

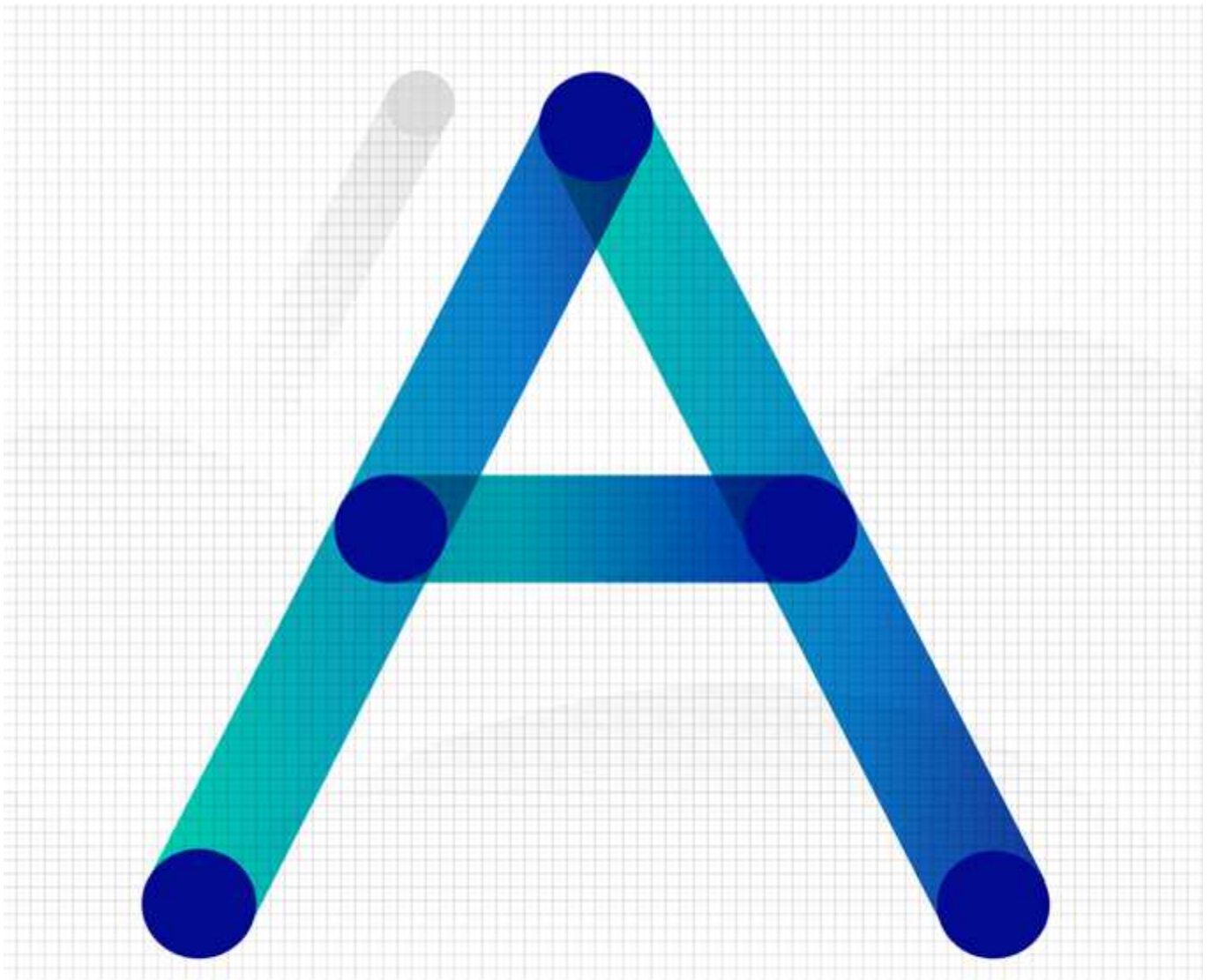


Photovoltaic Industry Trends in the First Half of 2023

I. Global Photovoltaic Industry
Trends II. Photovoltaic Industry
Major Issues and Corporate
Performance III. Domestic
Photovoltaic Industry Trends IV.
Implications

Write

Senior Researcher Kang Jeong-hwa (6252-3612)



<Essentials>

(Market Trend) Global solar installation volume in the first half of 2023 is estimated to significantly exceed the previous year's level due to a significant increase in demand from the Big2 (China and the United States) markets.

☞ The growth in global solar demand in 2023 is driven by the decline in product prices, especially in China, which is the largest demand destination.

With the decline in product prices, the installation cost has been significantly reduced compared to 2022, and the demand for solar power at a low price is rapidly increasing, and the installed volume of solar power in China from January ~ April 2023 increased by 190% year-on-year to 48GW.

