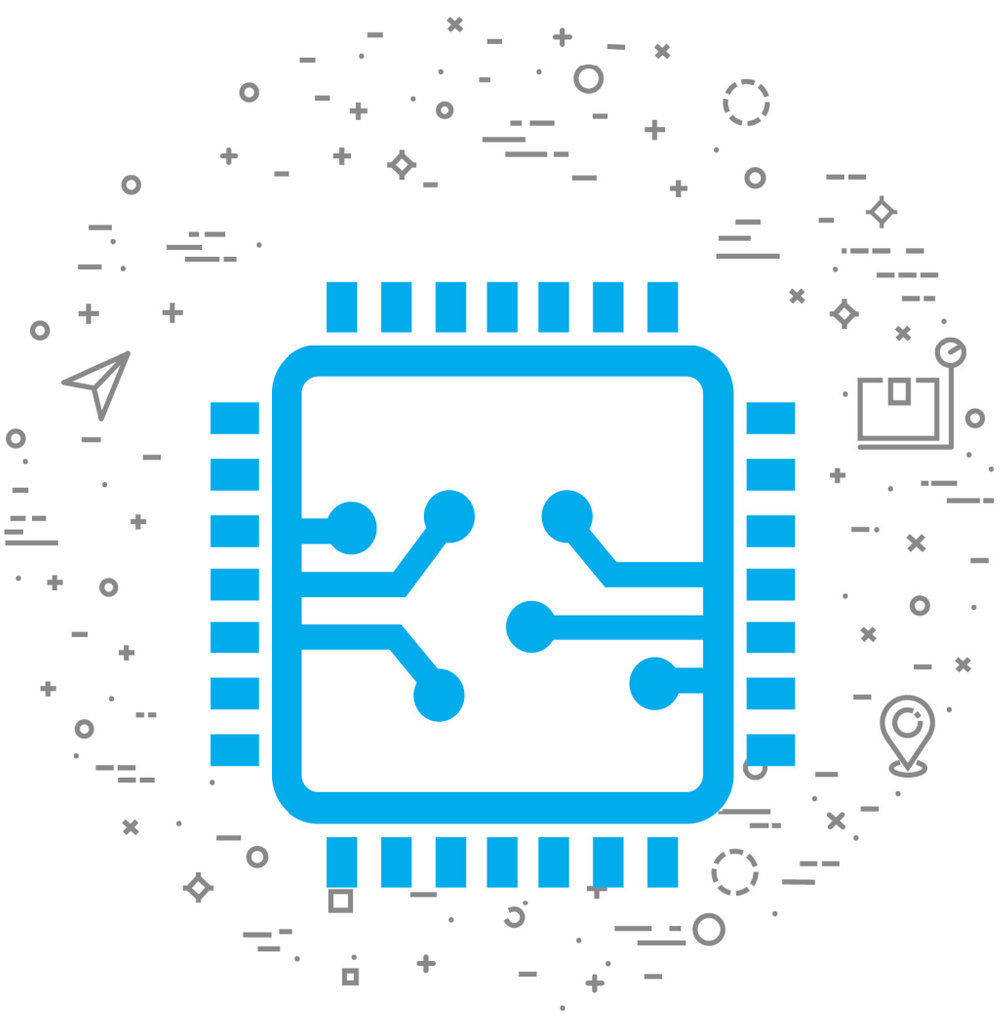
INVEST KOREA

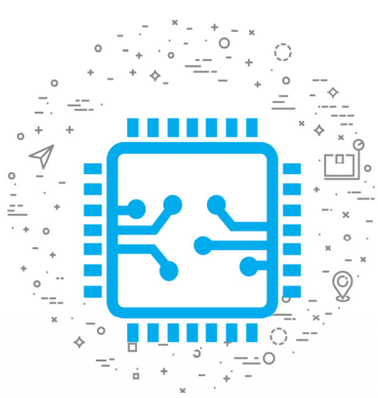
INVESTMENT
OPPORTUNITIES
IN KOREA

Semiconductor & Display



Contents

* Figures on the report show the likely adjustment of average yearly currency rates from Korean Won (KRW) to the US dollar (USD). A rate adjustment is adopted particularly reflecting the recent average market variations to eliminate the valuation effects arising from movements in exchange rates in case when the data expressed shows an annual growth rate on the paper.
* Rate adjusted figures are rounded off, but the sum is correct down or up to the decimal when the rounded values are not equal to the adjustment.



01

introduction

1 Industry Trends

Definition and Classification

- (Type) Semiconductors are divided into memory semiconductors that store and memorize data, system semiconductors that perform data processing functions (operation, control, etc.), and optical and discrete devices, such as LEDs and transistors/diodes.
  - As semiconductors are components of electronic products, they have different classification systems according to usage, technology, degree of integration, and manufacturing process.
- (Industrial areas) Industrial areas are divided into Integrated Device Manufacturer (IDM) that can design and manufacture semiconductors, such as Samsung Electronics (KOR) and SK hynix (KOR), fabless that specializes in design, such as Qualcomm (US) and Silicon Works (KOR), foundry such as TSMC (Taiwan) and DB HiTek (KOR), packaging and testing companies, such as Amkor Technology (KOR) and Nepass (KOR); and as a downstream industry with semiconductor manufacturing equipment companies, such as Applied Materials (US) and Wonik IPS (KOR), material producers, such as Shin-Etsu (Japan) and SK Siltron (KOR), and manufacturers of parts used in semiconductor equipment, such as MiCo (KOR) and Mecaro (KOR).

■ Semiconductor Company Classification ■

Classification	Characteristics	Major companies
IDM	Companies that perform all production processes, including design, manufacturing, test, and packaging	Samsung Electronics (KOR), SK hynix (KOR), Intel (US)
Fabless	Companies that only design and develop without semiconductor manufacturing facilities	Qualcomm (US), Nvidia (US), Silicon Works (KOR), MediaTek (Taiwan)
Foundry	Companies that manufacture circuits on consignment, designed by fabless	TSMC (Taiwan), GlobalFoundries (US), DB HiTek (KOR)
OSAT	Companies that assemble and test the finished wafers	Amkor (US), ASE (Taiwan), Hana Micron (KOR), Nepes (KOR)

- (Application fields) Semiconductors are widely used in various fields, ranging from toy to aerospace industries, and are recently gaining more attention as a key component driving the Fourth Industrial Revolution.
  - In the Fourth Industrial Revolution, most of the products are cross-sectoral smart ICT devices that are closely interconnected with each other (artificial intelligence, autonomous vehicles, IoT, wearable devices, drones, etc.). Thus, the demand for these devices is expected to increase as they help ease humans' daily activities.

1.1 Market Trends in Korea

- The total sales figure for Korea's semiconductors was USD 114.7 billion. In 2018, the sales for memory semiconductors were USD 101.6 billion, accounting for 88.6% of the total.

- In terms of sales in 2018, Korea accounts for 62% of the global memory semiconductor market. In particular, Korea occupies 72.4% of the global DRAM market and 49.7% of the global NAND market.
- As Korea is not only competitive in terms of proactive investment and advanced process technology but also holds a large technological gap with latecomers, the Korean memory semiconductors industry is expected to continuously lead the market.

Korean Semiconductor Sales Performance

(Unit: USD million)

Classification	2013	2014	2015	2016	2017	2018
Memory semiconductor	34,297	43,815	46,634	47,059	80,048	101,618
(Ratio)	67.8	76.1	79.1	80.4	86.8	88.6
System semiconductor	10,651	8,035	7,459	6,394	6,840	7,544
(Ratio)	21.1	14.0	12.7	10.9	7.4	6.6
Optical and discrete devices	5,603	5,718	4,835	5,073	5,353	5,496
(Ratio)	11.1	9.9	8.2	8.7	5.8	4.8
Total	50,551	57,568	58,928	58,526	92,241	114,658

Source: IHS Markit, 2019

- While Korea's memory semiconductors dominate the global market, the market share of Korean companies in the system semiconductor field is only 3%.
  - Compared with competing countries, Korea is not competitive in the number of companies, size, and human resources. Moreover, in terms of the base technology, Korea is in the stage of designing semiconductors by incorporating semiconductor design drawings, which were developed outside Korea and are subject to intellectual property (IP) rights.
  - Some Korean companies possess global competitiveness in the fields of home appliances, mobile, and automobile, but most of them have an insufficient connection with the semiconductor industry in Korea as they use the system semiconductors of foreign companies.
  - Although the industrial scale of semiconductor design firms (fabless) in Korea reached KRW 2 trillion (USD 2.15 billion) in 2006 through qualitative and quantitative growth, it did not grow further afterward and instead faced difficulty because of their small size, lack of high-quality human resources, lack of an ecosystem based on industrial cooperation, and weak price competitiveness.
- The localization rate of equipment is 20%, and the localization rate of material and parts is about 50%. These rates are constantly growing.

- Semiconductors are Korea's largest export item, recording USD 126.7 billion in 2018, which is a 29.4% increase compared to the previous year.
  - Memory semiconductors recorded USD 94 billion in exports, which is a 40% increase compared to the previous year. Meanwhile, system semiconductor exports amounted to USD 26.5 billion, a 4.4% increase compared to the previous year.
    * System semiconductor exports include packaging exports.
- Optical discrete devices worth USD 6.2 billion were exported, a 13.8% increase compared to the previous year.

