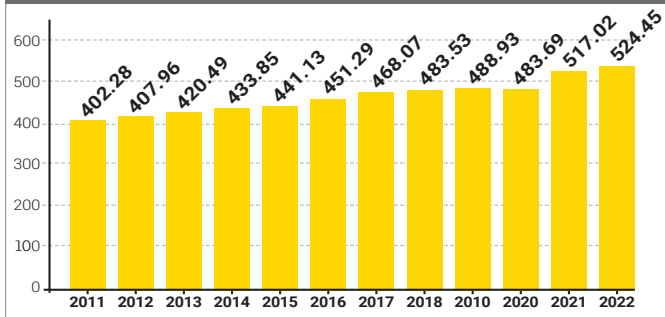


Korean industry and technologies to play a vital role in global supply-chain realignment

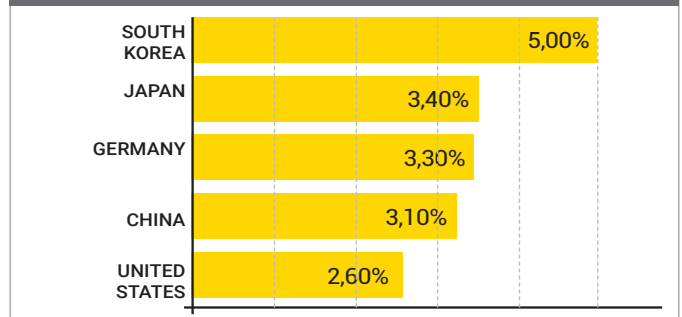
By combining an advanced digital environment with specialist technologies in high-tech fields and greater collaboration between industry giants and mid-size enterprises, South Korean industry is crafting an indispensable role in the global supply-chain.

Gross domestic product (GDP) from the manufacturing sector in South Korea from 2011 to 2022 (in trillion South Korean won)



Source: Statista 2023

R&D spending as % of GDP amongst world's largest manufacturing countries, 2022



Source: OECD (Organisation for Economic Co-operation and Development)

In October 2023, *Nikkei Asia* magazine released its much anticipated 'iPhone teardown', which breaks down where each part of the world's most popular handset originates from. The report revealed that South Korean-made components accounted for 30% of the iPhone 15 Pro's value, nearly on par with the U.S. and topping all other countries in the ranking. Today, this ranking stands as a testament to the evolution of the Korean industry, whose relevance and importance to global supply chains continues to grow.

While they represent the tip of the iceberg, South Korea's success cannot be attributed solely to conglomerates such as LG and Samsung, whose technologies are profusely present in the iPhone. Rather, it is the result of a concerted effort between the country's private and public sector to create a resilient supply-chain and industrial eco-system made up of so-called "Hidden Champions" – small-to-mid sized enterprises that are attaining technological leadership in niche areas.

Thanks to an advanced IT environment, increased government support, and greater collaboration with conglomerates, these suppliers have quickly expanded throughout the value-chain by providing technologies that allow Korea's entire industry to grow internationally.

Semiconductor materials and equipment

The semiconductor industry offers arguably the best case in point. Despite becoming the world's second largest manufacturer of advanced semiconductor chips and largest maker of memory devices, South Korea spent years relying on foreign suppliers for its materials and equipment.

In recent times however, this trend has arguably changed. In 2019, Japan imposed export curbs on certain advanced technologies required for semiconductor production. Instead of hampering the country's production capacity, the bilateral dispute forced large manufacturers to turn to locally produced solutions, thereby creating new opportunities for national firms.

Memorable examples include Samsung's 2020-21 investment strategy, which saw the conglomerate invest more than \$238 million in mid-sized enterprises. The investment spree began with Soulbrain, a provider of hydrogen fluoride that has now grown into a technology leader in various materials, including ultra-pure HF/BOE, and etchant and cleaning agents. The company is also a leading maker of CMP slurry for HBM production, a Samsung and SK Hynix memory interface that has the potential to dwarf existing DRAM products. Prior to Soulbrain's entry, the market for CMP slurry was dominated by U.S. and Japanese players.

"Soulbrain has long been a leader of technological innovation, contributing to South Korea's IT industry and economic development by localizing core materials used in the semiconductor and display processes," says Soulbrain CEO Hwan Chul Rho.

The company recently revealed plans to purchase a 19.7% stake in DNF, another Samsung supplier and investee that co-developed precursors used in semiconductor wafer patterning processes. "With our proprietary technology and stable production capabilities that we have accumulated over the past 35 years, Soulbrain will not stop continuous innovation to leap forward as a global top-tier company," adds the CEO.

On the back of their domestic success, Korean suppliers now have the technology to penetrate international markets. Such is the case of ENF TECHNOLOGY, a leading supplier of fine and processed chemicals for displays and semiconductors, including hydrofluoric acid. "Over the past two decades, our efforts have been dedicated to technology localization, thereby amassing considerable expertise in production practices," explains ENF CEO Jeong-Soo Kim. "A cornerstone of our achievements lies in our capability to cater to the demands and specifications of SK Hynix and Samsung."

