

Hanwha Newsletter

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Hanwha Seeks Measures to Enhance Its Global Competitiveness at Summer Davos

- Hanwha Q CELLS CCO Dong Kwan Kim served in a discussion panel on renewable energy
- Hanwha executives met with high-ranking officials from multinationals in chemical, finance, and leisure service



Hanwha Q CELLS CCO Dong Kwan Kim (left), FTChinese.com Editor-in-Chief Wang Feng (right)

Hanwha Group participated in the Annual Meeting of the New Champions 2017 (AMNC 2017), also known as the Summer Davos, held in Dalian, China to strengthen business ties with global experts and to find ways to enhance the competitiveness of its core businesses in solar, petrochemical, life insurance, and leisure services.

Over the three-day forum from June 27th to the 29th, about 1,500 experts in the political, economic, and cultural sphere from over 90 countries around the globe took part in various sessions and discussions under the theme, "Achieving Inclusive Growth in the Fourth Industrial Revolution."

Attendees from Hanwha Group included Hanwha Total Petrochemical CEO Hee Cheul Kim, Hanwha Hotels & Resorts CEO Seok Moon, Hanwha Q CELLS CCO Dong Kwan Kim, and Sino-Korea Life CEO Donwan Koo.

Dong Kwan Kim, CCO of Hanwha Q CELLS was one of the three panelists at the Dalian International Conference Center. The other two were Lin Boqiang, the

Director of China Center for Energy Economics Research (CCEER) and Jim Pass, Managing Director at Guggenheim Partners. Mr. Kim spoke on clean energy and its prospects in Asia and the value of investing in renewable energy.

"The solar energy business will maintain stable growth in China, India, the United States, and Australia. The drop in the price of solar panels and energy storage systems will further improve price competitiveness, suggesting a bright prospect for the solar energy market," said Mr. Kim at the session entitled, "Tomorrow's Clean Energy Giants."

He also shared his view on the growth of Chinese PV module makers, commenting, "They do pose serious competition but it also works in a positive way in that it drives down the price and revitalizes the solar ecosystem." On Hanwha's future strategy to remain competitive in the global solar market, he said, "We are eyeing the Turkey and the Middle East market with interest. Cooperation with solar energy startups is also a viable option."

Lin Boqiang said, "The global solar industry, including China, will continue to grow but we need to be aware of the recent protectionism trends and how they will affect the world market."

Dong Kwan Kim agreed with Lin's view, saying, "Hanwha is also watching closely the global trend – the rise in protectionism and the potential impact it can have on Hanwha Q CELLS and other clean energy firms. We have been preparing measures to effectively respond to this trend, not least by sharpening our own competitiveness."

Meanwhile, Hanwha Total Petrochemical CEO Hee Cheul Kim took part in a climate change and clean energy session and held business meetings with global chemical companies, including DSM of Netherland, SASOL of South Africa and Reliance, one of the biggest companies in India.

Hanwha Hotels & Resorts CEO Seok Moon and Sino-Korea Life CEO Donwan Koo also took part in many sessions of interest and industries. They exchanged information with experts and high-ranking officials from global leisure and financial service providers such as the JTB Group, the global hotel franchise Marriott, Switzerland's Zurich Insurance Group, and Japan's Nomura Securities. ■



Hanwha Total Petrochemical CEO Hee Cheul Kim (fourth from left)

Hanwha Advanced Materials Wins Electric Car Parts Order from SAIC Volkswagen



Amidst the shifting paradigm in the automotive industry, Hanwha Advanced Materials has come into the spotlight having moved aggressively into the future car market of smart cars and electric vehicles.

The company has already been producing battery cases to LG Electronics since last October. Hanwha has optimized sheet molding compounds (SMCs) to better protect the battery pack in the event of an impact from a collision. These batteries protected with Hanwha's battery cases are being supplied to the Chevy Bolt, GM's next-generation all-electric vehicle. Now, the Shanghai subsidiary of Hanwha Advanced Materials has won the contract to supply battery cases for the E-Lavida, an all-electric vehicle to be mass-produced starting in the second half of next year by SAIC Volkswagen Automotive Co., Ltd. SAIC Volkswagen Automotive Co. is a joint venture between SAIC Motor Corporation Limited and Volkswagen. The deal is indeed timely in that the growth of the Chinese e-vehicle market is picking up pace.