☞ Global solar installations in 2023 are revised upward to 20GW, an increase of 20GW 340~360GW compared to the 320~340GW forecast at the beginning of the year.

As of July 2023 , the price of polysilicon is \$7.85/kg, down 79.9% from its August 2022 high (\$39/kg).

☞ As we enter 2023, large-scale expansion volumes are being supplied to the market, and polysilicon prices are falling sharply due to the decline in the prices of key raw materials due to global interest rate hikes.

☞ In 2022, the global polysilicon production capacity was 980,000 tons, but the production capacity available by the end of 2023 is expected to increase to about 1.6 million tons due to large-scale capacity expansion.

- In 2023, the production capacity of polysilicon has been increased from 1.3 million tons to 1.6 million tons, and the 1.6 million tons of polysilicon has the capacity to make solar cells of about 6,000 GW, which is an oversupply of more than 240 GW compared to the global demand of 360 GW.

(Photovoltaic Industry Issues) The main keywords of the global photovoltaic supply chain in 2023 are the possibility of diversifying the supply chain due to China's monopolization and the implementation of the US IRA

☞ The polysilicon production capacity by country is 940,000 tons in China, 61,000 tons in the United States, 60,000 tons in Germany, 35,000 tons in Malaysia, 11,000 tons in Japan, 8,000 tons in Qatar , 7,000 tons in Norway, and 6.5 thousand tons in South Korea.

☞ In 2023, the module production capacity by country is 540GW in China, 26GW in Vietnam, 15GW in Malaysia, 14GW in India, Thailand 10GW, 한국 10GW 순

- When the current expansion is completed, the global module production capacity is expected to reach 740GW , of which Korea accounts for about 84%

✎ The core competitiveness of China's photovoltaic industry is competitive low investment cost through the development of its own production technology and cost competitiveness through securing a stable economy.

- With an annual production capacity of 1GW and as of 2022, the investment cost of the value chain of the photovoltaic industry's major regions is as follows:

The investment cost of polysilicon is \$ 34 million in China, \$ 44 million in Southeast Asia, and \$124 million in the U.S. and Europe, which is only 27% of that of the U.S. and Europe.

✎ With the implementation of the IRA, the price of U.S. solar modules is expected to compete with the price of modules manufactured in Southeast Asia.

- Wafers produced in Southeast Asia- Solar cells- The manufacturing cost of modules is about 24 cent/W , and it is estimated that the production cost will be 23 cent/W if the wafer is produced in the U.S. through IRA subsidies, which will be more competitive than products produced in Southeast Asia.

In 2023, the domestic photovoltaic market is expected to reach 2.7GW, a decrease of 15% compared to the previous year , and the demand is expected to be around 2.5~3.0GW per year by 2030.

✎ Domestic solar power installations are expected to stagnate due to changes in government policies, such as lowering the proportion of renewable energy to 21.6% in 2030, abolishing the RPS system, introducing an auction system, and fixing the ceiling on the wholesale electricity price (SMP).

✎ Domestic photovoltaic power generation is still recognized as an expensive source of power generation, but due to the continuous decline in module prices, Korea is also imminent in reaching grid parity in solar power generation, and the need for it is increasing as a means to reduce energy dependence on external sources.

After 2025, when a new U.S. solar supply chain is built, the China-centered solar supply system is expected to change, which is expected to further exacerbate the oversupply in China.

✎ When the supply chain is established in the United States, the oversupply of Chinese companies is expected to increase further, and if the oversupply volume cannot be digested in the domestic market, there is a possibility that the prices of major solar products such as modules will fall sharply.

In order to develop Korea's photovoltaic industry, it is necessary to develop a market not only in the manufacturing field but also in the field of developing solar photovoltaic projects, which are growing rapidly.

✎ Project development and operation can create more added value than the manufacturing field, and it is possible to enter various markets through program development linked to entering the market of developing countries using EDCF.

I. Global Photovoltaic Industry Trends

1. Global Solar Installation Trend

It is estimated that the global solar installation volume in the first half of 2023 significantly exceeded the previous year's level due to the significant increase in demand in the Big2 (China and the United States) market.

Ÿ As the price of polysilicon decreases, the cost of manufacturing modules is falling, and the decline in module manufacturing costs is leading to a decrease in the unit cost of solar installation.

Ÿ Falling cost of photovoltaic installations leads to improved profitability of photovoltaic projects, and as installation costs fall, the demand for photovoltaic increases proportionately.