Having increased revenue by more than 40% in just four years, ENF is accelerating its international

expansion. On top of its decade long operations in the Chinese market, the company is building a new factory in Austin, Texas. "The objective of our U.S. operation is to cover the demands of Samsung's facility and to start business relations with U.S. foundries. The fact that we are a Samsung supplier means that our products already abide to a high level of quality, showing other chip makers that we are qualified and can deliver," explains Mr. Jeong-Soo Kim. "Looking ahead, our aim is to become a global supplier that is trusted by major corporations in all semiconductor countries, including America, Japan and Taiwan."

Another supplier who plans to leverage on the growth of the North American market is LOT Vacuum. Founded in 2002, the company was among the first to localize the production of dry vacuum pumps, a critical equipment to semiconductor plants. Having built a long relationship with virtually all of Korea's major foundries, the company now plans to expand its business scope and international reach.

"We are expanding our product lines to meet specific semiconductor process requirements," explains Hank Oh, CEO of LOT Vacuum. "Beyond semiconductors, we see promising opportunities in clean energy sectors as well as next-generation transportation. Our strategic expansions position us for significant advancements in vacuum technology, with our plans for Austin enhancing our growth potential in the thriving North American market."

Deeper collaboration with conglomerates has also allowed SMEs to make technological breakthroughs. An admirable example has been MTI, whose combination of coating and cleaning products has addressed one of the most pressing challenges of CMOS sensor (CIS) production.

"CIS yield used to hover around 40% and could occasionally drop to 0%. One of the main reasons was the appearance of foreign particles during the dicing process. To a large extent, this problem still remains to this day," explains Mr.

James Park, President of MTI. After discovering that certain chemicals could reduce the number of foreign particles, Mr. Park's company went on a decade long R&D spree that led MTI to develop a combination of products that ultimately increased production yield to 99.99%.

"Our solution is composed of two products, namely, a coating material and a peeling technology. To this day, no other company produces these materials as our solution was so unique that it changed the existing CIS production process."

Soulbrain, ENF, MTI and LOT Vacuum are part of a growing list of suppliers who have seen sharp increase in their revenue since Japan's 2019 export curb, which, coincidentally or not, was lifted in 2023.

Secondary Batteries

In similar fashion to the semiconductors field, political tensions and technological innovation are paving growth avenues for the Korean battery industry. Designed to lessen America's dependence on Chinese technology by offering billions of dollars in subsidies to battery makers who source components and materials from the U.S. and its free trade partners, the Biden Administration's U.S. Inflation Reduction Act (IRA) is engineering a supply-chain realignment that bodes well for Korean makers.

While China invested its resources in the development of cost-efficient LFP batteries, Korea targeted higher-end segments, particularly NCM batteries. With the surge in demand for cylindrical 4680 battery cells from companies like Tesla, Korea maintains a competitive advantage over China in the premium market segment. To design IRA-compliant supply-chains, foreign firms are partnering with Korean ones to onshore production. Notable examples include Posco's joint venture with CNGR Advanced Material, and SK ON and EcoPRO's partnership with GME Resources to produce battery component in Saemangeum.

In turn, this increase in national activity coupled with burgeoning demand from the EV and electronic device markets has provided new growth channels for Korean enterprises. One such company has been ENPLUS. A historical leader in the field of firefighting equipment, the company has successfully diversified its operations to encompass dry electrodes and graphene solutions. "The production of secondary batteries requires four main materials: cathodes, anodes, electrolysis and separation membrane," explains Tae-Kyoung Kang, ENPLUS co-CEO. "Anode production requires water resources and cathodes require solvents that are harmful to the environment. As regulations place a heavy focus on environmental conservation, we foresee that the utilization of dry electrodes will become an irreversible trend by 2026, especially as the technology will have become cost-competitive and even more environmentally friendly," he predicts.

As graphene enjoys superior elasticity and an ability to restrain silicon from expanding, ENPLUS is also working on a powder-type graphene to be applied to high-volume batteries. "The achievements and products we developed in the battery material sector will lead our busi-

ness for the long term and will be the key to our future growth," explains the other co-CEO, Mr. Yong-In Choi.

Automation Technology

Despite the successes encountered by Korean firms in the aforementioned industries, the country currently faces a major challenge: dwindling fertility rates combined with a rapidly ageing population are tightening the labor market. But amidst challenges comes opportunity. With the highest robot density in the world, Korea is an early adopter of automation technologies, which provides its private sector with the perfect ecosystem to develop innovative solutions.

A vibrant example of this has been the LS Group, one of Korea's industrial juggernauts whose business encompasses cables, electrical equipment and automation systems, among others. Since 2021, one of the group's main subsidiaries, LS Electric, has been a member of the WEF's Global Lighthouse Network, a platform to develop and scale Industry 4.0 technologies. With a fully automated system from parts supply, assembly and test packaging, LS Electric's smart factory in Cheongju is a model of its kind.