Hanwha Advanced Materials' SMC-based Battery Case

In 2011, Hanwha Advanced Materials heavily invested in research and development on battery cases for electric vehicles using SMC. In 2015, the company succeeded in developing an SMC with excellent dimensional stability, watertight property and improved mechanical behavior, making it the ideal material for mass-producible battery cases for electric vehicles. SMC is a thermoset resin impregnated with glass fiber. It is, therefore, outstanding in strength, resistant to scratches, protected from damage, and possesses electrical insulation. The material also has superb plasticity making it an easy compound to work with to build automotive parts.

E-Lavida is a sedan specifically targeting the Chinese market. It is an all-electric vehicle powered by a lithium-ion battery. When fully charged, it has a range of about 200 kilometers.

Hanwha Advanced Materials' Shanghai subsidiary is producing the battery cases for 66,000 E-Lavidas every year, starting August of 2018.

Additionally, Hanwha Advanced Materials is aggressively engaging in activities to win more orders to expand its supply of the e-vehicle battery case to global joint-ventures based in China (GM and BMW) and keep pace with the growing e-vehicle market in the country. ■

What's Behind All the Buzz on Solar Energy?

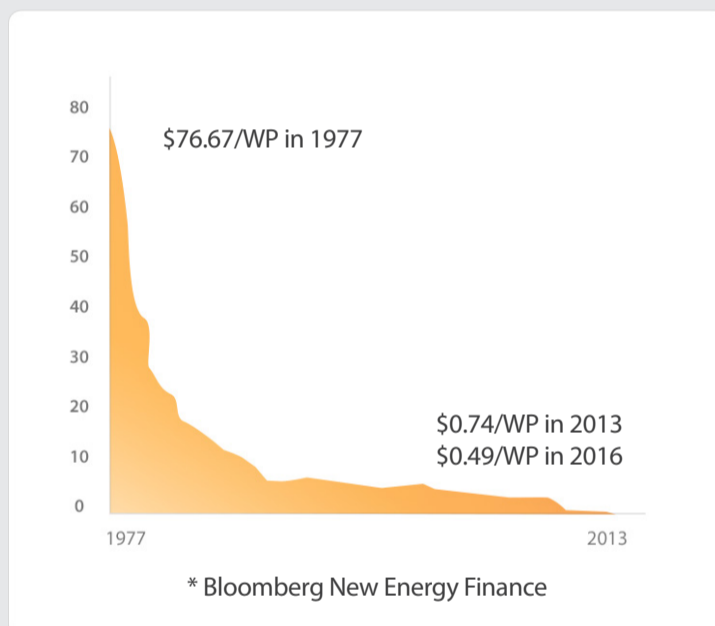
Ahmed Zaki Yamani served 25 years as the Minister of Oil and Mineral Resources of Saudi Arabia and has also chaired OPEC's Long-Term Strategy Committee. Back in 2000, he famously predicted that in 30 years, there would be "a huge amount of oil – and no buyers" because technological advances were creating new, cheaper, and viable substitutes for oil.

Today, we are seeing his predictions come true in the global energy market. Solar energy is quickly becoming the most promising next-generation source of energy. In some regions, solar energy has already overtaken fossil fuels because it has a low cost of entry and is environmentally-friendly.

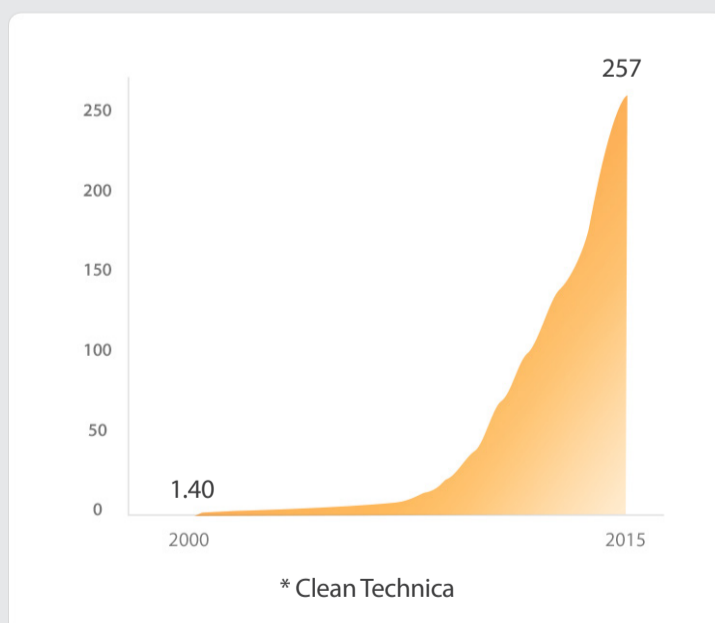
Let us take a look at why the energy world is abuzz with the talk of solar energy.