Ÿ The growth in global photovoltaic demand in 2023 is driven by a decline in product prices, especially in China, which is the largest demand destination, due to a surge in demand for solar power

With the decline in product prices , the installation cost has been significantly reduced compared to 2022, and the demand for solar power installation in China is soaring, and the installed volume of solar power in China increased by 190% year-on-year to 48GW from January ~ April 2023.

Considering that the first quarter is the off-season for solar power, the demand growth is significant, and the installation volume in the second half of the year is expected to be larger than the growth in the first quarter.

(Outlook) Global solar installation volume in 2023 will be revised upward to 340~360GW, an increase of 20GW from the forecast of 320~340GW at the beginning of the year.

Ÿ The U.S. installation forecast for 2023 has also been revised upward from 24GW to more than 30GW, and Germany, Europe's leading solar market, has also been revised upward from 7GW to 10GW.

Following 2022, which recorded a larger-than-expected growth , this year is expected to continue to grow significantly compared to the previous year.

Ÿ The demand for photovoltaic power in the Big2 (China and US) market, which accounts for more than 50% of global solar installations, is expected to exceed 165GW in 2023 (135GW in China and 30GW in the United States), continuing the good growth trend from the previous year.

Ÿ The demand for solar power installations in Europe for energy security and climate change prevention is also expected to reach 60GW from 50GW

The global solar installation forecast is 350 GW in 2024, 420 GW in 2027, and 2030

Upward revision from 530 GW to 400 GW in 2024 , 530 GW in 2027 and 680 GW in 2030

☞ China is expected to peak at 140 GW in 2025 and slow down, but demand is expected to grow faster than expected, reaching 180 GW in 2025, 200 GW in 2027, and 260 GW in 2030.

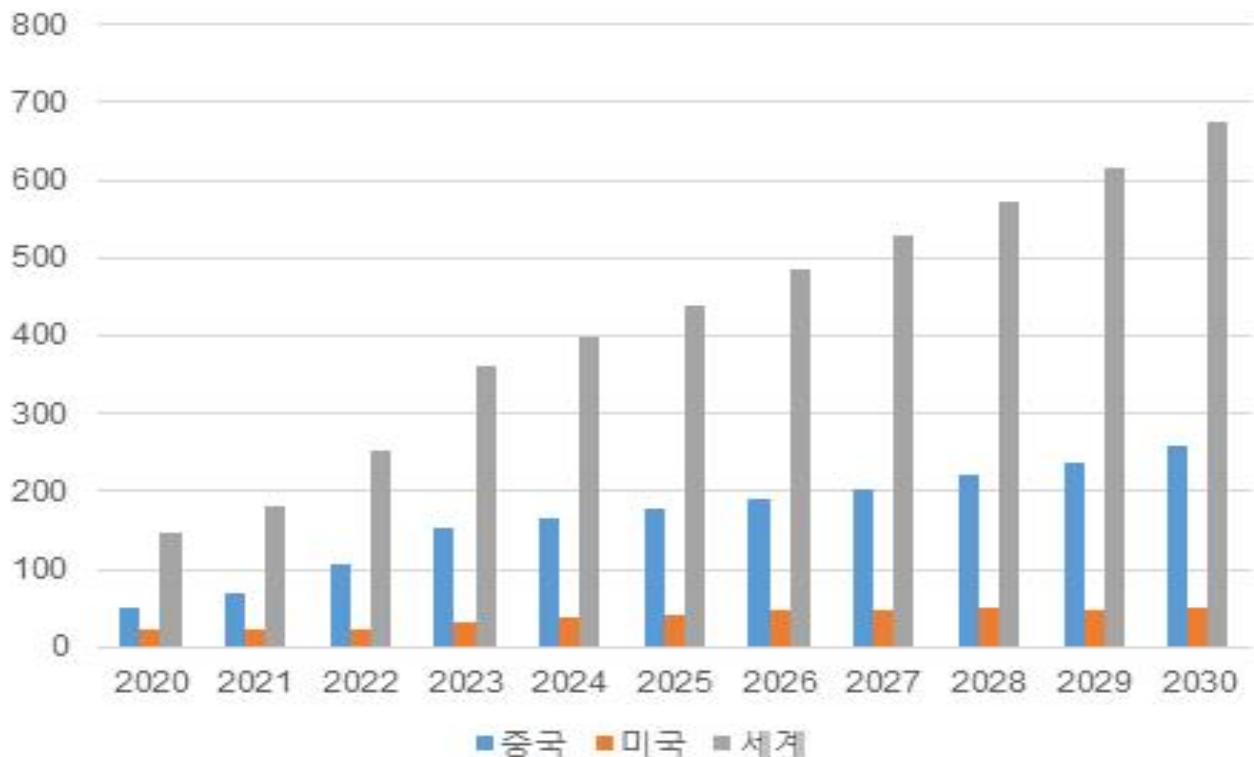
☞ The U.S., which ranks second in global solar installations, is expected to continue its steady growth, reaching 45 GW by 2025, 50 GW by 2028, and 55 GW by 2030 .