Korean Semiconductor Export Trends

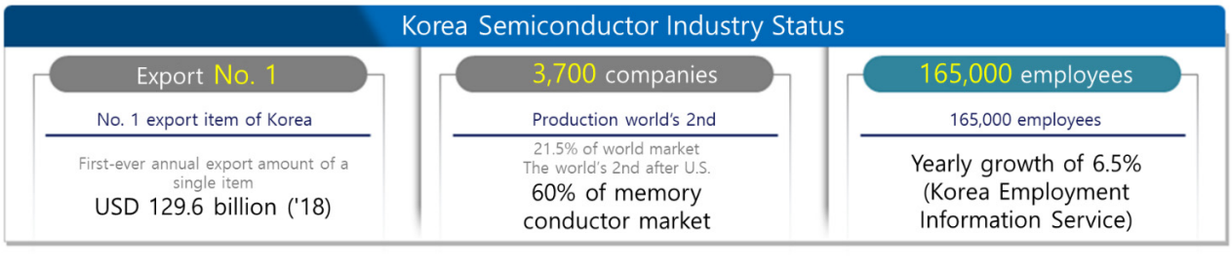
(Unit: USD million)

Classification	2013	2014	2015	2016	2017	2018
Semiconductor	**57,144**	**62,647**	**62,916**	**62,228**	**97,937**	**126,712**
(Rate of increase/ decrease)	**13.3**	**9.6**	**0.4**	**△1.1**	**57.3**	**29.4**
Memory semiconductor	25,507	33,984	33,785	35,223	67,167	94,078
(Rate of increase/ decrease)	32.2	39.1	-0.6	4.3	90.7	40.1
System semiconductor	24,973	22,518	23,133	20,471	25,366	26,480
(Rate of increase/ decrease)	1.7	△9.8	2.7	-11.5	23.9	4.4
Optical discrete devices	6,664	6,144	5,998	6,536	5,407	6,154
(Rate of increase/ decrease)	△1.1	△7.8	△2.4	9.0	△17.3	13.8

Source: Korea International Trade Association (KITA)

- Semiconductors are Korea's leading export item as of 2018, with the industry comprised of 3,700 companies and 165,000 employees.

Korean Semiconductor Industry Status



Source: Korea Semiconductor Industry Association (KSIA)

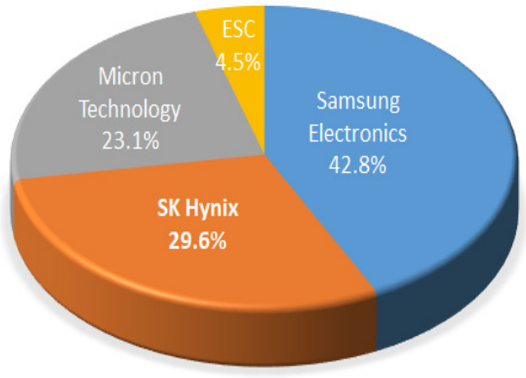
1.2 Industrial Competitiveness

Memory semiconductor

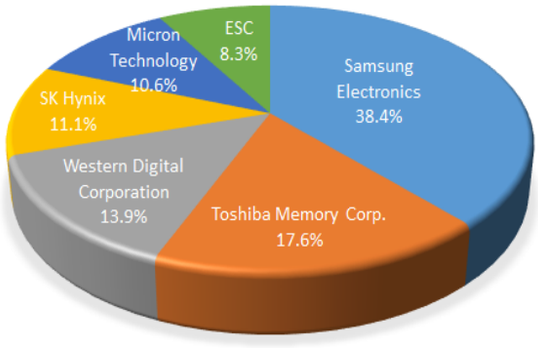
- Based on sales in 2018, Korean companies occupied 63.7% of the global memory market (72.4% of the DRAM market and 49.5% of the NAND market), and its technological competitiveness is world-class.

Market Share by Memory Semiconductor Company (2018)

〈DRAM〉



〈NAND〉



Source: IHS Markit

- In the case of DRAM, industry leaders Samsung Electronics and SK hynix had the most advanced micronization technology from 60 nm in 2017 to 18 nm in 2018.
  - DRAM micronization roadmap of companies in Korea: (2018) 18 nm → (2019^{e}) 1y nm → (2020^{e}) 1z nm
- In the case of NAND Flash technology, Samsung Electronics developed and produced 3D memory integration technology based on the world's first 3D NAND Flash process technology in 2013.
  - 3D NAND roadmap of companies in Korea: (2017) 64-Layer → (2018) 96-Layer → (2019^{e}) 128-Layer

Memory Semiconductor Technology Roadmap

DRAM	2014		2015		2016		2017		2018		2019	
	1H	2H	1H	2H	1H	2H	1H	2H	1H	2H	1H	2H
Samsung Electronics	20nm					18nm				1ynm		1znm
SK hynix	25nm				21nm			18nm		1ynm		
Micron			20nm				18nm			1ynm		1znm

NAND	2014		2015		2016		2017		2018		2019	
	1H	2H	1H	2H	1H	2H	1H	2H	1H	2H	1H	2H
Samsung Electronics			48-layer		64-layer				96-layer		128-layer	
SK hynix			36-layer		48-layer		72-layer			96-layer		
Toshiba + WD				48-layer		64-layer				96-layer		
YMTC										32-layer (prototype)		64-layer

Source: Woori Economic Research Institute, 2019

System semiconductor

- The system semiconductor field is securing competitiveness based on manufacturing technology.
  - In the area of system semiconductors, Korean companies account for only 3.1% of the market, equating to a lack of competitiveness. However, foundry (commission fabrication) has the world's best level of technology, along with the United States and Taiwan.
- Korean companies have technological competitiveness in the Application Processors (APs), CMOS Image Sensors, Display Driver ICs, and Power Management ICs used in mobile devices. However, they have less advanced technology in system semiconductors used in automobiles and industrial devices.

Semiconductor equipment

- In 2018, the Korean semiconductor equipment market was USD 17.1 billion, making up 27.5% of the global semiconductor equipment market.

Semiconductor Equipment Market Status

(Unit: USD 100 million)

Classification	2015	2016	2017	2018(F)	2019(F)	2020(F)
Global markets	365	412	566	621	596	719
Korea market	75	77	179	171	132	183

Source: Semiconductor Equipment and Materials International (SEMI), 2019

- The semiconductor equipment field secured competitiveness in memory semiconductor tester (inspection equipment), packaging, cleaning, and deposition equipment.
  - As for memory semiconductor testers, Korean companies have an advantage in technology and market as they meet most of the customers' demands.
  - Competitive edge has been secured in packaging equipment, centered on equipment for wafer marking, cutting, bonding, and molding.

- The Asher and Furnace sectors secured competitiveness equal to that of advanced companies in terms of technology.
- Although Japanese companies have a competitive advantage in cleaning and Chemical Mechanical Planarization (CMP) equipment, the technology of Korean companies is also catching up to an equal level.
- US companies have technical superiority in deposition equipment. However, Korean companies have secured the same level of technological competitiveness and are superior to the United States in Atomic Layer Deposition (ALD).
- Core equipment, such as the exposure process and ion implantation equipment, depends entirely on imports from ASML (Netherlands) and AMAT (US).

Semiconductor material

- In 2018, the global semiconductor material market amounted to USD 52.4 billion, and the Korean market reached USD 8.9 billion, accounting for 17% of the global semiconductor material market.

Semiconductor Material Market Status

(Unit: USD 100 million)

Classification	2012	2013	2014	2015	2016	2017	2018(F)
Global markets	448	433	440	429	473	525	524
Korean market	72	70	70	69	68	76	89

Source: SEMI, 2019

- The semiconductor material field has secured technological competitiveness in some general-purpose products, but the advanced material field is dependent on imports.
  - The technological competitiveness of silicon wafers, which have the largest market size among semiconductor materials, has been secured, but the production does not meet the demand in Korea.
  - Although some photoresist technologies used in the exposure process have been secured, the registry used in the most advanced processes is highly dependent on Japan.
  - Gas and chemical materials are produced and supplied in Korea except for high-tech materials.
  - As for materials used for packaging, such as lead frames, bonding wires, and encapsulants, companies in Korea have secured technology and market competitiveness.
  - Blank masks, advanced photoresist, advanced slurry, advanced chemical materials, and others are in high demand in Korea but are imported from abroad for use. Hence, their development and production in Korea are highly necessary.

1.3 Promising Fields in Korea

System semiconductor: Balanced growth of memory semiconductor and system semiconductor

- Korea's semiconductor industry will additionally reinforce the technological competitiveness of the memory sector and is expected to enhance market competitiveness in the system semiconductor sector.
  - In the short term (2-3 years), memory technology and facility investment will continue, eliminating any significant change in maintaining competitiveness. However, in the long term, the balanced growth of the semiconductor industry will be achieved by fostering not only the memory semiconductor industry but also the system semiconductor industry.
  - It is predicted that the new demands for system semiconductors, such as those in smart cars, health care, and industrial convergence, will expand. Thus, Samsung Electronics is focusing on system semiconductors, and SK hynix is expected to gradually expand its entry into the system semiconductor sector from the memory sector.