Lower Installation Costs

Price of PV modules over the past 40 years



Number of accumulated global PV generator installation within 15 years

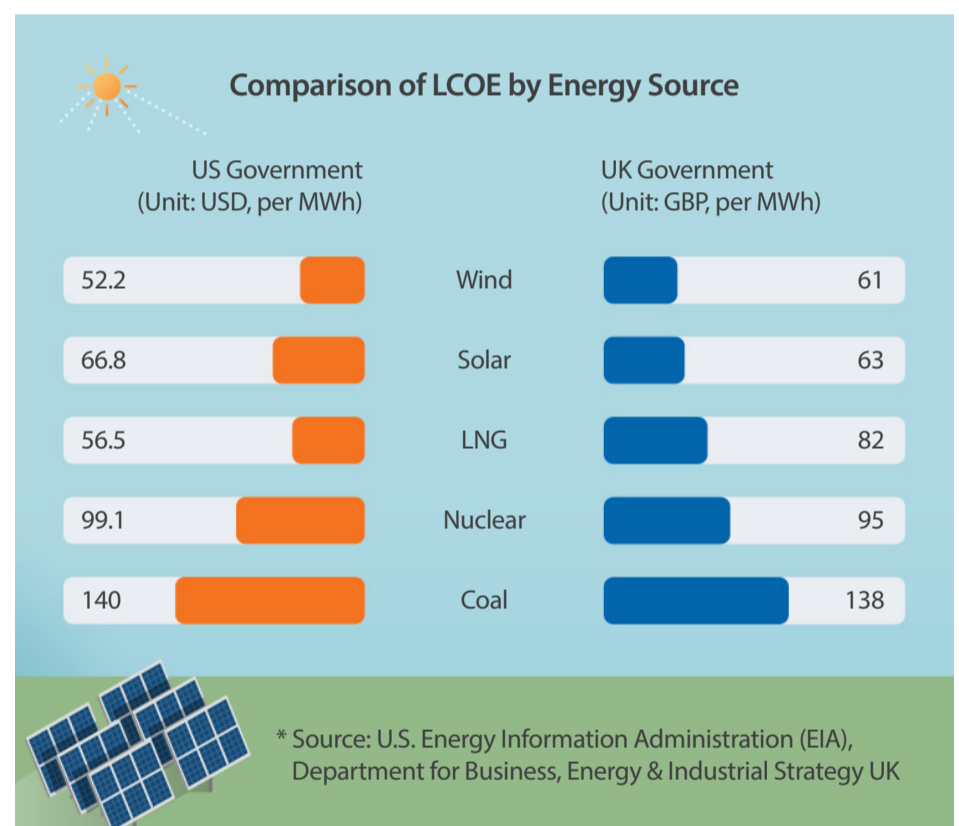


The price of photovoltaic modules, which account for about half of the cost of building a solar power plant, dropped 99% in the past 40 years from \$76.67/Wp in 1977 to only a fraction of the cost at \$0.74/Wp in 2013. The drop in price

corresponded with a dramatic increase in the number of new installations of solar energy facilities around the world, with the cumulative installation volume rising 180-fold in the past fifteen years.

Saving Maintenance Costs

The appeal of solar energy and its increasing adoption across the global energy market is also due to low cost of maintenance. There is only a small number of moving parts in a photovoltaic system and this equates to lower running and maintenance costs than fossil fuel plants operating over the same period of time. Unlike traditional fossil fuels such as coal, natural gas and petroleum, solar energy uses sunlight as its fuel to generate power, making its raw material costs, effectively zero.



The energy industry uses a concept called 'Levelized Cost of Energy' (LCOE) to calculate the present value of a system's lifetime costs by combining all costs that go into the development, construction and operation of different energy generation systems.