☞ As demand from developing countries such as Asia, the Middle East and Africa increases, the share of the Big2 (China and US) market , which has exceeded 50%, is expected to fall below 50% after 2025.

- Rapidly growing demand for solar in developing countries is expected to replace a significant portion of the demand in the Big2 market after 2025

<Global Solar Installations Status and Forecast>

(단위: GW)



materials : BNEF

<Solar Installations in Major Countries and Prospects>

(단위: GW)

country	2017	2018	2019	2020	2021	2022	2023 Year-to-date forecast	2023 Revised Forecast
People's Republic of China	53.0	44.3	33.1	52.1	69.0	125	130	155
United States	10.9	10.2	11.5	18.7	24.0	25	30	35
India	10.3	11.1	11.6	4.2	12.4	17	15	15
Brazil	1.4	1.5	2.8	3.9	6.7	11	10	15
Germany	1.7	3.6	3.8	4.9	5.3	7.0	9.0	10
Japan	7.4	6.7	6.7	8.7	6.5	5.5	5.0	5.0
Spain	0.1	0.3	5.0	2.9	4.6	7.0	8.0	8.0
Australia	1.3	4.0	3.5	3.6	4.7	4.5	5.0	5.0
South Korea	1.3	2.3	3.7	4.1	4.2	3.0	3.0	2.5
France	0.08	0.2	0.8	0.3	2.6	2.5	3.5	3.5
Global	106	118	145	182	244	270	320	340

Source: BNEF, Export-Import Bank forecast

2. Photovoltaic Main Product Price Trend

As of July 2023, the polysilicon price was \$7.85/kg, down 79.9% from the August 2022 high (\$39/kg).

☞ In 2022, due to the tight polysilicon supply situation due to the increase in global solar demand and the surge in raw material prices due to global inflation, the polysilicon price soared to \$39/kg.

☞ As we enter 2023, large-scale expansion volumes are being supplied to the market, and polysilicon prices are falling sharply due to the easing of inflation due to global interest rate hikes.

- Polysilicon prices rebounded from \$24/kg in January 2023 to \$29.9/kg in March, but fell below \$10/kg in May

☞ From January to April 2023, the output of Chinese polysilicon enterprises is about 420,000 tons, a year-on-year increase of 90%

From the second half of 2022, newly expanded polysilicon volumes are entering the market, and the supply is higher than expected, resulting in a sharp price situation.

✧ In 2022, the global polysilicon production capacity was 980,000 tons, but the production capacity is expected to increase to about 1.6 million tons in 2023 due to large-scale facility expansion.

- 1.6 million tons of polysilicon has the capacity to make about 600GW of solar cells, which is more than 240GW of oversupply compared to the global demand of 360GW

✧ Due to the oversupply of polysilicon, polysilicon prices were expected to be below \$15/kg from the first half of this year, but the pace of decline is steeper due to the higher than expected supply.

Elongation · U.S. trade sanctions on polysilicon produced in the Uyghur region (which accounts for about 40% of China's polysilicon production) have led to Xinjiang · The fact that polysilicon produced in Uyghur has to be digested in China's domestic market is also a factor that further fuels the price plunge.

- Polysilicon produced in Europe and Southeast Asia is produced in Xinjiang · Compared to Uyghur acid, it is receiving a premium of \$5~10/kg, so the price is relatively defensible

(Wafer) As of July 2023, 210mm monocrystalline silicon wafer price is \$0.48/piece in 2022 7 63.1% lower than July high (\$1.31/piece)