Foundry: System semiconductor manufacturing foundry* empowerment

* Manufacturing foundry: Semiconductor consignment manufacturing

- Korea's foundry sales ranked second worldwide
  - Samsung Electronics Foundry began its mass production of 7 nm process at the end of 2018 and placed second in the industry (USD 10.4 billion) in 2018.
  - DB HiTek ranks 11th but is no. 1 in the world in terms of competitiveness for the analog semiconductor foundry field.

World Foundry Companies Sales Ranking

(Unit: USD million)

2018 rank	Company name	2017		2018	
		Sales	Share	Sales	Share
1	TSMC (Taiwan)	32,163	47.6%	34,208	48.2%
2	Samsung Electronics (Korea)	9,800	14.5%	10,400	14.6%
3	GlobalFoundries (US)	6,176	9.1%	6,209	8.7%
4	UMC (Taiwan)	4,898	7.2%	5,021	7.1%
5	SMIC (China)	3,101	4.6%	3,195	4.5%
6	Powerchip (Taiwan)	1,498	2.2%	1,633	2.3%
7	Huahong Group (China)	1,395	2.1%	1,542	2.2%
8	TowerJazz (Israel)	1,388	2.1%	1,311	1.8%
9	Vanguard (Taiwan)	820	1.2%	959	1.4%

2018 rank	Company name	2017		2018	
		Sales	Share	Sales	Share
11	Fujitsu (Japan)	910	1.3%	940	1.3%
12	Dongbu HiTek (Korea)	601	0.9%	615	0.9%
13	X-Fab (Europe)	582	0.9%	586	0.8%
Other Foundries		4,293	6.3%	4,411	6.2%
Total Foundry		67,625	100.0%	71,030	100.0%

Source: IC Insights, 2019

Large-capacity memory and high-performance system semiconductor

- Large-capacity memory and high-performance system semiconductors are expected to be promising as 5G service and the autonomous vehicle market grows.
  - As the industries in demand for system semiconductors, such as IoT, autonomous cars, artificial intelligence, etc., are expected to grow, Korea will intensively promote the system semiconductor industry.
  - With 5G modem chips included in the 5G construction plan, constructing a network and the simultaneous development of related semiconductors will secure the demand for next-generation mobile communication semiconductors.
  - The government and corporations will concentrate on developing artificial intelligence semiconductors and SW technology to secure competitiveness in the era of the Fourth Industrial Revolution.

2 Foreign Direct Investment Trends

2.1 Foreign Direct Investment Status

Investment environment

- Korea has large-scale IDMs, such as Samsung Electronics and SK hynix. As such, large-scale investments are made by industries that are in demand for semiconductors, such as smartphones and smart cars.
- Korea serves as a hub for Asian businesses with high efficiency in finance and logistics and strong competitiveness in the semiconductor industry.
- Korea is rich in ICT-related human resources, including semiconductors, making it suitable for fostering knowledge-based industries. As such, Korea is attracting much attention and investment from foreign investors.
  - The Seoul/Gyeonggi-do areas are the center of Asia's semiconductor business and are active in the development of ICT-based convergence technology.

- Korea is rich in high-quality human resources and has a good environment for R&D investment. Thus, many foreign companies are establishing research centers in the country.

Investment status

- In 2018, foreign investment in the semiconductor industry was USD 710 million—the highest since 2010 and the fourth-largest investment ever.
  - USD 1.1 billion in 1998, USD 1.6 billion in 2000, and USD 0.86 billion in 2004
- In Korea, large semiconductor companies, such as Samsung Electronics and SK hynix, have invested large amounts every year, causing foreign direct investment (FDI) to be active in the semiconductor equipment and material industry.
  - Samsung Electronics has been constructing large-scale semiconductor complexes in Pyeongtaek, Gyeonggi-do, since 2015. Meanwhile, SK hynix announced plans to build large-scale semiconductor complexes in Yongin, Gyeonggi-do, in 2021. Therefore, large-scale facility investments have been made continuously, and foreign investment will continue to increase in the future.

Foreign Investment Trends in Semiconductor Industry

(Unit: USD million)

Classification	2010	2011	2012	2013	2014	2015	2016	2017	2018
No. of reported investments	37	20	17	12	24	20	19	10	21
Reported amount	424	293	274	61	196	275	232	89	711

Source: Ministry of Trade, Industry and Energy

- In Korea, many related system industries have been highly developed, such as smartphones, information and communication, home appliances, automobiles, medical devices, etc. As such, several foreign-invested companies have entered the market to deliver the necessary semiconductors.
- Overall, foreign semiconductor companies are making various investments in Korea to meet the demands in the upstream and downstream processes, from the semiconductor design, device, material, and equipment fields to the semiconductor packaging and test industries.

Foreign-Invested Companies in the Semiconductor Industry

ON Semiconductor Korea, ASML KOREA, ASE Korea, STATS ChipPAC Korea, Amkor Technology Korea, Synopsys Inc., TowerJazz Semiconductor, AIXTRON Korea Co., Ltd., Hitachi High-Technologies Korea Co., Ltd., Henkel Technologies Co., Ltd., Cadence Design Systems Korea Inc., KLA Tencor Korea Inc., Ushio Korea Inc., Axcelis Technologies Korea Ltd., Tokyo Electron Korea Ltd., Nikon Precision Korea Ltd., Applied Materials Korea, ltd., Lam Research Manufacturing Korea Inc., ASML Korea, Mentor Graphics Korea, CHINO Korea, Yokowo Korea Co., Ltd., Infineon Technologies Korea Co., LLC, Dongwoo Fine-Chem, ULVAC Korea branch, Varian Technologies Korea branch, Intel Korea Ltd., Qualcomm Korea Ltd., Texas Instruments Korea, Infineon Technologies Korea, etc.

Source: Korea Institute for Industrial Economics &Trade (KIET)

2.2 Success Cases of Major Foreign-Invested Companies

Advantest Korea Co., Ltd.

- Advantest Korea Co., Ltd. is a local corporation established in April 1996 by Advantest Co., Ltd. in Japan, and is in charge of the production, sales, and technical service of semiconductor inspection equipment and key components in Cheonan Industrial Complex Korea.
- Sales in Korea have steadily increased because of the expansion of a semiconductor manufacturing plant in Korea.
  - The new plant, which integrates Advantest Korea's first and second factories, produces all test handlers for memory system-on-chip (SoC), which was manufactured in Japan.
- Japan Advantest, the world's No. 1 semiconductor test equipment company, completely moved its business base of memory semiconductor and test handler for manufacturing SoC to Korea.
  - Advantest Korea was in charge of not only the relocated production facilities but also the entire division.

ON Semiconductor Korea Co., Ltd.

- ON Semiconductor acquired Fairchild in September 2016, therefore acquiring Fairchild Korea Semiconductor Ltd. as well
  - Fairchild Semiconductor has strengths in high-voltage semiconductors, and ON Semiconductor has strengths in low-voltage semiconductor, thus resulting in various product portfolios.
- Fairchild Korea Semiconductor Co., Ltd. generates annual sales of KRW 700 billion (USD 600 million) and has more than 1,800 employees, 80 master's and doctoral

staff, and 430 university graduates. Moreover, the company's major products are power semiconductor products, such as IGBT, Q-FET, SIP-TR, SPS, and Mortor IC.

- Fairchild's Gyeonggi Bucheon plant accounts for 60% of Fairchild's total semiconductor production, the largest among Fairchild's semiconductor plants.

Lam Research Manufacturing Korea

- Lam Research Corporation is a leading semiconductor equipment company in etching equipment, ranking third in global market share.
- Lam Research Manufacturing Korea, a manufacturing company established in Korea by the Lam Research Corporation, is advancing into the global market with products manufactured in Korea.
  - Lam Research Manufacturing Korea is one of Lam Research's global equipment manufacturing facilities. Since its establishment in 2011, it has supplied semiconductor etching and deposition process equipment and major semiconductor process modules to the global market.
- On May 24, 2019, Lam Research Manufacturing Korea celebrated the release of 5,000 pieces of semiconductor manufacturing equipment at its Korean factory.
- In addition, Lam Research Corporation, which marked its 30th anniversary in the Korean market in 2019, is striving to enhance the Korean semiconductor technology and strengthen the semiconductor industry ecosystem by localizing equipment and components.

Infineon Korea

- The best technical service is provided to Korean companies by establishing xEV High Power Center, Failure Analysis (FA), and Radar Research Center equipped with various electrical, physical, and chemical analysis equipment in Korea
- In 2014, the Infineon Daegu Office was opened in Daegu Gyeongsangbuk-do Institute of Science & Technology (DGIST) to provide technical support to customers in the region, south of the capital area.
- Training centers were established at Kookmin University, Hanyang University, Soongsil University, Changwon University, and DGIST to foster a professional workforce in Korea's automotive semiconductor field.
- In cooperation with the Korea Semiconductor Industry Association, "Curriculum for Automotive Semiconductor Experts" is operated for masters and PhD courses of semiconductor majors in Korea.