According to the United Nations Environment Program (UNEP), the LCOE of solar PV energy dropped by 17 percent between 2015 and 2016. And the statistics released by both the U.S. and the UK government confirm that the LCOE of solar energy is already at a level far lower than that of other energy sources in advanced markets.

Sustaining Energy and Great Growth Potential

Besides being cost effective, solar energy has a myriad of benefits and great potential for growth. Relative to other sources of energy, it takes considerably less time to install the solar panels that can generate 3 kW for a small household to a massive 500 MW at a 1 GW plant. Construction of these environmentally-friendly plants take much less time too and with the current ability to accurately predict sunlight, barriers to entry are low and the incentives high. These benefits combined with the eager support from national and regional governments are making solar energy tomorrow's highest growth-potential power source.

According to the CFO of Hanwha Q CELLS Seo Jung-pyo, increasing public awareness of global climate change is expected to further fuel the demand for solar energy. And solar energy with its virtually limitless potential for growth will continue to play a pivotal role in the future development of the new and renewable energy industry with its eco-friendly and affordable energy production. ■



Explore This Month's News of Hanwha and Its Affiliates, Taking the Initiative in All Corners of the World



China



Hanwha Advanced Materials

Hanwha Advanced Materials Beijing

Hanwha Advanced Materials Beijing's production line is currently undergoing a manufacturing process inspection by BMW China. The inspection is part of BMW's process to select the provider of Energy Absorber parts that will be utilized in its F39 model. The F39 is the code name for the new BMW X2 prototype currently under development. Absorber parts are sections of the automobile that protect the occupants by forming "crumple zones" at both ends of the car to absorb impacts while the central cage remains stiff and intact.



Germany



Hanwha Q CELLS

Hanwha Q CELLS GmbH

Hanwha Q CELLS Q.PEAK RSF L-G4.2 Wins Intersolar Award 2017

Hanwha Q CELLS' Q.PEAK RSF L-G4.2 received the Intersolar Award 2017 in the Photovoltaics category for its reinforced steel frame module innovation. Q.PEAK RSF L-G4.2 was chosen as the most innovative solar module out of 51 total submissions. The Global Chief Technology Officer Daniel JW Jeong received the award on behalf of Hanwha Q CELLS and said "The improvements in terms of performance, installation costs and leveled electricity costs are such that we believe this technology is likely to set the next industry standard in solar modules for utility scale applications."

The reinforced steel frame is a brand-new innovation and substantial in that it lowers manufacturing costs and increases control. The modules feature a



decentralized junction box with shorter cables but higher performance and lower losses from electrical resistance. The Easy-Mounting-System developed by Q CELLS requires only half the installation material of conventional systems and takes 60% less time to install. These modules also take up less system space because they can be placed next to each other on mounting structures without gaps. And with the proprietary Q.ANTUM technology on monocrystalline wafers, the power rating of the module hovers at 375 Wp.



Malaysia



Hanwha Q CELLS

Hanwha Q CELLS Malaysia Sdn. Bhd.

Hanwha Q CELLS Malaysia Undergoes Emergency Firefighting Training

The management of Hanwha Q CELLS Malaysia views emergency preparation as an essential part of doing business. In keeping with this philosophy, 54 employees were recently trained on how to handle a potential fire outbreak in a production plant. And in the event that it occurs, these trainees would form the Emergency Response Team (ERT) to fight the fire. Professional trainers from

MSE Academy – a safety and emergency response training provider in Malaysia – were appointed by the Environmental, Health & Safety (EHS) department to conduct the training May 15th-16th and May 24th-25th this year.

Each of the two-day training exercises were designed to educate participants on the potential causes of fires as well as realistic projections of what to expect when fires occur based on real life examples in production plants. This knowledge served as an important foundation to educate participants on fire prevention especially in high risks areas of a plant such as the waste storage and chemical handling areas.

The second part of the training involved more hands-on sessions where participants were taught how to use fire extinguishers, distinguish the various types of extinguishers according to the type of fires they are best suited to put out. Participants were also brought to various plant locations where fire hoses & water sources could be found. They were then trained to use them.