While Korea and its neighbor Japan are at the head of the demographic crisis, many industrialized economies are experiencing population issues, including China and the U.S. By facing this global phenomena ahead of others, Korean firms have the opportunity to export their smart technologies. "The greater need for automated solutions creates new opportunities for us," says Jeong Ha Kim, CEO of THIRA-UTECH, which offers end-to-end solutions for factory automation to a range of industries, including displays and semiconductors, automotives and secondary batteries. "We now plan to form an American corporation and to start operating our Georgia subsidiary," he adds.

By providing a combination of Supply Chain Management systems, Manufacturing Execution Systems, and automation software, THIRA-UTECH has attracted a long list of clients in critical industries, and will most likely continue to do so. "Prominent players like Hyundai, GM, and Ford are increasingly shifting their focus towards EVs. Given that the growth of EVs and rechargeable batteries are intrinsically linked, our objective extends beyond software. We aim to provide comprehensive solutions encompassing AI and automated hardware." Turning words into action, the company already commercializes AMRs that have quickly grown in popularity over the past years.

The necessity to develop unmanned solutions combined with Korea's advanced IT environment has also proven a fertile soil for the creation of innovative start-ups. Mr. Yeongseok Cheon, co-founder of Twinny – which manufactures artificial intelligence-based transportation robots – sees major potential for the sector's growth in the country. "The utilization of robotics is continually growing, particularly in cutting-edge applications like smart factories. Consequently, we anticipate a rise in our sector's technological competitiveness."

In an increasingly competitive global robotic market, Mr. Cheon believes that Korea must

carve a niche for itself by developing unique technological capabilities. "Developing standardized and universal robots has its limitations. The challenge faced by Twinny, as well as other Korean companies, is to channel our efforts into the technological capacities that can propel us into global niche markets."

Industrial Safety

As Korea continues to embrace greater automation technologies, the importance of safety measures along factory lines is becoming a paramount concern. While often overlooked, the country's successful expansion in critical sectors was also made possible thanks to advanced industrial safety solutions.

In the secondary battery industry, the thermal behavior of lithium ion batteries means that supply chains are exposed to greater risks of fire-related incidents. To overcome this challenge, GFI, a specialist provider of fire suppression technologies, has developed a series of capsules, pads, tapes and wires that extinguish fire when exposed to heat. Supported by a unique powder-based formulation, these products are unmanned and do not rely on sensors or power, allowing the technology to raise the safety standards of various critical industries and devices.

"Existing fire extinguishing systems operate reactively, incurring significant costs and requiring ample space due to their reliance on post-fire outbreak intervention. Our approach diverges fundamentally by focusing on fire prevention. Our products are designed to thwart fire at its inception, even within exceptionally tight spaces like those behind refrigerators, within cell phone batteries, EVs, wind power plants, and energy storage systems (ESS)," explains Sangseop Lee, CEO of GFI. "Notably, our products find significant application in secondary batteries, addressing instability issues that contribute to fire incidents. Their pivotal role is in ensuring vehicular safety due to the direct impact on human lives."

Another example is in semiconductor production, where foundries utilize diverse gases in their manufacturing processes. Because of their toxicity and hazardous nature, these gases require specialized detection technologies to ensure a safe environment. "Chip production involves processes where 6 to 8 different gasses need to be utilized. Consequently, the need for detecting various gasses is extensive, and this requires multiple gas detectors," explain Mr Dong-Jin Choi, President of Gastron. "Our products are already equipped to detect multiple gasses and have received certification from leading semiconductor companies," he explains. "Presently, our objective is to create a single gas detector capable of identifying up to 16 different gasses simultaneously." A technology that would be an industry first.

As the Korean industry continues to grow into a cornerstone of the global supply chain, the country's "hidden champions" are gradually transforming into "global champions." So for the next iPhone teardown, you shouldn't be surprised to learn that while your favorite handset is still designed in California, its components and materials were most likely engineered by South Korea.

Technology leader in fine and process chemicals expands in global semiconductor and display markets

A South Korean company that has flourished on the back of successful partnerships with domestic giants Samsung and SK Hynix, ENF now has major international ambitions as it bids to capitalize on a growing semiconductor sector.

Founded in 2000, the South Korean company ENF Technology has established itself as a trusted specialist in supplying electronic materials for the manufacture of displays and semiconductors. ENF counts domestic titans of the electronics sector among a portfolio of customers that know they can rely on its products – and as the Yongin-based firm continues to go from strength to strength, its sights are now trained on the ambitious goals it has set itself for international expansion.

In recent years, ENF's ability to remedy supply chain disruptions brought about by various factors – including the COVID-19 pandemic and Japanese restrictions on the export of semiconductor materials to South Korea – has played a key role in what has been a period of significant growth for the company. Indeed, its revenue rose from 486 billion KRW in 2020 to 600 billion KRW in 2022.

"In the past, most raw materials consumed in South Korea came from China, while the underlying technology and equipment mainly came from Japan," explains ENF CEO Jeong-Soo Kim. "However, regulatory changes combined with import restrictions pushed the country to change its supply chain structure.