3 Policies and Locations

3.1 Key Policies and Incentives

Tax support for M&A and overseas technology introduction

- M&A acquisition funds (more than USD 2.27 billion) and tax support are available if the technology of key items is difficult to secure within the supply chain in Korea.*
  * Companies specializing in materials, components, and equipment with new core technologies are added to the recipients of technology innovation-type M&A funds and support.
  * Corporate tax deduction applies to the cost of the acquisition of overseas companies that specialize in materials, components, and equipment (level of facility investment for new growth technology).
- The rate of cash support is increased from 30% to 40% for foreign investment in core strategic items. When moving to a foreign investment zone, free rent applies for up to 50 years.

Expedited licensing for strategic items and priority support to expand social overhead capital, including roads and electric power

Classification	Present	Improvement
Expedited licensing	Consult individually on the complex and diverse license of many authorities * Clearance of capital goods, environmental evaluation, building permits, etc.	Provide one-stop licensing service for the construction permit and operation of factories
Deregulation	Many regulations that make it difficult to establish and operate factories	Plan to provide temporary support for investment related to Japan's export restrictions
Infrastructure support	Support sequentially roads, electric power, water, etc. according to the expansion plan of social overhead capital	Support preferentially or construct additionally only in relation to investments related to export restrictions in Japan

Expansion of benefits for attracting and retaining overseas professionals in Korea

- E-visa is issued when attracting overseas experts* in material, parts, and equipment.
  * (E-visa) Issuance period, about two weeks → within three days, (foreigner registration) after receipt, about one week → within three days
- If employment is recommended by KOTRA when inviting experts in materials, parts, and equipment (E-7), priority visa screening and issuance of an electronic visa is provided preferentially.
- Foreign research institutes are allowed to participate in R&D consortiums when necessary to respond to market changes in the process of R&D using outstanding overseas research personnel.

- When attracting overseas workforce for materials, parts, and equipment, the deduction of income tax on the overseas workforce is provided up to 70% for five years, temporarily effective three years from 2020 (first three years 70% and two years 50%).

Expansion of support for environment, labor, and funding

- Significantly shorten the location and environmental procedures related to R&D and the expansion of production facilities

Chemicals Control Act	▸ Shorten the term of application for the license and approval of export restraint response materials handling facility and the change of business license of existing workplaces (75 days → 30 days) ▸ Apply separate facility management standards considering facility characteristics, such as semiconductors ▸ Integrate over-the-counter impact assessments and risk management plans to ease the burden of paper submission
Act on the Registration and Evaluation, Etc. of Chemical Substances	▸ Allow pre-manufacturing for newly developed export restraint response materials under limited time and conditions when submitting material information and test plans. ▸ Allow registration exemption temporarily to export restraint response materials for R&D upon the submission and verification of minimum information. ▸ Exempt the submission of test materials temporarily (two years), as for less than 1 ton per year of new materials for export restraint response
Occupational Safety and Health Act	▸ Shorten the audit period for process safety report (54 days → 30 days)

- Special overtime work is approved, and a discretionary work system is available when additional overtime work is inevitable.*

  * Distribution of discretionary work utilization guide for R&D personnel (July 31)

Strengthening investment support

- A close support for the resolution of difficulties, such as deregulation of location and environment for the investment of 13 materials, parts, and equipment for mass production facilities of future car and semiconductor fields
- Priority support of cash grants for the transfer of key items to rural areas and for new and additional investment
- Support for facility investment, such as new plant and equipment introduction and plant expansion

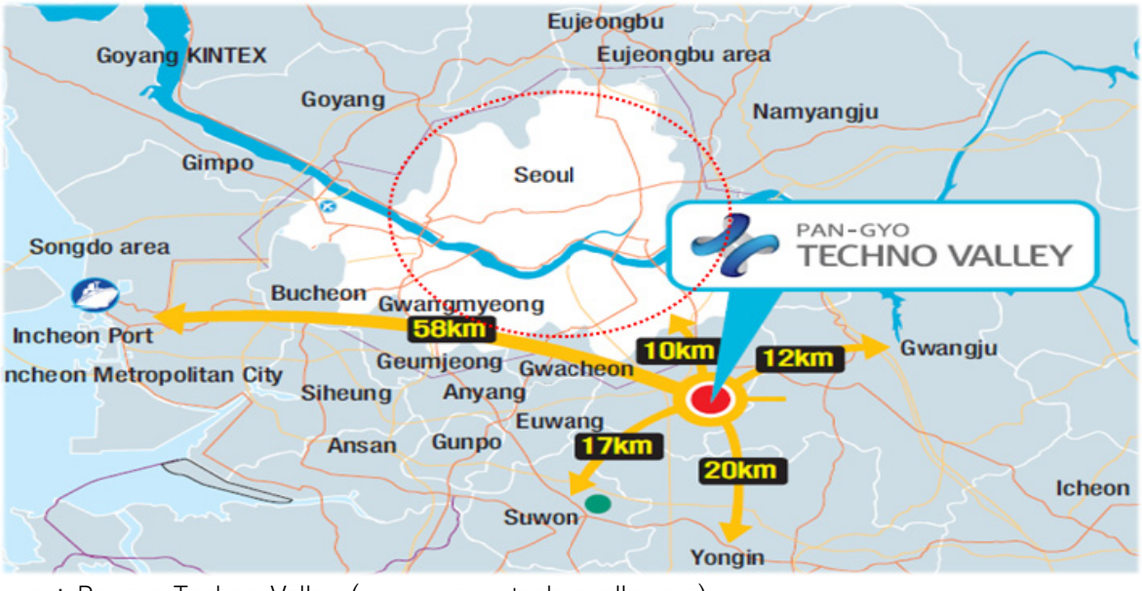
  * Increase financing limit per company: (present) USD 5 million (in case of local, USD 6 million) → (improvement) USD 9 million

3.2 Major Locations

Pangyo Semiconductor Industry Cluster

- In the metropolitan area, most semiconductor companies are distributed throughout Seongnam, centered in Pangyo, and mostly composed of fabless companies.
- The concentration in Pangyo is due to easy access to the metropolitan area where companies that want to practice technologies and excellent personnel are concentrated. In addition, innovative institutions, business support organizations, etc. have regional advantages that enable competition and cooperation among related peers.
- The semiconductor clusters linking innovation actors, such as SW companies and companies in demand of semiconductors, are concentrated in the Pangyo Semiconductor Cluster.
  - Cooperating and contributing to industrial development by field, such as SW, semiconductor, semiconductor equipment, parts, and materials

Semiconductor Clusters in Pangyo Area



Source: Pangyo Techno Valley (www.pangyotechnovalley.org)

Pyeongtaek & Yongin Semiconductor Industry Cluster

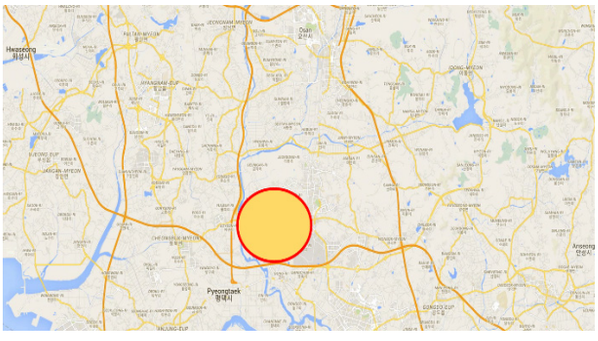
- Samsung Electronics is constructing the world's largest semiconductor factory in Pyeongtaek, Gyeonggi-do, about 80 km away from Seoul, following 17 lines in Xi'an, China, and Hwaseong, Gyeonggi-do.
  - Samsung has constructed the world's largest semiconductor production belt by building a factory in Pyeongtaek, following Giheung and Hwaseong in Gyeonggi-do.

- Samsung Electronics plans to build various facilities, including four production lines and a dormitory in an area spanning 2.89 million ㎡ (0.875 million pyeong) at Godeok Industrial Complex in Pyeongtaek.
- Currently, Samsung Electronics' largest semiconductor business site is the Hwaseong Plant (approximately 1.59 million ㎡), and Pyeongtaek is about twice as large as the Hwaseong Complex.
- Samsung Electronics constructed a semiconductor manufacturing line spanning 0.79 million ㎡ (0.238 million pyeong), and USD 14.1 billion was invested in just the first stage of investment. In the mid- to long-term, total investment is expected to reach USD 90.8 billion. It is expected to be the largest semiconductor factory in the world.

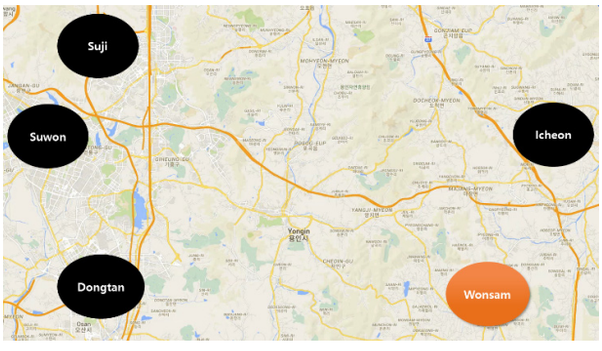
- SK hynix plans to build a semiconductor cluster of 4.48 million ㎡ (1.33 million pyeong) in Wonsam-myeon, Yongin-si, Gyeonggi-do.
  - The construction will start in 2021, and the mass production of semiconductors will begin in 2024.
  - A total of 4 semiconductor production plants will be established in phases, and more than 50 domestic and overseas partners of the material and equipment sector will enter the semiconductor cluster and create 17,000 new jobs.