Finally, through simulated fire scenarios, participants were given the opportunity to rescue fire victims where there was limited visibility in unfamiliar



environments. The emergency firefighting training session provided invaluable knowledge and training to the employees that could potentially reduce risks, save lives, and minimize plant operations in the event of fire in a plant.



Vietnam



Hanwha Life Vietnam

Hanwha Life Vietnam Inks Deal with Shinhan Bank to Distribute Insurance Products

On June 13, Hanwha Life Vietnam signed a strategic partnership with Shinhan Bank Vietnam to sell bancassurance products. Shinhan Bank will partner with Hanwha to provide the latest insurance products to clients through its network in Vietnam.

The co-operation is expected to create a comprehensive financial service that will increase value to customers of both companies. Jong Kook Baek, the Chairman and General Director of Hanwha Life Vietnam, said "I believe this co-operation will effectively help to harness the great potential and strength of both parties." He added "This partnership will bring advanced insurance products to customers in a more comfortable and professional manner."



The concept of bancassurance is quite new in Vietnam but its potential is enormous. It is set to be an important and rapidly growing sales channel in the future. ■

Hanwha Chemical *Produces* *Next-generation Eco-friendly Plasticizers*

- Hanwha Chemical's new phthalate-free plasticizer poised to replace conventional plasticizers
- Commercial production of Hanwha's plasticizer has begun at its 15,000-ton capacity plant



Hanwha Chemical Ulsan Plant

Hanwha Chemical is advancing into the next-generation eco-friendly plasticizer with the production of ECO-DEHCH (Diethylhexyl-cyclohexane), a phthalate-free premium plasticizer. At its plant located in the Ulsan Petrochemical Industry Complex, the annual production capacity is expected to be 15,000 tons.

Plasticizers are additives that soften and thereby improve the flexibility of plastics. However, the phthalate content in plasticizer is known to be toxic to humans. Therefore, its use is prohibited in wallpapers, flooring materials, toys and many other products. Dioctyl terephthalate (DOTP) plasticizers are used as an alternative, but done so at the expense of product quality.

The new eco-friendly plasticizer ECO-DEHCH from Hanwha, however, is not short on quality and it is safe for humans. Over the course of eight years of relentless R&D efforts and by developing its own technology, Hanwha Chemical has been able to produce a plasticizer that can combine with hydrogen and not use phthalate. The ECO-DEHCH has a high absorption rate that makes processing easier and when processing plastics, less material is used than using DOTP plasticizers. ECO-DEHCH also has high UV-stability and tolerance to cold, making its use perfect for outdoor products.

In 2014, Hanwha Chemical's ECO-DEHCH earned the New Excellent Technology (NET) certificate from the Korean Agency for Technology and Standards (KATS). It passed the safety test by the US Food and Drug Administration (FDA) for its use in plastic wraps, bottle caps, and other food-related products. It has also passed the toxicity test conducted at SGS, the world's leading verification and testing company, for its use in children's toys.