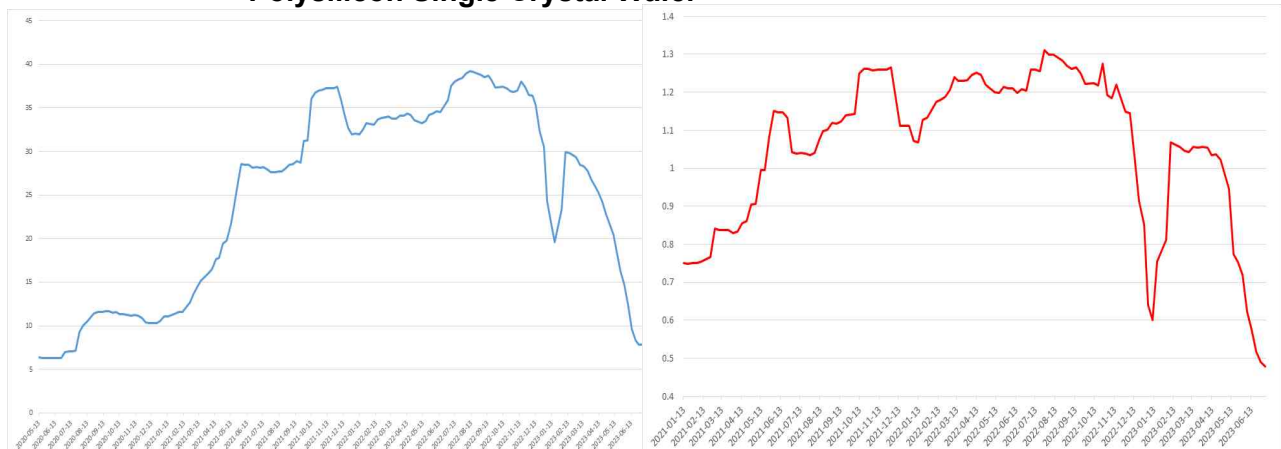
✧ Wafer prices, which have been bearish since 2019, continued to be strong throughout the first half of 2022, but reversed to the downside starting from November 2022

✧ In 2023, wafer prices are declining in a pattern similar to the decline in polysilicon prices, and there is a high probability that they will fall further

Elongation · In the case of wafers made from polysilicon produced in the Uyghur region, exports are restricted and should be digested in China's export market, but this is not the case, so the oversupply is more serious than expected.

<Polysilicon and Monocrystalline Wafer Price Trends> (unit : \$/kg, \$/piece)

Polysilicon Single Crystal Wafer



materials : BNEF, 210mm monocrystalline wafer price standard

As of July 2023, the price of 210mm monocrystalline solar cells is \$0.09/W and the price of 210mm monocrystalline modules is \$0.18/W, down 45.0% and 33.3% respectively from the year-on-year highs.

☞ In July 2023, the prices of solar cells and modules also fell significantly compared to the previous year's highs, but the decline compared to the prices of polysilicon and wafers was relatively small

Since product prices reflect the rise and fall of raw material prices with a time lag, product prices fall relatively gently even when they fall

☞ Product price decline in 2023 is expected to act as a positive factor for the growth of solar demand in the second half of the year.

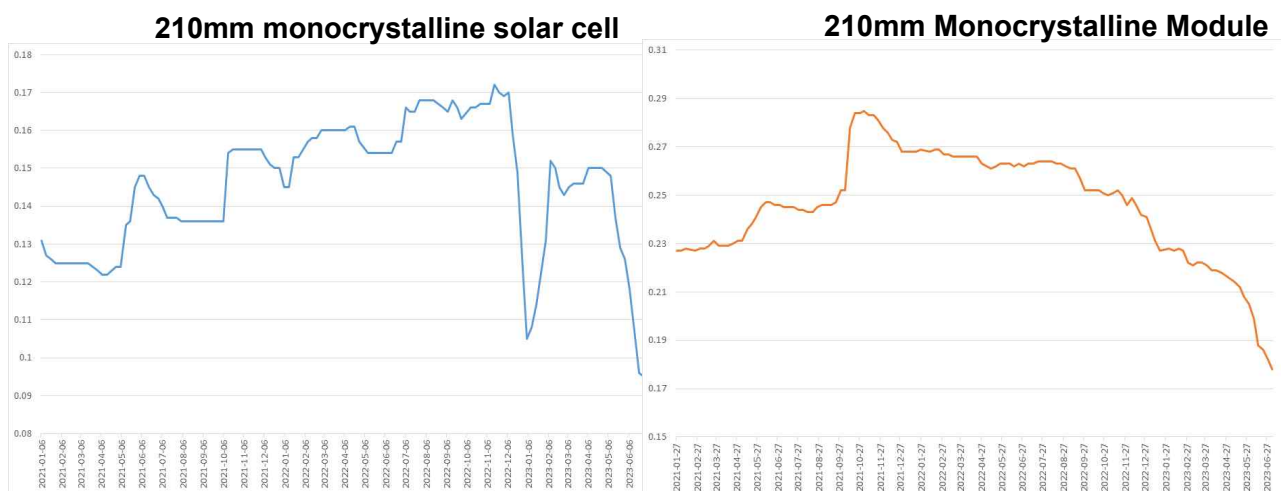
Module cost accounts for 20~40% of the cost of photovoltaic projects, so the decline in module prices leads to a decrease in project costs and photovoltaic power generation unit prices. Since cost reduction is directly related to the improvement of solar project economics, the solar project profit margin, which was low in 2022, is expected to improve from the second half of 2023 onwards.

