some cost advantages using aluminum interconnect versus copper layers.

In 2021, the fast growth of the company was mainly supported by continued full utilization of all fabs when logic chips were in shortage and memory in high demand. More than 75% of both the logic and memory business has been secured by LTAs. Sequentially quarter over quarter revenue growth has been double-digit, allowing the company to achieve a 48% gross profit margin exiting 2021.

The company owns three 300 mm fabs with 50 kwpm on memory and 55 kwpm on logic and two 200 mm fabs at about 125 kwpm. In March 2021, the company broke ground for a new 12-inch wafer fab at the Tongluo area of the Hsinchu Science Park. The new fab is designed for an installed capacity of 100,000 12-inch wafers monthly, which will be put into production in phases starting in 2023.

Shanghai Huahong Grace Semiconductor Manufacturing

Foundry companies Shanghai Huahong Grace Semiconductor Manufacturing (HHGrace) and Shanghai Huali Microelectronics Corp. (HLMC) are among the member companies of the Huahong investment group. Shanghai Huahong Group in 2017 renamed all the wafer fabs under the group, now offering 1 micron to 28 nm technology nodes, which allow customers to identify wafer foundry services under the group.

Huahong Grace revenue reached \$1.631 billion at 69.7% growth in 2021 from \$961 million in 2020, making it No. 7 in revenue ranking in 2021. This significant achievement benefited from its “8+12” strategy in serving the China local market. Of the company’s 2021 revenue, 75.5% came from local Chinese customers, 10% from the U.S. and 12% from other Asian customers. Three 200 mm fabs operated by the company have 180 kwpm capacity in higher than 100% utilization rate, and the ASP of these 200 mm wafers improved to \$494 per wafer in 2021 from \$434 in 2020. The company’s 300 mm Wuxi fab experienced rapid capacity increase due to the Phase 2 expansion from 20 kwpm in 2020 to 60 kwpm. Further expansion of Phase 3 of 30 kwpm is planned by 2022. During such a ramping phase, the 300 mm wafer ASP went up to \$1,081 in 2021, increased from \$952 a year before.

The highest technology nodes contributed to revenue was 0.35 micron at 41% while 90 nm generated 20%. Thirty-three percent of the revenue was from discrete, 26% from eNVM, and 16% each from logic/RF and analog. In meeting the use in smart card ICs, microcontrollers, power and discrete, the company has a wide technology portfolio on insulated-gate bipolar transistors (IGBTs), MOSFETs, super junction, MCU, eFlash, NOR Flash, CIS, specific RF and BCD technology to serve applications from smart card, consumer, industrial to automotive electronics.

Vanguard International Semiconductor (VIS)

VIS made a record high \$1.57 billion revenue in 2021 to achieved 39.4% growth from the combination of a 15% wafer ASP increase and 21% shipment growth. Higher ASPs started in 1H21, and many LTA with customers were secured during 2H21.

VIS has been the only Taiwanese foundry in aggressively expanding the 200 mm during a particularly tight supply year. The new AUO fab purchase with 40,000 8-inch wafers per month allowed the company's total 8-inch capacity to be increased to 250 kwpm, while more 8-inch capacity is planned for 2022 and 2023.

The gross profit margin rose from 37.4% a year ago to a record high 47.6% in 4Q21. The company has experienced strong growth by serving the high PMIC (which was 8% of the company revenue) and the growth of high resolution drive IC market for small displays (10% of the revenue), although driver ICs for large displays still accounted for 27% of revenue.

Of the revenue, 56% now comes from 0.18 micron and finer geometries, while 0.5 micron and wider nodes accounted for 17%. The company has been in a seller's market with a choice to selectively serve preferred customers at higher revenue/margin.

Shanghai Huali Microelectronics Corp. (HLMC)

HLMC operates two 300 mm fabs with 75 kwpm capacity, offering 65 nm complementary metal-oxide semiconductor (CMOS) image sensors (CIS) and 55 nm embedded flash, NOR and logic process technologies and 55/40/28/22 nm logic technology process platforms and specific technology including CIS, RF IC, high voltage, eNVM, low power and stand-alone NOR flash device solutions. HLMC ranked No. 10 and had 31% YoY growth due to a 15% wafer ASP increase and a 14% wafer shipment increase. Its \$1.298 billion revenue of 2021 was 74% from 65 nm node, 11% from 55 nm and 14% from 28 nm.

Intel Foundry Services (IFS)

Under the new CEO, Intel in 2021 decided to give its foundry business another try by forming a new division, IFS, and having actively recruited experts from the foundry industry. Also, Intel intends to regain its leadership in the Moore's Law race by having committed to a very aggressive development schedule of the renamed Intel7, Intel4, 3, Intel20A and Intel18A process technologies. Shown by Intel in its investor meeting in early 2022 was its 2021 IFS foundry revenue at \$0.9 billion. It is our judgment that only one-third of it was the actual wafer foundry manufacturing, and the majority was from ASIC design service and packaging services.

Mergers and Acquisitions

Since the beginning of 2021, there have been two proposed mergers and acquisitions in the foundry industry. In October 2021, SK hynix disclosed a proposal to acquire a 100% stake of Key Foundry for 575.8 billion won (US\$475 million) in a move to boost its presence in the foundry business. In February 2022, Intel proposed to acquire Tower Semiconductor for \$5.4 billion to expand its foundry services. Both deals were not officially completed as of today.

Document Revision History

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[Semiconductor Inventory Analysis, Worldwide, 4Q21 Update](#)

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