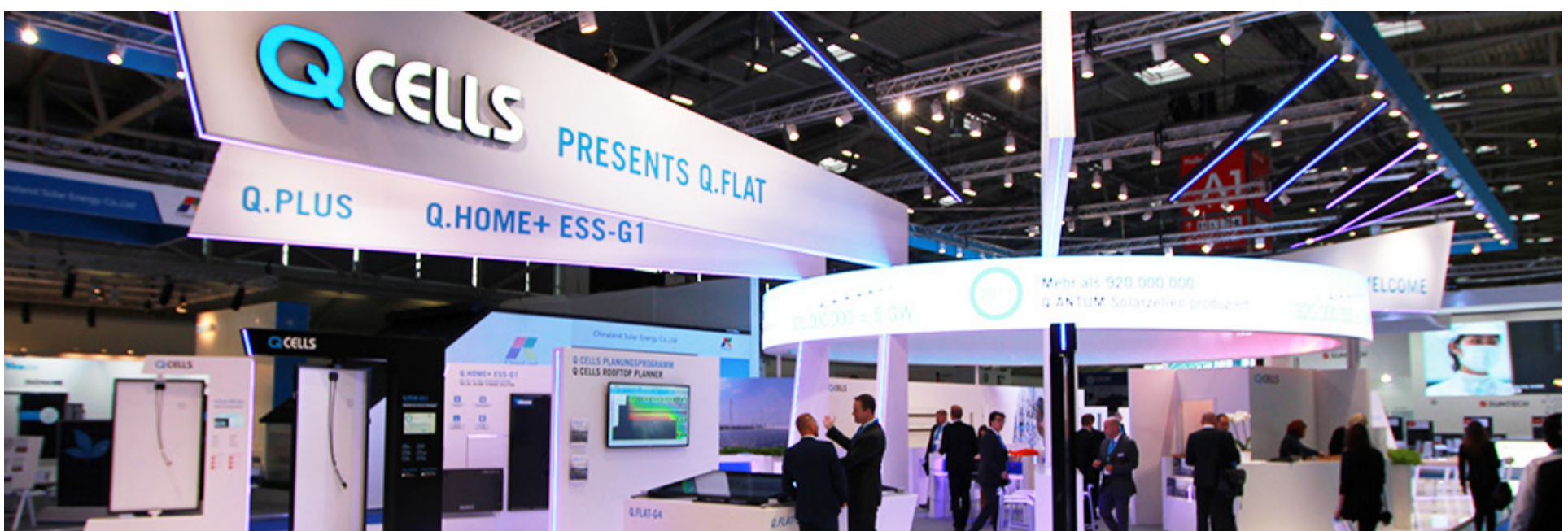
As the production of eco-friendly plasticizers require advanced technology, the barrier to entry is high and its key strengths and strong value proposition assures there is no concern for oversupply. The hydrogen-added plasticizer is currently being manufactured by only two companies in the world: BASF and EVONIK.

The current market size of conventional plasticizers is about \$7.1 billion worldwide, but amid increasing regulations on the use of phthalate globally, eco-friendly plasticizers are replacing the conventional plasticizers in the market. The global market size of eco-friendly plasticizers is currently \$1.3 billion, growing at

a rate of more than 6 percent annually. Recognizing the opportunity, Hanwha Chemical has recently reorganized its business portfolio to shift its focus to high-value-added specialty chemicals and continue making inroads into chlorinated polyvinyl chloride (CPVC), hydrogenated petroleum resin, and other lucrative areas in the industry. ■

Intersolar Award 2017 Goes to Hanwha Q CELLS' Reinforced Steel Frame Module Innovation

- The Q.PEAK RSF L-G4.2 convinces Intersolar Award jury with reinforced steel-frame concept and many additional innovations
- Reinforced steel frame design, decentralized junction box, easy mounting system and Q.ANTUM technology combine numerous advantages for higher yields and system performance as well as lower installation cost and lower LCOE
- Hanwha Q CELLS CTO Ph.D. Daniel JW Jeong said: "Our steel frame module has a good chance of setting the next industry standard for utility scale solar modules."



Hanwha Chemical Ulsan Plant

Hanwha Q CELLS Co., Ltd. ("Hanwha Q CELLS" or the "Company") (Nasdaq: HQCL), has won the Intersolar Award 2017 in the category Photovoltaics. The jury judged Hanwha Q CELLS' Q.PEAK RSF L-G4.2 solar module as the most innovative out of ten shortlisted entries and out of 51 applications in total. Receiving the award on behalf of Hanwha Q CELLS, the company's Global CTO, Ph.D. Daniel JW Jeong, said: "We are very pleased about the judgement of the Intersolar Award Jury. Our new steel frame module combines a number of innovations on different levels with our high performance cell technology Q.ANTUM. The improvements in terms of performance, installation cost and LCOE are such that we believe this technology is likely to be setting the next industry standard regarding solar modules for utility scale applications."

Q.PEAK RSF L-G4.2 : THE NEXT LEVEL OF UTILITY SCALE SOLAR MODULES

Q.PEAK RSF L - G4.1 is a monocrystalline 72-cell Q.ANTUM solar module ready for a maximum system voltage of 1.500 V and combining the following innovations to reach lowest LCOE:

- **Q CELLS Reinforced Steel Frame technology**
 - Framing concept based on innovative steel coated with alloy of zinc-aluminium-magnesium
 - 10 times better corrosion resistance compared to galvanised steel
 - Self-repairing mechanism for cut edges
- **Decentralized Q.BOX**
 - Decentralised junction box with pluggable MC4-connectors in upper corners of the module
 - Cable length can be customized to fit perfectly to any installation