"Industry giants such as Samsung and SK Hynix were facing serious supply challenges, as they could not get the raw materials required on time. Consequently, these large corporate groups started looking for alternative suppliers, one of which was ENF. Amid this challenging situation, we have showcased our ability to react, adapt and deliver timely solutions to customers confronting difficulties."

ENF, whose products include process chemicals, fine chemicals and color pastes, has amply met the quality standards required by such leading manu-



"Convincing global giants such as Micron and Intel to use our products is an important part of our international strategy."

Jeong-Soo Kim,
CEO,
ENF Technology Co., Ltd.

semiconductor supply is unlikely to keep up with the advancing technology landscape, especially as it draws in a larger consumer base. In my view, this indicates a highly optimistic future, making it an opportune moment to invest in the semiconductor sector."

Mr. Kim continues: "We must continue to expand in international markets. As we do so, the fact that we are a supplier to Samsung and SK Hynix means that our products already abide to a high level of quality. This shows other chip makers that we are qualified and that we can deliver. Our next strategic move is to extend our influence to the American and Chinese markets. Convincing global giants such as Micron and Intel to use our products is an important part of this strategy."

ENF is currently in the process of building a U.S. manufacturing plant in Austin, Texas – a move that it sees as an opening step on the road to success in a variety of countries, with Japan and Taiwan also among the firm's targets.

"Our new factory in Austin is strategically located near a primary Samsung factory," Mr. Kim says. "The objective of our U.S. operation is to comprehensively cover the demands of Samsung's facility and start business relations with American foundries. But our vision is more ambitious than that. Looking ahead, our aim is to become a global supplier that is trusted by major corporations in all semiconductor countries."

And while ENF may have enjoyed major financial growth in the past few years, the company is confident that, by the time its 30th anniversary comes around in 2030, its current plans for overseas expansion will have led sales to multiply many times further. "Our current revenue is around 600 million USD, but our vision is set firmly on a future where this figure reaches the one billion mark," Mr. Kim declares.



Headquarters building of ENF in Yong-in city



Plant site: filling & packaging



Plant site: manufacturing

facturers. "A cornerstone of our achievements in the South Korean market lies in our capability to understand and cater to the demands and specifications of SK Hynix and Samsung," Mr. Kim says. "These companies play a crucial role in the industry as they require industrial grade materials that necessitate a high degree of competence."

Now, as ENF targets overseas growth, its successful partnership with companies that stand for excellence can only serve to

boost its expansion efforts, as the firm looks to capitalize on an expected global boom in the semiconductor industry.

"I firmly believe that we are on the verge of a tremendous surge in the sector," Mr. Kim says. "This is largely due to the rising prominence of big data and artificial intelligence (AI), with demand projected to skyrocket by tenfold, possibly even a hundredfold, within the coming decades. Looking at the long-term perspective, the current

ENF is Enabling New Future

Founded as an electronic materials manufacturer and fine chemical corporation in 2000, ENF Technology Co., Ltd. has been pioneering in the field of electronic materials with the development of new technology and a spirit of challenge. Through diversification of our business and ceaseless R&D, we have accomplished significant growth in sales and are now preparing to take the second leap.

<http://www.enftech.com/en>



MTI's coating and cleaning solutions revolutionize the CIS semiconductor production process

With a business model centered around creating one-of-a-kind solutions for its partners in the semiconductor industry, the South Korean company MTI has developed a cutting-edge combination of products that have drastically increased CMOS image sensor manufacturers' yields.



"My obsession with uniqueness is how I turned MTI into what it is today."

James Park,
President,
MTI Co., Ltd.

From digital imaging to automotive and security applications, CMOS Image Sensors (CIS) have grown to become a vital technology utilized across industries and devices.

Despite the ubiquitous nature and immense potential of their product, CIS factories spent years grappling with relatively unstable and unproductive manufacturing yields, which hovered around 40% and greatly reduced the profitability of their operations. Part of the reason for this lack of productivity was the appearance of foreign particles during the dicing process, a key stage of back-end semiconductor production.

In recent years however, a Korean manufacturer of coating and cleaning materials has developed a unique combination of products to address this industrial challenge; a solution that is set to revolutionize CIS production.

Established in 2005, South Korean company MTI specializes in making chemicals and materials that are critical to the manufacture of semiconductors, supplying its top-quality products to major clients in the domestic and international markets. Notably, MTI is a trusted partner to the South Korean electronics giant Samsung.

In the nearly two decades since MTI's president, James Park, founded the Ansan-based company, its dedication to offering clients unique, leading-edge solutions has led the company to become a niche leader of the Korean semiconductor industry.

Looking back on MTI's beginnings, Mr. Park recalls: "When you start something new, you have to follow a logical sequence of events. First, you need to figure out which area you may be successful in. Then, you need to analyze if you're capable of doing that type of work. Once you start, your thoughts then need to evolve from 'can I do it?' to 'I must do it!'. After that evolution takes place, it becomes important to differentiate between 'what I can do' and 'what I must do'. I think I was lucky to understand the importance of respecting this sequence."

For MTI and Mr. Park, that area of success soon became sawing, coating and cleaning solutions specifically targeted at semiconductor production.