☞ Despite the increase in global photovoltaic demand in 2023, the prices of solar cells and modules are expected to continue their downward trend in the second half of the year due to weak prices of raw materials such as polysilicon and wafers and oversupply of goods.

The production capacity of solar cells and modules by Chinese companies has significantly exceeded demand, and the prices of solar cells and modules are expected to return to 2019 levels this year due to the decline in manufacturing costs due to the decline in raw material prices.

<Monocrystalline Solar Cells & Modules Price Trend>

(단위: \$/W)



materials : BNEF

3. Solar Supply Trends

(Polysilicon) As of completion in 2023, the global polysilicon production capacity is 1.13 million tons

☞ The polysilicon production capacity by country is 940,000 tons in China, 61,000 tons in the United States, 60,000 tons in Germany, 35,000 tons in Malaysia, 11,000 tons in Japan, 8,000 tons in Qatar, 7,000 tons in Norway, and 6.5 thousand tons in South Korea.

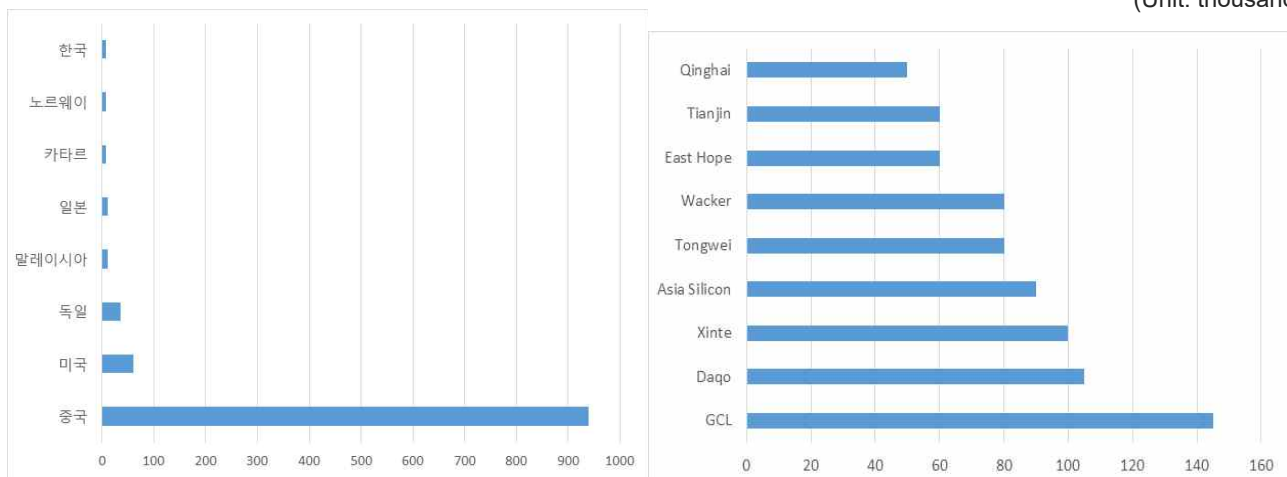
- As of 2023, China's share of production capacity by country is 83%, followed by the United States (5.4%), Germany (5.3%), and Malaysia (3.1%).

☞ 업체별 생산용량을 살펴보면 GCL 사 14.5 만 톤, Daqo New Energy 10.5 만 톤, Xinte Energy 10 만 톤, Asia Silicon 9 만 톤, Wacker 8 만 톤 순

☞ In 2020, China's share in polysilicon production was only about 60%, but with the large-scale expansion, the proportion of Chinese products in the global polysilicon supply has exceeded 80%, securing China's monopoly position in the polysilicon field.

< Polysilicon Production Capacity Status by Global and Company as of 2023 >

(Unit: thousand tons)