- Lower losses from electrical resistance due to optimised cable length
- Faster and safer installation
- **Easy Mounting System**
 - Only small mounting key and self-tapping screw needed to fix modules on mounting structure
 - Reduction of installation time on a standing mounting structure by over 60% compared to standard systems with clamp mounting
 - Modules can be mounted without any gap between modules, thus reducing installation size or increasing total system power
 - Saves a large amount of mounting materials
- **Q CELLS proprietary Q.ANTUM cell technology**
 - Rear side passivated monocrystalline solar cells for power classes up to 375 Wp
 - Strongest standard 72 cell module on the market
 - High power density leads to low BoS costs
 - Q CELLS Yield Security: Anti LeTID, Anti LID, Anti PID, Hot-Spot Protect, Tra.Q ■

Hanwha Investment Seeks to Collaborate with World's Leading AI Startup Element AI

- Hanwha seeks to strengthen its competitiveness in AI
- Hanwha co-invests in Element AI, a company established by the co-founder of deep learning



Hanwha Group's venture capital arm, Hanwha Investment, participated in the \$100 million Series A funding round of Element AI, a world-renowned Canadian artificial intelligence startup. Hanwha is the first company in Asia to take part in the joint investment. The investment is part of Hanwha's plan to collaborate across diverse fields in AI with a company that could lead the global AI industry.

By partnering with Element AI, Hanwha Investment expects to kickstart Korea's AI industry and eventually turn the nation into an AI powerhouse. To this end, Hanwha is taking lead in the efforts to develop AI related industries along with the jobs they will create.

Element AI is in Canada and built in partnership with businesses and research institutes. The company pursues an open business platform and with its in-house developed AI algorithm, Element AI's global team of experts jointly develop AI solutions and share the intellectual property with its partners.

Element AI was only established 10 months ago in August, 2016 and yet has already attracted funds from global tech giants, venture capitals and investors, including Data Collective (DCVC), a venture capital specializing in Silicon Valley's AI startups, Microsoft Ventures, Intel Capital, Nvidia, Fidelity Investments Canada, and GIC, a Singapore-based global investment firm. Element AI is currently valued at \$300 million.

University of Montreal professor Yoshua Bengio, the co-father of deep learning technology, is credited for the rapid growth of the company. He is one of the three leading authorities on deep learning, alongside New York University professor Yann LeCun (Facebook) and University of Toronto professor Geoffrey Hinton (Google).

Deep learning is a machine learning algorithm based on artificial neural networks and vast amounts of data; the technology enables a machine to self-learn, like humans. ■

Hanwha Techwin to Build Aircraft Engine Parts Factory in Vietnam

- Construction of 60,000m² plant near Hanoi to begin this year
- Sales of civil aircraft engine parts expected to reach 1 trillion won (USD 879 million) by 2025



Hanwha Techwin announced it will expand its aircraft engine parts production capacity by building a new plant in Vietnam.

At 60,000m², the new factory is roughly eight times the size of a regular soccer field. It will be built on approximately 100,000 square meters of land near Hanoi, Vietnam. Construction of the plant is expected to start in August this year so that operations can begin at the second half of 2018.

Hanwha Techwin is looking to increase its sales of civil aircraft engine parts to about 1 trillion won (USD 879 million) and lead the aircraft parts processing industry by 2025. To achieve this goal, the company is expanding its engine parts production capacity with factories overseas and stepping up activities to win contracts.

Hanwha Techwin is winning large-scale parts orders from world-leading aircraft engine manufacturers, including GE, Pratt & Whitney (P&W), and Rolls-Royce. Against this backdrop of growth, the company conducted a feasibility study and concluded that it needed to establish an overseas engine parts manufacturing facility. While there were a number of potential locations, Hanwha Techwin selected Vietnam as its production base strategic location and to maintain cost competitiveness.

"Aircraft engine parts makers such as Dynamic Precision, Barns, and Magellan are also expanding their production capacities by building manufacturing plants abroad to support their production bases at home," said a spokesperson of Hanwha Techwin. "Going forward, the Changwon factory in Korea will serve as a production base to manufacture high-value-added products with highly sophisticated technology and provide technical support to the factory in Vietnam.

The Vietnamese factory will leverage Changwon Factory's technology and business experience to produce parts in volume to keep its prices competitive." ■