Semiconductor Clusters in Pyeongtaek and Yongin Areas

Pyeongtaek Cluster



Yongin Cluster



Source: KSIA

4 Potential Partners

4.1 List of Related Companies

Company name		Main items	Website	Location
Semiconductor device	Samsung Electronics	DRAM, NAND Flash, AP, CIS, DDI	www.samsung.com	Seoul Head Office
	SK hynix	DRAM, NAND Flash, CIS	www.skhynix.com	Seoul Head Office
	ON Semiconductor Korea	Power Discrete, Analog Power IC	www.fairchildsemi.com	Bucheon, Gyeonggi-do
	KEC	TR, DIODE, LED	www.kec.co.kr	Gumi, Gyeongsangbuk-do
Packaging / Test	Amkor Technology Korea	IC Packaging & Test	www.amkor.co.kr	Seoul Head Office
	HANA MICRON	FPGA, TSOP	www.hanamicron.co.kr	Asan, Chungcheongnam-do
	STATS ChipPAC Korea	IC Packaging & Test	www.statschippac.co.kr	Icheon, Gyeonggi-do
	DB HiTek	Foundry	www.dbitek.com	Jincheon, Chungcheongbuk-do
Fabless	Silicon Works	Chip Design Solution	www.siliconworks.co.kr	Daejeon
	Dongwoon Anatek	AF Driver IC	www.dwanatech.com	Seoul Head Office
	PIXEL PLUS	CMOS Image Sensor	www.pixelplus.com	Suwon, Gyeonggi-do
	Alpha Holdings	Chip Design Solution	www.alphachips.com	Seongnam, Gyeonggi-do
	I&C Technology	Wi-Fi, PLC, LTE-A chip	www.inctech.co.kr	Seongnam, Gyeonggi-do
	Mtek Vision	Chip Design Solution	www.mtekvision.co.kr	Seongnam, Gyeonggi-do
	iA	Automotive Chip	www.ia-inc.kr	Songpa, Seoul
	Jeju Semiconductor	Nand MCP	www.jeju-semi.com	Jeju
	ABOV	MCU	www.abov.co.kr	Cheongju, Chungcheongbuk-do
	TLi Inc	Timing Controller	www.tli.co.kr	Seongnam, Gyeonggi-do
	Silicon Mitus	Power Management IC	www.siliconmitus.com	Seongnam, Gyeonggi-do
	Raon Tech	VR/AR Microdisplay	www.raon-tech.com	Seongnam, Gyeonggi-do
	Telechips	Multimedia Processor	www.telechips.com	Songpa, Seoul
Equipment	SFA Engineering	Cleaner, AGV (LGV), Stocker	www.sfa.co.kr	Hwaseong, Gyeonggi-do
	AVACO	Sputtering System	www.avaco.com	Gumi, Gyeongsangbuk-do
	Tera Semicon	Batch deposition equipment	www.terasemicon.com	Hwaseong, Gyeonggi-do
	Advantest Korea	Probe Card, Handler	www.advantest.com/KR	Cheonan, Chungcheongnam-do
	JUSUNG Engineering	CVD/MO CVD/HDP CVD/UHV	www.jseng.com	Gwangju, Gyeonggi-do
	WONIK IPS	MAHA MP, AKRA, Dry Etcher	www.ips.co.kr	Pyeongtaek, Gyeonggi-do
	SEMES	Photo Track, Dry Etcher	www.semes.com	Cheonan, Chungcheongnam-do

Company name		Main items	Website	Location
Foreign-Invested company	Synopsys Korea	EDA Tool	www.synopsys.com	Seongnam, Gyeonggi-do
	Lam Research Manufacturing Korea	Plasma etch	www.lamresearch.com	Seongnam, Gyeonggi-do
	Applied Materials Korea	Deposition, Inspection, Etch, Plating, Implant	www.appliedmaterials.com	Seongnam, Gyeonggi-do
	Infineon Technologies Korea	Automotive Chip	www.infineon.com	Gangnam, Seoul
	ASML Korea	Lithography system	www.asml.com	Hwaseong, Gyeonggi-do
	AIXTRON Korea	MOCVD, CVD, ALD	www.aixtron.com	Seongnam, Gyeonggi-do
	KLA-Tencor Korea	Wafer Inspection System	www.kla-tencor.com	Hwaseong, Gyeonggi-do

4.2 Related Associations

Institution name	Website	Major role
Korea Semiconductor Industry Association	www.ksia.or.kr	Semiconductor industry association
Consortium of Semiconductor Advanced Research	www.cosar.kr	Public-private joint research and development
Electronics and Telecommunications Research Institute	www.etri.re.kr	Semiconductor R&D
Korea Electronics Association	www.gokea.org	Electronics industry organization
Korea Association for ICT Promotion	www.kait.or.kr	Telecommunication industry association
Korea Electronics Technology Institute	www.keti.re.kr	Electronic component research and development
Korea Display Industry Association	www.kdia.org	Display industry organization

INVESTMENT OPPORTUNITIES IN KOREA

02

1 Industry Trends

Definition and Characteristics

- (Definition) A display is a device that transmits various kinds of information via images and plays the role of the "industry's eye" by converging with devices such as touch/sensors and other industries, including automobile, IoT, and AI.
  - With the advent of a hyper-connected society following the Fourth Industrial Revolution, the display emerges as a key role that visualizes information and interconnects people and machines.
- (Scope) The display industry includes all activities involved with the production of the panel (LCD, OLED, etc.) by large companies as well as the production of materials, parts, and equipment by SMEs.
- (Characteristics) The display industry is a process industry that requires large-scale production facilities, and its ratio of the equipment investment to the total facility investment shall be more than 60% to produce display panels.
  - The competitiveness of the downstream industry that supplies materials, parts, and equipment centered on the panel and that of the upstream industry that produces applied products such as TVs, smartphones, automobiles, and wearable devices are mutually affected.
  - According to the trends of application devices, the display technology development and proactive investment are significant to secure the leading position in the global market.

1.1 Market Trends in Korea

Status of the display production in Korea

- Based on the display panel production capacity in 2019, the domestic production capacity slightly decreased.
  - Samsung Display China Suzhou's LCD production capacity and LG Display Guangzhou's LCD production capacity are not included
  - Korean companies continue to increase OLED production capacity to lead the OLED market of the next generation. However, LCD production capacity continues to decrease because of oversupply and market demand shrinkage.
  - In the future, LCD production capacity in Korea will continue to decline as a result of accelerated business transformation, and AMOLED production capacity will rise not only because of the increased demand but also because of the LG Display's 10G OLED investment in Paju.

Display Production Capacity in Korea

(unit: 1,000 m2)

Classification	2017	2018	2019
LCD	71,759	69,149	66,274
AMOLED	11,264	14,616	16,159
Total	83,023	83,765	82,433

Source: IHS Markit Q1, 2019

- In 2017, the display industry increased slightly in terms of the production amount in Korea, and the value added by production had a tendency to increase every year.
  - A production amount includes all display panels, component materials, and equipment fields, and the added value generated in production increases with the development of next-generation parts, materials, and equipment. This also includes the expansion of its ripple effect on other industries.

Production in Korea and Value Added of the Display Industry

(unit: USD 10 million)

Classification	2014	2015	2016	2017
Production	6,738	5,927	6,195	7,196
Value added	2,771	2,685	2,900	3,281

Source: The Statistics Korea (Display Manufacturing + Display Manufacturing Machine + Display Glass)
Note: USD 1 = KRW 1,100.30 (Apply an annual average foreign exchange rate in 2018, Hana Bank's initial announced basic rate of exchange)

Status of display export

- In 2018, the exports of display panels recorded USD 24.7 billion, which is a 9.9% decrease as compared to that in the previous year.
  - Despite the increase of OLED exports, where demand is expanding, LCD exports continue to decline because of the drop in LCD prices caused by increased production in China.
  - As Samsung Display produced its 8.5G LCDs at its Suzhou China plant in 2013, and LG Display produced its 8.5G LCDs at its Guangzhou China plant in 2014, the LCD production bases were diversified.
  - Most of the display panels are exported to China (47%) and Vietnam (34%), in which the module plants of Korean companies and the production plants of global TV and IT companies are concentrated, followed by Mexico (5%), Poland (2%), etc.

- In 2018, display equipment exports recorded USD 4.28 billion, which is a 16.9% increase compared to that in the previous year.
  - Display equipment exports to China are increasing as a result of the order increase of equipment companies in Korea, following the investments made by Chinese panel companies in LCD and OLED simultaneously.

Display Exports

(Unit: USD million)

Classification	2014	2015	2016	2017	2018
Panel subtotal	32,401	29,717	25,106	27,378	24,679
LCD	28,098	24,189	18,245	18,048	14,378
OLED	4,303	5,528	6,861	9,330	10,301
Equipment subtotal	1,209	1,647	1,731	3,662	4,284
Manufacturing equipment	1,022	1,440	1,439	3,147	3,837
Parts	187	207	292	515	447

Source: Korea International Trade Association (KITA), Korea Display Industry Association (KDIA)

Status of display companies and employment

- The number of display-related companies increased steadily every year from 775 in 2014 to 914 in 2017.
  - The large companies that produce panels, such as Samsung Display and LG Display, remain unchanged, but the total number of companies increases as mid-sized companies that create next-generation parts and materials and manufacture equipment increases according to the development of OLED technology.
- Employment in the display industry declined from 102,000 in 2014 to 95,000 in 2017.
  - Employment in equipment companies increased because of the rise in equipment orders of companies in Korea as a result of production facility expansion of domestic and Chinese panel companies. However, employment in the entire display industry decreased because of the changes in business strategies of panel companies (LCD → OLED).