materials : BNEF

(Wafer) As of completion in 2023, the global wafer production capacity is 492GW

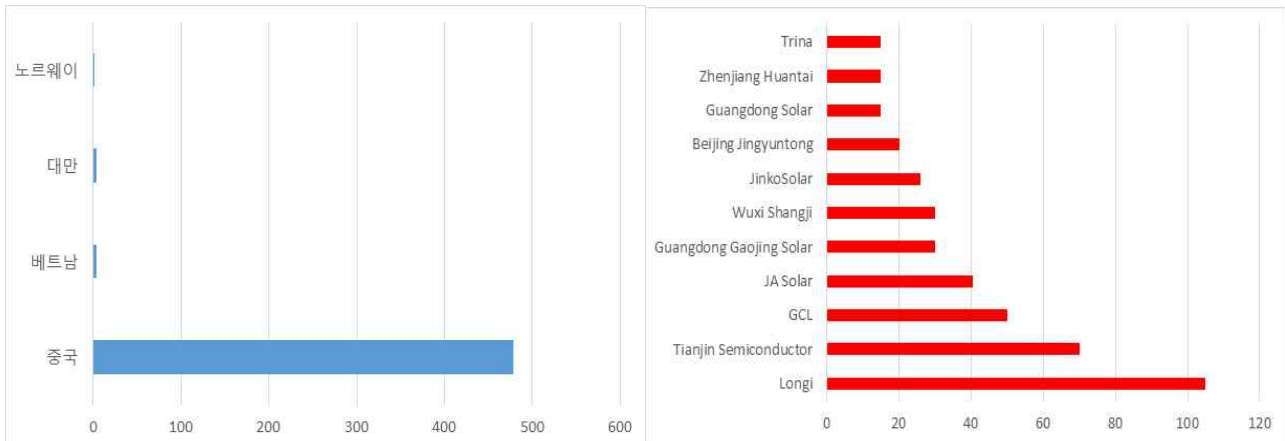
☞ Looking at the production capacity by country in 2023, China 478GW, Vietnam 4GW, Taiwan 3.7GW, and Norway 1GW

☞ As of 2023, the wafer production capacity under construction is 116GW, with 101GW in China and 15GW in Vietnam under construction

- Wafer production capacity is expected to exceed 600GW by 2024, and China's wafer production capacity is expected to reach 580GW

< Wafer Production Capacity Status by World and Company as of 2023 >

Unit: GW



Source: BNEF

(Solar cell) As of completion in 2023, the world's solar cell production capacity is 538W

2023 년 국가별 생산용량은 중국 460GW, 베트남 18GW, 태국 16GW, 말레이시아 16GW, 한국 7.8GW 순

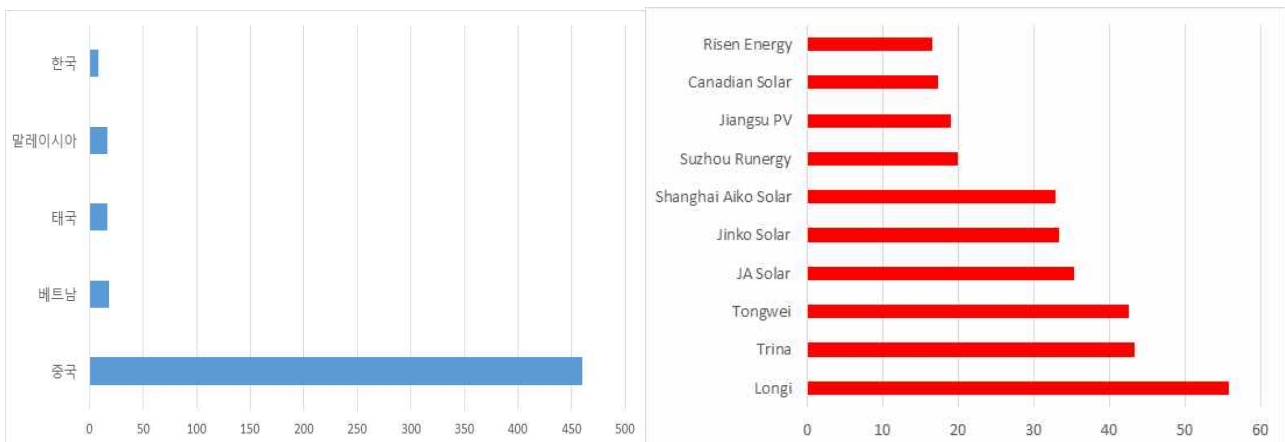
- As of 2023, the share by country is 86% in China, 3.3% in Vietnam, 3.0% in Thailand, 3.0% in Malaysia, and 1.4% in South Korea.

Currently, the solar cell capacity under expansion is about 110GW , and when the expansion is completed, the global solar cell production capacity is expected to reach 650GW.

- The volume of new solar cells expanded to 106GW in China and 5.4GW in Thailand

< 2023 Solar Cell Production Capacity Status by World and Company>

Unit: GW



Source: BNEF

(Module) As of 2023, the global module production capacity as of completion is 657GW

☞ 2023 년 국가별 모듈 생산용량은 중국 540GW, 베트남 26GW, 말레이시아 15GW, 인도 14GW, 태국 10GW, 한국 10GW 순

☞ As of 2023, the production capacity under construction for expansion is 81GW , followed by 72GW in China, 4.5GW in India, 1GW in Austria, and 1GW in Turkey.