"The turning point came when I successfully found the area that worked for me. This allowed me to start with something I was good at. In 2008, my thinking evolved from 'I can do this' to 'I must do this', and that was another important moment. I started dealing with chemicals and my very first product was Hyper-Pro®, a wafer blade sawing solution used during the dicing process in semiconductor production."

The application of MTI's product is found in the later stages of semiconductor production. After having completed front-end processing, the silicon wafer exits the foundry and moves to a fabrication step entitled backgrinding, at which stage wafer thickness is reduced to allow for stacking and high-density

packaging of integrated circuits. Once this step is completed, the dicing process, where the wafer is sawed and each individual chip cut out, can begin.

"Back in the day, one of the main reasons for low semiconductor production yield was the appearance of foreign particles during that process," explains Mr. Park. In 2008, however, we found that chemicals could be applied to the semiconductor surface to reduce the number of foreign particles during dicing, increasing production yield."

Since then, MTI has harnessed its world-class R&D capabilities to develop a range of chemicals and materials designed to coat and clean semiconductors during production. Now able to reduce foreign particles at both the dicing and backgrinding stages, the company has created a flagship product combination that has transformed CIS semiconductor yield rates – much to manufacturers' delight.

"Our solution is so unique that it changed the existing CIS production process," Mr. Park reveals. "Our unique solution series is composed of a coating material and a peeling technology. Before the backgrinding process, the wafer is coated with a material that can handle a pressure equivalent to three tons and that is strong enough to resist the dicing process," he adds.

When the wafer goes through the backgrinding process, MTI attaches a special tape equipped with a unique adhesive material to further protect the wafer from silicon particles. Right before undergoing automated visual inspection, the last stage of the process where the production yield is calculated, MTI applies a unique cleaning chemical to seamlessly get rid of the coating that was previously applied.

"For CIS semiconductors, the yield used to hover around 40% and could occasionally drop to 0%. After we applied our special coating material, the production yield increased to 99.9%, explains the MTI representative. When we

showed that technology to Samsung, they were ecstatic!"

Creating such one-of-a-kind products is what drives MTI's team of experts and dedicated professionals each and every day, Mr. Park declares: "We have a strong company identity that is taken from my obsession with uniqueness and with being the only one. If you compete against others, you will fight to become first, second, or third. In comparison, if you manage to create your own business or your own niche, you will always be the best. This obsession with uniqueness is how I turned MTI into what it is today."

MTI's impressive growth also comes down to the company's commitment to continuous evolution. "The semiconductor industry will never stop advancing," Mr. Park explains. "To remain competitive, our products must evolve in tandem with the market. Our first product, Hyper-Pro®, has gone through numerous changes and will continue to do so. Our ability to adapt to the evolution of the market is the reason why our cleaning chemicals enjoy a 90% market share within South Korea."

As MTI plots its course towards ongoing success in its third decade and beyond, the firm's business focus is clear: "Our core area of expertise is in CIS semiconductors. As part of a private-sector investment plan supported by the South Korean government, Samsung announced that they would invest 300 trillion KRW (230 billion USD) over the next 20 years to become the top system semiconductor maker in the world. Part of this investment will deal with CIS. Most of our future strategies, both domestically and internationally, are centered around the development of CIS technologies."



www.mtisemi.com

ENPLUS: Charging ahead as a new battery market player

CNT
solution

A leading disaster prevention and environmental solutions provider, ENPLUS has recently diversified its business with investments in battery materials alongside its existing firefighting and environmental vehicle businesses.

Established in 1966, ENPLUS started out more than half a century ago as a manufacturer of fire-fighting equipment such as fire extinguishers and sprinklers for the Seoul Fire Service. That was before asserting itself as an industry leader in 1980s with the production of the largest fleet of fire-fighting vehicles in Korea. Today, the company – which is run by Co-CEOs Yong-In Choi and Tae-Kyoung Kang – continues to lead the industry as a disaster prevention solution provider and a SoBuSan specialist (the Korean term used to describe businesses engaged in the production of materials, parts and equipment).

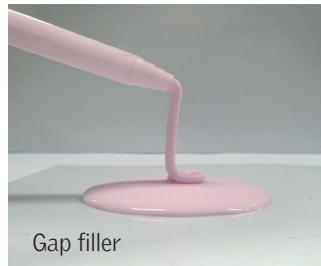
"The main products of ENPLUS today are special vehicles, especially for firefighting and environmental purposes, and new materials, where we specialize in the provision of secondary battery materials, such as electrodes, heat dissipation, and insulation which help to reduce carbon emissions," says Mr Choi.

One of the company's main representative products in the field of special vehicles is the EV YARD tractor, an autonomous environmentally friendly vehicle and one of ENPLUS's best-selling products. This innovation is significant and reflective of the company's new strategy of diversification into sustainable solutions and materials.

"While firefighting equipment is an attractive and profitable sector, it also holds a couple of weaknesses. The biggest one is that it is, by essence, unpredictable. This factor makes it difficult for companies to grow and to significantly scale up their business," says Mr Choi. "The unpredictability of the market is the reason why ENPLUS has diversified into new sectors instead of focusing only on firefighting equipment."