Display Industry Businesses and Employment

(Unit: One company, one person)

Classification	2014	2015	2016	2017
Businesses	775	770	880	914
Employees	102,103	91,106	97,177	95,668

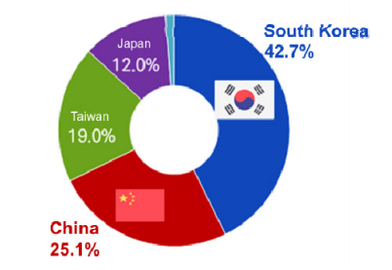
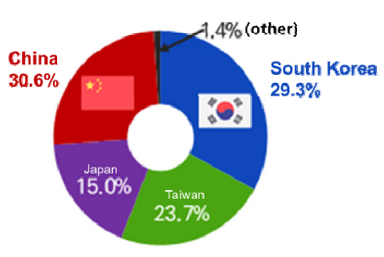
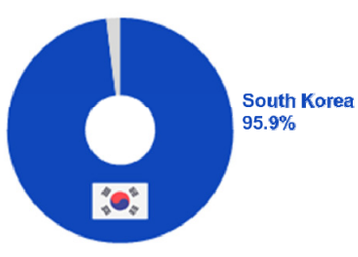
Source: The Statistics Korea (Display Manufacturing + Display Manufacturing Machine + Display Glass)

1.2 Industrial Competitiveness

Display panel competitiveness

- As of 2018, the market share of Korean display manufacturers was 42.7% in the global display market, keeping the country's position as the world's largest display panel producer. Moreover, Korea almost monopolized the newly growing OLEC market by occupying 95.9% in the market.
  - However, China grew rapidly in the global LCD market and occupied the largest share in the global LCD market in 2018.

2018 Global Display Market Share (Based on Amount)

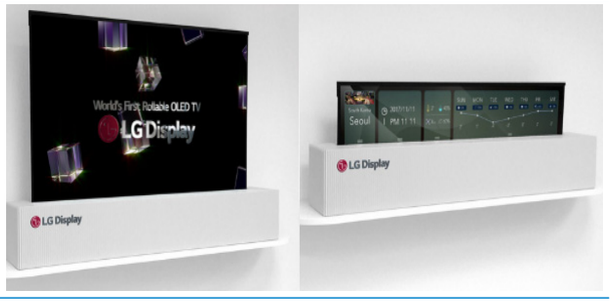
Display total	LCD panel	OLED panel
		

Source: IHS Market 2019

Competitiveness in display materials, parts, and equipment

- The localization rate of the downstream industry has also improved, but key areas remain dependent on Japan, the United States, and Europe.
  - (Materials) Although partly localized through the technology development of materials and parts companies and through the cooperation with panel companies, most core materials (liquid crystal, glass, etc.) depend on Japan, the United States, and Germany.
  - (Equipment) Core equipment (exposure, ion implanter, etc.) is dependent on Japan, the United States, etc. Moreover, localization proceeds with a focus on noncore processes, such as module and automation equipment.

Creating a new form factor through technology development

World's First Foldable Display (Samsung, February 2019)	World's First Rollable Display (LG, January 2019)
	

Source: Samsung Electronics, LG Electronics

- Following the development of flexible display, Samsung Display developed the world's first small- and medium-sized foldable display to be applied to foldable phones.
- LG Display developed the world's first large OLED and Rollable Display that can be applied to rollable TVs.

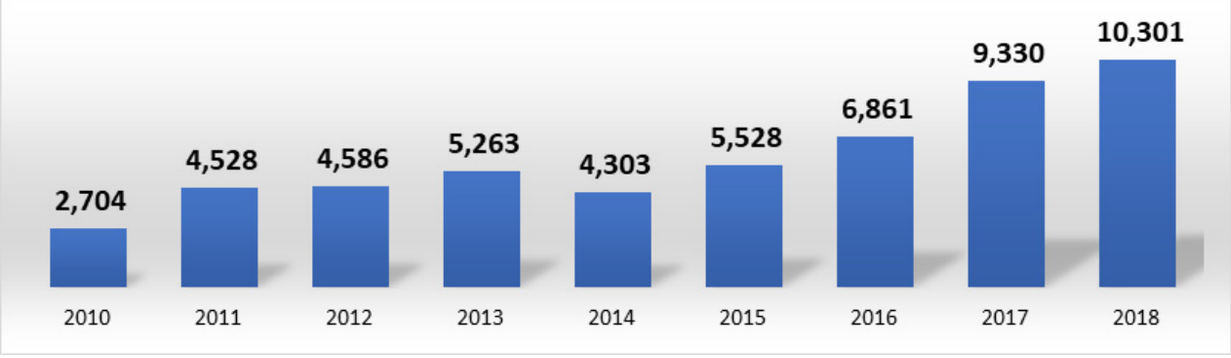
1.3 Promising Fields in Korea

Highest exports in the newly growing OLED field

- OLED exports were USD 10.3 billion in 2018, increasing by 10.4% as compared to those in the previous year, which exceeds USD 10 billion for the first time.
  - Korean companies are rapidly moving ahead from their competitors—from LCD to the newly growing OLED field.

Korea OLED Export Performance

(Unit: USD million)



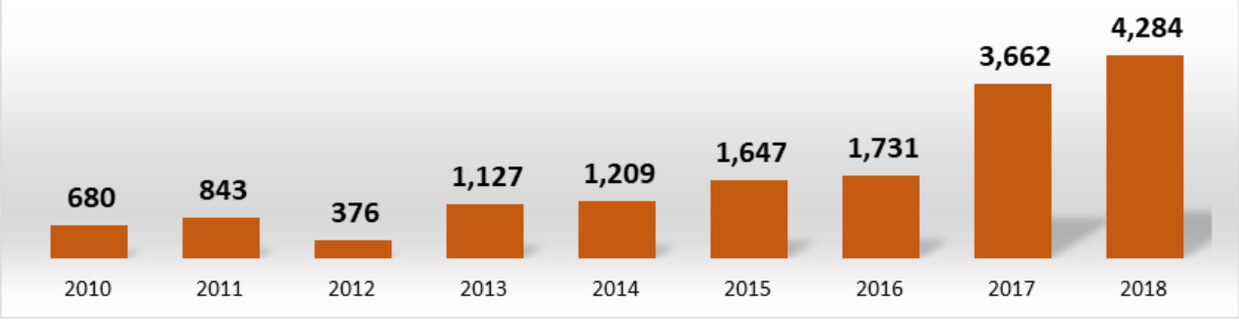
Source: KITA

Highest exports of display manufacturing equipment

- Manufacturing equipment exports produced by small- and medium-sized enterprises reached USD 4.3 billion, the largest ever in 2018.
  - The small- and medium-sized enterprises reached record high exports through technological development for localizing manufacturing equipment and actively entering into foreign markets, such as China.

Exports of Korea's Display Manufacturing Equipment

(unit: USD million)



Source: KITA

Increase of display investment in Korea

- The display industry has invested about KRW 45 trillion (USD 40.9 billion) in facilities in the last three years (2016-2018).
  - Samsung Display Asan 6G OLED, Vietnam OLED Module, LG Display Paju 10.5G OLED, Guangzhou 8G OLED, etc.
- After 2019, investments will be made to expand the gap with China and preoccupy new markets.
  - LG Display announced the new investment plan of KRW 3 trillion (USD 2.7 billion) in Paju to produce 10.5G OLED (July 2019).

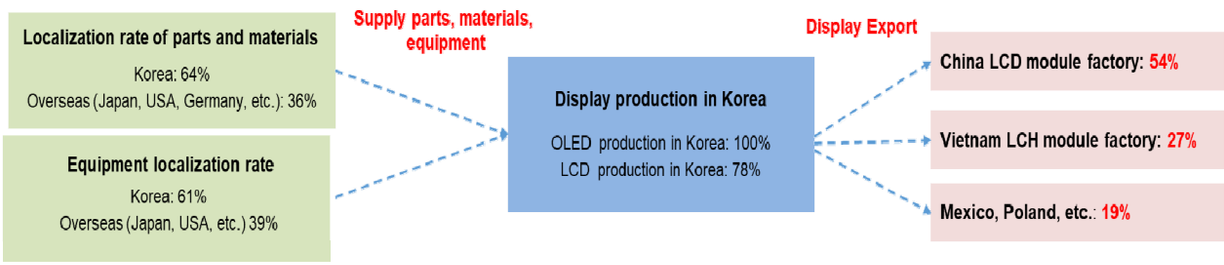
2 Foreign Direct Investment Trends

2.1 Foreign Direct Investment Status

Supply chain of the display industry

- Produce panels by procuring materials and equipment from Korea, Japan, or the United States → Export to China and Vietnam, where Korean module factories and set companies are located

Display Industry Supply Chain



Source: Korea Display Industry Association

- 78% of LCDs are produced in Korea, and 22% of LCDs are produced in China. But the proportion of LCD production in China is on the rise.
  * Share of Korean companies' LCD production in China (%): (in 2014) 6.1 → (in 2016) 15.6 → (in 2018) 24.2 → (in 2020) 26.6
- LG Display began the mass production of 8G OLED at LG Display Guangzhou factory (August 2019).

Status of foreign-invested companies in the display industry in Korea

- (Background) As Korean panel companies have grown since 2000, a large number of overseas parts, materials, and equipment companies—with their weak foundations in Korea—have entered the country.
- (Entry status) Most parts and materials companies that produce liquid crystal, glass, film, etc. make their products in Korea. Equipment companies consist of corporations that produce equipment in Korea and the ones that perform installation, repair, and exchange.
  - The representative foreign-invested companies in parts and materials are as follows: in case of liquid crystal, Merck (Germany), Chiso (Japan); in case of glass, Corning Precision Materials (U.S.), Paju Electric Glass Co., Ltd. (Japan); and in case of film, Dongwoo Fine-Chem (Japan), Toray Advanced Materials (Japan), etc.
    * Corning Precision Materials, Merck, Dongwoo Fine-Chem, and Toray Advanced Materials, etc. are operating their own research centers in Korea.
  - The representative foreign-invested companies in equipment are as follows: for deposition machine, ULVAC Korea (Japan), Applied Materials Korea (US); for vacuum pump, Edward Korea (UK); for etching machine, Tokyo Electron Korea (Japan); and for printing equipment, Catiba Korea (US), and others.
    * ULVAC Korea, Edward Korea, Korea Ebara Precision Machinery, etc. are producing their products in Korea.

2.2 Success Cases of Major Foreign-Invested Companies

Parts and materials

- Dongwoo Fine-Chem
  - (Parent company) Sumitomo (Japan)
  - (Entry) In 1991, Dongwoo Fine-Chem was established in Korea based on the technology of Sumitomo Chemical (Japan). It contributed to the growth of Korean companies by supplying key materials for displays and semiconductors.
    * Production: Display chemical (etchant, photoresist, etc.), touch sensor panel, etc.
    * Major customers: Samsung Display, LG Display
  - (Production base) Three production plants of parts and materials are operated in the areas of Pyeongtaek, Iksan, and Samgi. R&D centers have been established in Pyeongtaek and Iksan to conduct R&D on next-generation chemical materials such as flexible materials, etc.
  - (Sales) In 2018, the sales figure was USD 1.99 billion (USD 1.36 billion from display), operating profits were USD 150 million, and 2,300 employees were employed.
- Corning Precision Materials
  - (Parent company) Corning (US)
  - (Entry) Corning Precision Materials was established by cooperating with Samsung in 1995, which was an early period for the display business in Korea, and producing display glasses. → Corning Precision Materials contributed to the growth of Korean companies.
    * Samsung Corning Precision Glass changed its name to Samsung Corning Precision Materials in 2010.
    * Samsung Corning Precision Materials changed its name to “Corning Precision Materials” in January 2014. (Samsung sold all its shares to Corning.)
  - (Production base) The first product was produced at the Gumi Plant in 1996, and the Cheonan Plant was completed in 2002.
    * Production: Display material (glass for LCD/OLED)
    * Major customers: Samsung Display, LG Display
  - (Sales) In 2018, the sales figure was USD 1.55 billion, operating profits were USD 340 million, and 3,010 employees were employed.

Equipment field

- ULVAC Korea
  - (Parent company) ULVAC, Inc (Japan)

- (Entry) ULVAC Korea was established in 1995 based on the technology that Japan ULVAC had accumulated and provided the equipment necessary to construct a display production plant → Korean companies produced panels
  * Pyeongtaek Plant 1 was completed in 2000, and Plants 2 and 3 were completed, respectively, until 2003.
  * In 2005, the Hyeongok Plant (Plant 4) and Hyeongok Plant 5 were completed in 2005 and 2006, respectively.
- (Production base) Two equipment manufacturing plants are operated in Pyeongtaek and Hyeongok and the first foreign-invested equipment company to have established a research institute, conducting R&D on the next-generation equipment and process technology.
  * Production: Display manufacturing equipment (etching machine, deposition machine, vacuum equipment, etc.)
  * Major customers: Samsung Display, LG Display
- (Subsidiary company) Five subsidiaries are also in operation, including ULVAC Korea PRECISION, ULVAC Materials Korea, PS Technology, etc.
- (Sales) In 2017, the sales figure was USD 331 million, operating profits were USD 19.99 million, and 442 employees were employed.

Status of Major Foreign-Invested Companies in Korea

Country	Sector	Company name	Representative product	Production status	Process in use	Plant in Korea
Japan	Material	Dongwoo Fine-Chem	Color filter, polarizing film, polyimide film	Produced 235 t in 2018	Transparent cover window for foldable phones	Iksan, Pyeongtaek
		Toray Advanced Materials	Optical film for display	Produced 37,830 ㎢ in 2018 (21.7% of the total production)	Reflective film for polarizers	Gumi, Gunsan
		SU Materials	PI varnish	Produced 290 t in 2018 (96% of the total production)	Flexible OLED Substrate	Asan
		Korea Nitto Optical	Polarizer surface treatment film	Sold USD 909 million in 2018 (12% of the total sales)	Polarizer manufacturing process	Pyeongtaek
		AGC Fine Techno Korea	LCD glass	Produced 42 million ㎡ in 2018 (31% of the total production)	Array process to make thin-film transistors	Gumi
		Paju Electric Glass	LCD glass	Produced 36 million ㎡ in 2018 (36% of the total production)	Array process to create thin-film transistors	Paju
		Kotem	Photoresist	Produced 3,500 t in 2018 (36% of the total production)	Coating process to form a pattern	Paju

Country	Sector	Company name	Representative product	Production status	Process in use	Plant in Korea
	Component	Samick THK	LM SYSTEM parts	Produced 17.34 million parts in 2018	Operation check in LCD panel manufacturing	Daegu
		Taekwang Fujikin	Valve, filter, regulator	Parts (customized production)	Gas pipeline	Busan
		CSK	Scrubber, LDS	Parts (customized production)	At the latter part of the gas use process, such as deposition, etching process, etc.	Yongin
		Azbil Korea	Controller, flow meter, sensors, switches, etc.	Produced none in Korea; sold in Korea up to USD 45 million (2018)	Equipment parts	Seoul
		Ushio Korea	Ultra-high-pressure UV LAMP for exposure	Produced none in Korea; sold up to USD 40 billion in Korea (2018)	LCD pattern forming light source	Suwon
	Equipment	Tokyo Electron Korea	Coater, developer	Equipment (customized production)	Dual and multiple patterning	Hwaseong
		ULVAC Korea	Sputter system, evaporator system	Equipment (customized production)	TFT deposition and coating process	Pyeongtaek
		Ebara Precision Machinery Korea	Semiconductor vacuum pump and CMP equipment	Equipment (customized production)	Deposition, etching process	Pyeongtaek, Pangyo
		TEK Korea	Inspection equipment	Equipment (customized production)	Flip chip bonder, wafer appearance inspection	Gumi, Cheonan
		Mitsubishi Diamond Industrial Korea	LCD flat glass splitter, diamond	Equipment (customized production)	Panel cutting	Incheon
USA	Material	DuPont Korea	Low-molecular, light emitting material	Produced 8,905 kg in 2018 (80.7% of the total production)	OLED emitting layer formation	Cheonan
		Corning Precision Materials	Substrate glass for LCD and OLED	Produced 290 million ㎡ in 2018 (50% of the total production)	Array process to make thin-film transistors	Cheonan
	Equipment	Kateeva Korea	Inkjet printing equipment	Equipment (customized production)	OLED organic material formation and encapsulation process	Hwaseong, Cheonan
		Applied Materials Korea	PECVD, sputter	Equipment (customized production)	TFT deposition and coating Process	Paju, Cheonan
UK	Equipment	Edward Korea	Vacuum pump, E gas treatment system	Accounted for 90% in Korea	Vacuum pump for OLED fabrication	Cheonan, Seongnam
		Korea Cambridge Filter	Clean room filter, combined air filter	Equipment (customized production)	Clean room	Cheongwon
Germany	Material	Merck Performance Materials	LCD	Produced 230 t in 2018 (67% of the total production)	TFT liquid crystal injection process	Pyeongtaek
	Equipment	Henkel Technologies	Sealant, soldering	Equipment (customized production)	Coating equipment solution	Eumseong
		Bosch Rexroth Korea	Linear motor, LMS	Equipment (customized production)	Deposition, etching process, etc.	Busan

Source: KDIA

3 Policy and Location

3.1 Major Locations

Status of display clusters in Korea

- In Korea, display panels had been produced mainly in the areas of Giheung, Cheonan, and Gumi from 1995 to 2004. However, these were moved to Tangjeong (Samsung) and Paju (LG) for production line expansion.
  - Samsung and LG Display have built new lines in Paju, Gyeonggi-do, and Tangjeong, Chungcheongnam-do, respectively. As such, LCD and OLED related parts and materials companies are clustered around the two regions.