At the forefront of this shift is ENPLUS's investment in the secondary battery materials sec-

tor, which the Co-CEO believes will lead the business' growth for the long term.



"Looking ahead, our focus will be placed on the development of new materials, especially secondary battery materials, where we plan to allocate 70% of our manpower and resources," says Mr Choi. "This strategy does not mean that we will downsize our firefighting equipment business. Our firefighting vehicles are praised by many countries around the world and we are capable of keeping a stable and reliable supply chain. Furthermore, the barrier to entry in this market is very high and requires large investments to enter, so we are not scared of new competitors."

On the other hand, the secondary battery material industry is a completely different ball game, says the Co-CEO.

"In terms of location, we already have access to a variety of different global markets that we did not have access to with our firefighting business. Consequently, we designed a new global strategy for the development of our material business and we are currently deploying our tactics to penetrate new international regions."

And since the production of secondary batteries is an analogue process, as opposed to a digital one, it requires engi-

neering expertise and craftsmanship, two requirements that are difficult to replicate and that give ENPLUS a competitive advantage in the production of innovative secondary battery materials, such as dry electrodes and graphene solutions.

"The priority of companies and researchers in the battery industry is to reduce production costs during the development of their products. To follow the market, we must also limit development cost as much as possible," says Mr Kang. "To do this, we are focusing on the development of dry electrodes, which reduce the investment cost by 70% and the utility cost by 50%. I believe this technology will lead to a sharp decrease in the price of battery products. For instance, our company has a 0.3-gigawatt facility.

The monthly utility bill of that factory is around 70 million KRW. If we were to scale up our facility to 3 gigawatts, a significant boost in profitability might not be guaranteed. However, the adoption of dry electrodes has the potential to generate substantial savings on our electricity expenses, which would contribute positively to our overall business operations."

This cost-saving potential is a driving force motivating numerous companies to actively pursue advancements in dry electrode technology. Internationally, the battery and automotive sectors are experiencing a division on this front however, with some brands embracing high-end technologies, while others are choosing

more budget-friendly alternatives. Dry electrodes and LFP batteries cater to the budget-conscious segment, whereas NCM and NCA batteries, recognized for their compactness, rapid charging capabilities, and high energy density, target the premium market. Either way, the Korean battery sector is well established to serve both these distinct marketplaces going forward.

"The Korean battery sector is performing strongly in the global market for two main reasons.

Firstly, Korean firms enjoy fast speed of execution. Secondly, Korea has a long experience in heat control technologies," says Mr Kang. "Around 800 years ago, Korean people were excellent at making pottery, which involves baking. To this day, Korean pottery is admired the world over for its beauty and aesthetics. This robust experience in heat dissipation technologies provides us with an advantage in making cathodes as these materials are baked in high temperature furnaces. The production of secondary batteries requires four key materials: cathodes, anodes, electrolysis and separation membranes. ENPLUS' product development strategy is focused on LFP materials, nanotubes, and nickel for NCM; each of which are key materials for the market. Some of these products are already generating revenue for ENPLUS while others are currently moving from R&D to commercialization."



Cathode
electrode



Anode
electrode

EN+

<http://www.en3.co.kr/>

THiRA-UTECH set to launch new U.S. subsidiary

Continued growth of the secondary battery market and escalating tensions between the U.S. and China make it the perfect time for the company to establish its base in Atlanta, Georgia.



"My vision is to establish ourselves as a global software service provider, catering not only to renowned Korean conglomerates such as Samsung and LG but also expanding our reach internationally."

Jeong Ha Kim, CEO THiRA-UTECH

Founded in 2006, THiRA-UTECH offers end-to-end solutions for factory automation, and is active in a wide range of sectors, including displays and semiconductors, secondary batteries and the automotive industry.

Providing an extensive suite of automation solutions, it aims to streamline operations, improve efficiency and help companies achieve success at different phases of the manufacturing process.

Major clients include LG Energy Solution, and the company is proud to count giants such as Samsung and Hanwha as partners.

THiRA-UTECH CEO, Jeong Ha Kim, says: "We started our journey as a software design engineering company and eventually expanded into integrating hardware for our customers."

"Our solutions are primarily built around three major pillars," he continues. "The first one is Thira SCM, or Supply Chain Management, a solution geared towards production planning, which provides precise guidelines for factory workers. The second pillar is the MES, or Manufacturing Execution System, and the third revolves around automation software, which facilitates automated and unmanned operations in the manufacturing line."

In addition to these three pillars, the company is also developing AMRs (Autonomous Mobile Robots) as well as various components, such as actuators.

With a number of industries in the Korean manufacturing sector having slowed somewhat in recent years, THiRA-UTECH is keen to target those sectors where growth is predicted.

Certainly, Mr. Kim is in no doubt about the company's priorities: "Our principal target is the rechargeable, or secondary, battery market, and, given that the growth of rechargeable batteries and electric vehicles (EVs) is inextricably linked, that scope extends to EVs as well."

Partly this can be seen as a result of the current geopolitical situation. South Korean President Yoon recently met with his American counterpart, in order to discuss, among other things, President Biden's open invitation for Korean companies to integrate into the American supply chain.

"In my view," Mr. Kim asserts, "the tensions between the U.S. and China, along with a greater need for automated solutions, create new opportunities for us."

This is perhaps an understatement: THiRA-UTECH's share price



THiRA-UTECH Korea headquarters

has more than doubled since the start of 2023, from 7,000 KRW in January to more than 16,000 KRW in June, a development that has paved the way for the establishment of a new subsidiary, THiRA Corp., in Atlanta, Georgia.

Through THiRA Corp., the company's expansion into the U.S. - predicated on the continuing growth of the secondary battery industry - will give traditional American manufacturing companies access to smart factory solutions, and facilitate the transition to digitization. Thus, in addition to covering smart factory SW solutions such as SCM, MES, MCS, WCS and FMCS, THiRA Corp. will also focus on setup and maintenance for manufacturers, as well

as AMR and Fleet Management System (FMS).

And it is fair to say that things are moving quickly, with THiRA Corp. soon to sign its first contract with SK Battery America (SKBA) and Blue Oval SK (BOSK).

The last word, however, goes to Mr. Kim: "We aim to provide comprehensive solutions encompassing AI and automated hardware, and are ready to make significant strides in the American market, forging collaborations with prominent corporations and establishing our presence on a global scale."



www.thirautech.com

Labeling specialists chasing South Korea's No. 1 spot

South Korean firm Hanwool's automatic labeling machines offer speed and precision that competitors can't match.



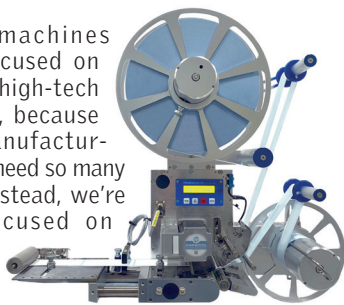
"When you use our product, its quality shines through right away."

Han Gil-Yong,
President, Hanwool

The South Korean company Hanwool specializes in premium-quality automatic labeling machines used on products manufactured in a range of industries.

"Our labelers are faster and more precise than our competitors' – that's what chiefly sets us apart," says Hanwool's president, Han Gil-Yong.

"Our machines aren't focused on labeling high-tech products, because their manufacturers don't need so many labels. Instead, we're more focused on food and drink, cosmetics, and pharmaceutical products, which are consumed quickly."



Smart easy labeler

Hanwool's labeling machines are split into two core product ranges, each designed to cater to differing customer needs. "On the one hand, we have the Step Type STR, which is widely used for food, cosmetics and pharmaceuticals," Mr. Han explains. "On the other, we have the Servo Type SVR, which is for industries that require faster and more precise labeling, such as beverages."

As Hanwool looks to expand the scope of its labeling machines, Mr. Han adds, the company sees an opportunity for success in a changing automobile sector: "Due to the transition to electric vehicles, there are a lot of parts where barcodes need to be attached. I think there's potential growth in this market."

Hanwool's ambitions also include increased overseas sales – with countries such as Thailand and Indonesia the immediate priority – and domestic domination. "We're going to be the number one in the South Korean labeling industry within 10 years," Mr. Han declares. "In fact, I expect it to take less than that."



Korea must harness indigenous technological strengths, says Twinny

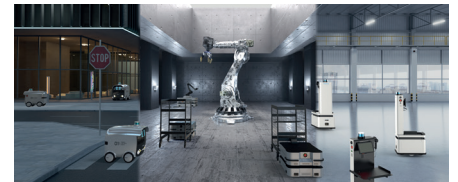
The challenge faced by Twinny, as well as other Korean tech SMEs, is how to cultivate future growth momentum to enhance the country's technological prowess.



"The only sustainable way for Korean companies to maintain competitiveness is to harness our indigenous technological strengths."

Yeongseok Cheon (left),
Hongseok Cheon (right),
CEOs, TWINNY Co., Ltd.

Although South Korea boasts exceptional engineering pedigree in the emerging robotics industry, many of the country's homegrown robotics researchers tend to diverge from the field, opting for careers in smartphone development or other more developed markets. This 'brain drain' effect has been a notable issue in Korea over the last decade, however, the recent global pandemic presented opportunities to attract highly skilled experts to the Korean robotics industry. An example is the emergence of Twinny, a key company that benefits from the influx of Masters and PhD holders from institutions like Korea Advanced Institute of Science and Tech-



Robots

nology (KAIST). With these strengthened technological capabilities and a burgeoning market, there is substantial potential in this sector for foreign investors.

"I believe that the only sustainable way for Korean companies to maintain competitiveness in the global arena is to harness our indigenous technological strengths," says Yeongseok Cheon, co-founder of Twinny. "Rather than focusing on developing service robots, we prioritize nurturing our own technological capabilities. The challenge faced by Twinny, as well as other Korean domestic companies, is how to cultivate future growth momentum to enhance our technological prowess. This entails reducing our reliance on large conglomerates and instead channeling our efforts into bolstering the technological capacities that can propel us into global niche markets."