Geographical Status of Major Display Clusters

Classification	Paju	Tangjeong
Distance from Incheon International Airport	50 km	164 km
Port	50 km (Incheon)	30 km (Pyeongtaek, Dangjin)
Seoul	35 km	85 km
Seoul Station	60 min (by car, by train)	34 min (by KTX), 90 min (by car)
Water	Paldang Dam	Daecheong Dam
Nearby cities	Ilsan	Asan, Cheonan

Source: KOTRA

Paju display industrial complex

- LG Display produces LCD and OLED panels for large TVs and operates OLED production lines and module factories, including 7G and 8G plants.
- As the port and airport are located nearby, more than 90% of the products can be exported, and a convenient transportation network is established.
  - The Uijeongbu Branch of Seoul Customs is located in Paju LCD Industrial Complex, where import customs can be cleared within 30 min. Thus, it is possible to save the time required for customs clearance.
- Adjacent to the metropolitan area, it is possible to be supplied with high-quality human resources from universities in the metropolitan area. Moreover, it is easy to secure local talents by entering into an agreement with nearby universities and designating specialized high schools, etc.

Tangjeong industrial complex

- Chungcheongnam-do is an area critical to the display industry as it accounts for more than 50% of the display industry in Korea and more than 25% of the global display industry.
  - In the future, a mega cluster of displays will be constructed, linking Asan, Tangjeong, Cheonan, and Naepo areas.
- The Tangjeong industrial complex has secured the support of local governments, such as the construction of a display support center, etc., together with an excellent R&D basis, such as about 35 colleges near Asan and Tangjeong since the 1980s.

3.2 Key Policies and Incentives

Paju display industrial complex

- The advantage of this location is that the cluster led by LG Display is located in Paju and is close to the metropolitan area.

Benefits of Moving into Paju LCD Industrial Complex and Dangdong Industrial Complex

Tax	- Full exemption of acquisition tax - 50% exemption of property tax for 5 years (within 5 years of the initial acquisition)
Finance	- Gyeonggi-do Small- and Medium-Sized Business Support Fund ・Support Business Automation, Informatization, Technology Development, Business Transition, Transfer of Large Company Business to SMBs - General start-up, Small business development, Promising new industry - A business that is subject to support and is in operation with a manufacturing industry rate of 30% or more - Those who run promising new industries ・USD 180,000-900,000 by business subject to support with an annual interest rate of 7.3% ・The term of the loan with 3 years and installment repayment with a 5-year grace period.

Source: KOTRA

Tangjeong industrial complex

- Partner companies have moved in, focusing on Samsung Display. It is farther from the metropolitan area than Paju is.

Benefits of Moving into Tangjeong Industrial Complex

Tax	- Full exemption of acquisition and registration tax - 50% exemption of property tax and aggregate land tax for the first 5 years of the initial acquisition				
Finance	Funds for support	Target of support	Support limit	Grace period / repayment terms	Benefit interest rate (Interest rate compensation)
	Start-up and Competitiveness Reinforcement Fund	Facility funds, such as factory building, manufacturing equipment, etc.	USD 1.36 million - Facility USD 1.09 million - Operation USD 0.27 million	- Facility: 3 or 5 years - Operation: 1 or 2 years	2.5% (1.51%)
	Innovative funding	Venture, new technology, INNOBIZ Commercialization of developed technology	USD 450 thousand	2 or 3 years	3.7%-3.5% (2.51%)
	Corporate rehabilitation fund	Company damaged by natural disasters or major accidents	USD 450 thousand	1 or 2 years	3.5% (2.51%)

Source: KOTRA

Tax credit for research and human resources development expenses in OLED field

- Law
  - Article 10 of the Restriction of Special Taxation Act, Tax Credit for Research and Human Resources Development Expenses “New Growth Engine and Source Technology”
- Target technology
  - Panel: 9 inches or more AMOLED, Flexible AMOLED
  - Materials, parts, and equipment: All materials, parts, and equipment needed for AMOLED panel production
- Tax credit rate: 30% for large companies, 25% for small and medium-sized companies
- Tax credit method: Deduct a specific percentage of R&D expenses incurred in the previous year from corporate taxes.

Tax credit for facility investment in the OLED field

- Law
  - Article 25 (5) of the Restriction of Special Taxation Act (Tax Credit for Investment in Facilities for Commercializing New Growth Technologies)
- Target technology
  - Panel: 9″ or more AMOLED, Flexible AMOLED
  - Materials, parts, and equipment: All materials, parts, and equipment needed for AMOLED panel production
- Tax credit rate: 5% for large companies, 7% for small or medium enterprise, 10% for SMEs
- Tax credit method: Deduct a specific percentage of facility investment expenses incurred in the previous year from corporate taxes, etc.

4 Potential Partners

4.1 List of Related Companies

Company name	Main items	Website	Location
Samsung Display	OLED, flexible display, and TFT-LCD	www.samsungdisplay.com	Asan, Yongin
LG Display	TFT-LCD, OLED, and flexible display	www.lgdisplay.com	Seoul, Paju, Gumi
Dongjin Semichem	LCD material (photoresist etching)	www.dongjin.com	Hwaseong, Siheung
Mirae Nanotech	Display optical film, touch sensor	www.mntech.co.kr	Ochang, Cheongju
Duksan Neolux	AMOLED materials	www.dsneolux.co.kr/	Cheonan
Dongwoo Fine-Chem	Other than polarizing film, color filter, touch sensor	www.dwchem.co.kr	Iksan, Pyeongtaek
Doosan Corporation Electro-Materials BG	Copper clad laminate, OLED material	www.doosanelectronics.com	Jeungpyeong, Gimcheon, Iksan
Samsung SDI	Polarizing film, OLED light emitting material, etc.	www.samsungsdi.co.kr	Yongin, Suwon
SK Materials	NF3 (nitrogen trifluoride), SiH4 (monosilane)	www.sk-materials.com	Yeongju
SKC hi-tech & marketing	Polyester film, optical film for LCD	www.skchtm.com	Seoul, Cheonan, Jincheon-gun
Corning Precision Materials	LCD/OLED substrate glass, cover glass	www.corning.com	Asan

Company name	Main items	Website	Location
Kolon Industries	Light diffusion film, prism film, dry film	www.kolonindustries.com	Gumi, Gimcheon, Ulsan
Hyosung	TAC FILM for display	www.hyosung.co.kr	Seoul, Cheongju, Ulsan
LG Electronics	OLED TV, smartphone, LCD TV	www.lge.co.kr	Seoul, Pyeongtaek, Changwon
Dong A Eltek	Display inspection equipment	www.dongaeltek.co.kr	Anyang
meerecompany	Display/semiconductor equipment, 3D sensor	www.meerecompany.com	Hwaseong, Yongin
Semes	WET, PHOTO, INK-JET, AFC, etc.	www.semes.co.kr	Cheonan, Hwaseong
SFA	OLED deposition machine, logistics automation equipment	www.sfa.co.kr	Hwaseong, Asan
Jusung Engineering	OLED deposition machine, thin-film encapsulation equipment	www.jusung.com	Gwangju, Gyeonggi-do
Top Engineering	Glass-cutting, direct bonding	www.topengnet.com	Pangyo
AP System	OLED laser crystallization equipment, heat treatment equipment	www.apsystems.co.kr	Hwaseong
Wonik IPS	PECVD, dry etcher	www.ips.co.kr	Asan, Hwaseong
KC Tech	Cleaning equipment, coater, track system	www.kctech.com	Anseong
DMS	Cleaning equipment, photoresist stripper	http://www.dms21.co.kr	Yongin, Hwaseong
YAS	Large OLED deposition equipment, vacuum equipment	www.yasoled.com	Paju
New Power Plasma	Remote plasma generator	www.newpower.co.kr	Pyeongtaek, Suwon
Woori Micron	OLED thin-film measurement	www.woorimicron.co.kr	Cheonan
SUNGDO ENGINEERING & CONSTRUCTION	Display and semiconductor facility construction	www.sungdokorea.com	Seoul, Hwaseong
In-Atec	Factory automation system manufacturing	www.inatech.co.kr	Incheon

4.2 Related Associations

Company name	Website	Major role
Korea Display Industry Association	www.kdia.org	- Investigate display company difficulties and suggest to the government - Provide display industry status, market trend, and statistical information - Support R&D for panels, parts, materials, and equipment - Improve environmental regulations, respond to trade, train human resources, and comply with international standardization, etc. - Participate in exhibitions at home or abroad, support overseas marketing such as overseas roadshows
Chungnam Techno Park Display Center	www.ctp.or.kr	- Support Display SMEs that invested in the Chungcheongnam-do area - Train and educate experts - Support to measure, analyze, test produce, standardize, and evaluate reliability in the display field - Support SMEs to use and lease equipment
Korea Core Industrial Technology Investment Association	www.kitia.or.kr	- Register and manage parts and materials investment associations - Support commercialization: Attract overseas funds, operate global M&A Desk, support marketing, etc. - Support finances and follow-up management for companies invested by investment companies: Support to select investment briefing sessions, investment negotiations, eligible investment targets, etc.
Korea Electronics Association	www.gokea.org	- Provide external cooperation network and member service - Support to develop electronic and IT industry - Support exhibitions - Provide industrial development policy support, etc.

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Korea Trade-Investment Promotion Agency

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