To ensure the competitiveness and survival of Korean SMEs in the global arena, Twinny recognizes the importance of focusing on its core competencies, says Mr. Cheon, who founded the company with his twin brother Hongseok.

"The rest must be achieved through collaboration and partnerships. Our core competency lies in autonomous software, enabling us to navigate various challenges with our robotic solutions. With 160 employees, some might consider Twinny relatively large for an SME. However, we remain far from complacent and aspire to rival larger entities on the global stage."



Order Picking



GFI: Creators of innovative fire-suppression technology look to go global

Founded just under a decade ago, the South Korean company has developed a range of cutting-edge products that harness a patented microcapsule system to provide early fire detection and suppression.



"Our products are designed to thwart fire at its inception; extinguishing a candle is simpler than combating a raging wildfire."

Sangseop Lee,
CEO, GFI Co., Ltd

Founded in 2014, GFI has developed early-detection fire-suppression technology that has established the South Korean company as a pioneer in its field.

"Existing fire-extinguishing systems, such as the traditional red fire extinguisher, operate reactively," says GFI's CEO, Sangseop Lee. "They are all about post-outbreak intervention. Our approach, however,



Aegis Power Strip

diverges fundamentally by focusing on prevention. Our products are designed to thwart fire at its inception; extinguishing a candle is simpler than combating a raging wildfire."

Under the brand name AEGIS, GFI has created a range of fire-suppressing pads, wires, shields, films and tapes that incorporate the company's patented, award-winning microcapsule system: temperature-sensitive capsules that are filled with an eco-friendly, highly effective fire-extinguishing

agent. AEGIS products are attached to objects that represent an ignition risk – and the instant that fire erupts, the rise in temperature causes the capsules to break open, releasing the agent.

GFI's fire-prevention technology is durable, requires no power source and is resistant to false triggers. Furthermore, it is easy to install and can fit into tight spaces – right down to spots just 1mm wide. "Envision a room with potential ignition points such as power outlets, cords and lamps," Mr. Lee explains. "Our products can be positioned within these minuscule spaces to preclude fire outbreaks."

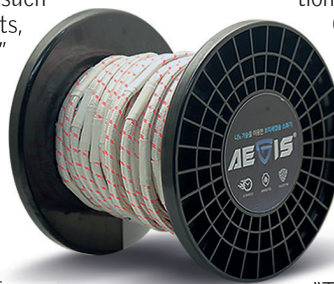
AEGIS tape, for example, is the ideal solution for avoiding fires caused by cords, cables and wires. "Consider the typical scenario where fires don't originate from within cables but rather from their connecting points," Mr. Lee says. "Currently, black insulation tape is commonly employed for these connectors, despite its limited fire-preventing capabilities. In such instances, our fire-prevention tape proves invaluable. Alternatively, our products can be seamlessly integrated during the cable manufacturing stage, providing inherent fire protection from the outset."

Another common fire source is the secondary battery, better known as the rechargeable battery, which is found in everyday technology such as cell phones, tablets and computers. "Visualize a laptop engulfed in flames," Mr. Lee says. "The battery is often the source of the fire. With our products affixed to the battery, any excessive temperature rise triggers our intervention, preventing fire. While your laptop might still suffer damage, we've shielded you from the peril of fire. Incorporating our products into laptops is a relatively straightforward endeavor."



Aegis Shield

Fire risks such as cables and batteries are key to GFI's international strategy, as the Gimpo-based company seeks to bolster its presence beyond South Korea. "This year, we are committed to breaking into the global arena," Mr. Lee declares.



Aegis Wire

"The South Korean market, although significant, has its limitations. We aim to provide assistance not only domestically but also to other countries around the world.

"We have identified two key areas for our growth strategy.



Aegis Film

Firstly, we intend to target the main secondary battery manufacturing countries, which – other than South Korea – are China and Japan. Currently, no other countries are on a par with these three powerhouses in secondary battery production. Secondly, we aim to engage general businesses and individuals, specifically focusing on cable and household electronic device manufacturers. For this aspect, our scope encompasses the entire globe."

As it bids to take its technology around the planet, GFI is also committed to making its products accessible to all sections of society. "Fire vulnerabilities disproportionately affect the vulnerable and disadvantaged," Mr. Lee says.



Aegis Tape

"The affluent often reside in safer, meticulously equipped environments with advanced sensors, while those with fewer resources often inhabit older homes with deteriorating electrical systems. Such environments are predisposed to fire outbreaks.

"My goal is to craft products that are not only of high quality but also affordable. Our products hold tremendous potential for widespread use in underdeveloped nations. Even in developed countries, pockets of underprivileged communities exist. By extending our products to these demographics, we can potentially save countless lives and valuable property."

"I firmly believe our products can be a force for good," Mr. Lee concludes. "My aspiration is to benefit not only my company but also the local community, South Korea, and the global community."