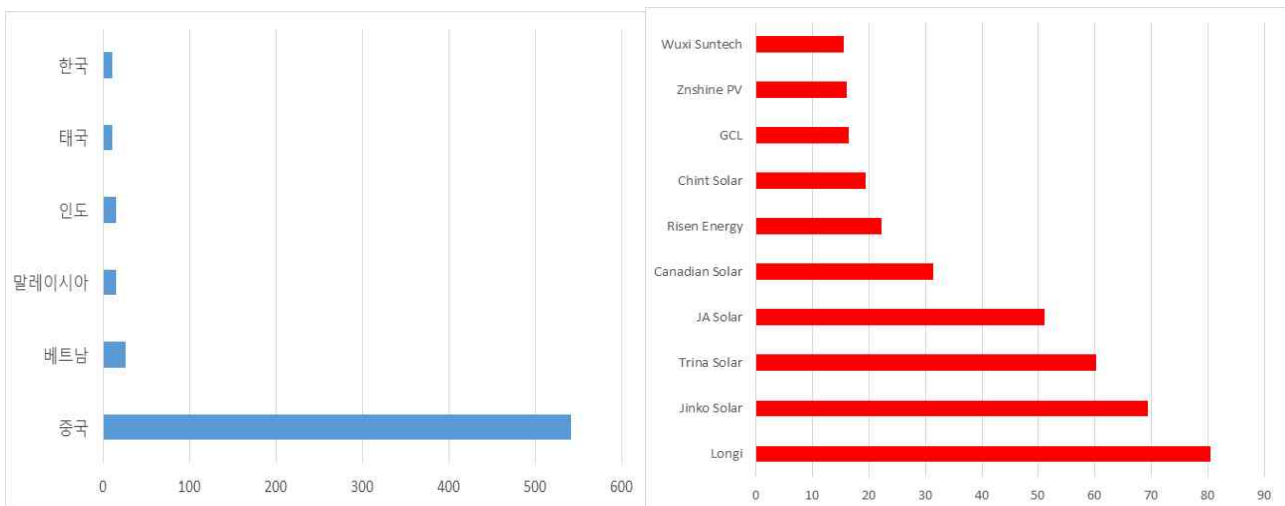
- When the current expansion is completed, the global module production capacity is expected to reach 740GW , of which China accounts for about 84%

☞ 2022 년 기업별 모듈 생산용량을 살펴보면 Longi 80.4GW, Jinko Solar 69.3GW, Trina Solar 60.3GW, JA Solar 51.0GW and Canadian Solar 31.4GW , while Korea's Hanwha Q CELLS ranked 13th with 12.4GW.

☞ Compared to the global photovoltaic demand (320GW) in 2023, the module supply capacity will reach 657GW, and the oversupply will exceed 300GW, and module prices are expected to weaken for the time being.

< 2022 Global and Company-Specific Module Production Capacity Status >

Unit: GW



materials : BNEF

II. Photovoltaic Industry Major Issues and Corporate Performance

1. Analysis of the Competitiveness of China's Photovoltaic Industry

The core competitiveness of China's photovoltaic industry is competitive low investment cost through the development of its own production technology and cost competitiveness through securing economies of scale.

☞ Chinese photovoltaic companies have dominated the global photovoltaic industry by securing economies of scale through large-scale investments, and there are currently no competitors through continuous investment .

☞ Based on the annual production capacity of 1GW in 2022, the investment cost of each value chain in the photovoltaic industry major regions is as follows.

The investment cost of polysilicon is 34 million US dollars in China , 44 million US dollars in Southeast Asia, 124 million US dollars in the United States and Europe , and the investment in solar cells is only 27% of that of the US and Europe, 46 million US dollars in China, 68 million US dollars in Southeast Asia, and 196 million US dollars in Europe, which is only 23% of the US and Europe . It takes more than twice as much investment

The investment cost of solar modules is 19 million US dollars in China, 25 million US dollars in Southeast Asia, 84 million US dollars in Europe and 23% of the US and Europe

☞ The key to the cost competitiveness of China's photovoltaic industry is due to low capital investment costs through self-sufficiency of manufacturing facilities.

In the early days, China's photovoltaic industry technology entered the market through the introduction of equipment developed in Europe and the United States, but now it has internalized a large part of the production equipment to produce photovoltaic products, especially ingot and diamond cutting technologies. We have secured the world's best technology in the wafer field and there are no competitors

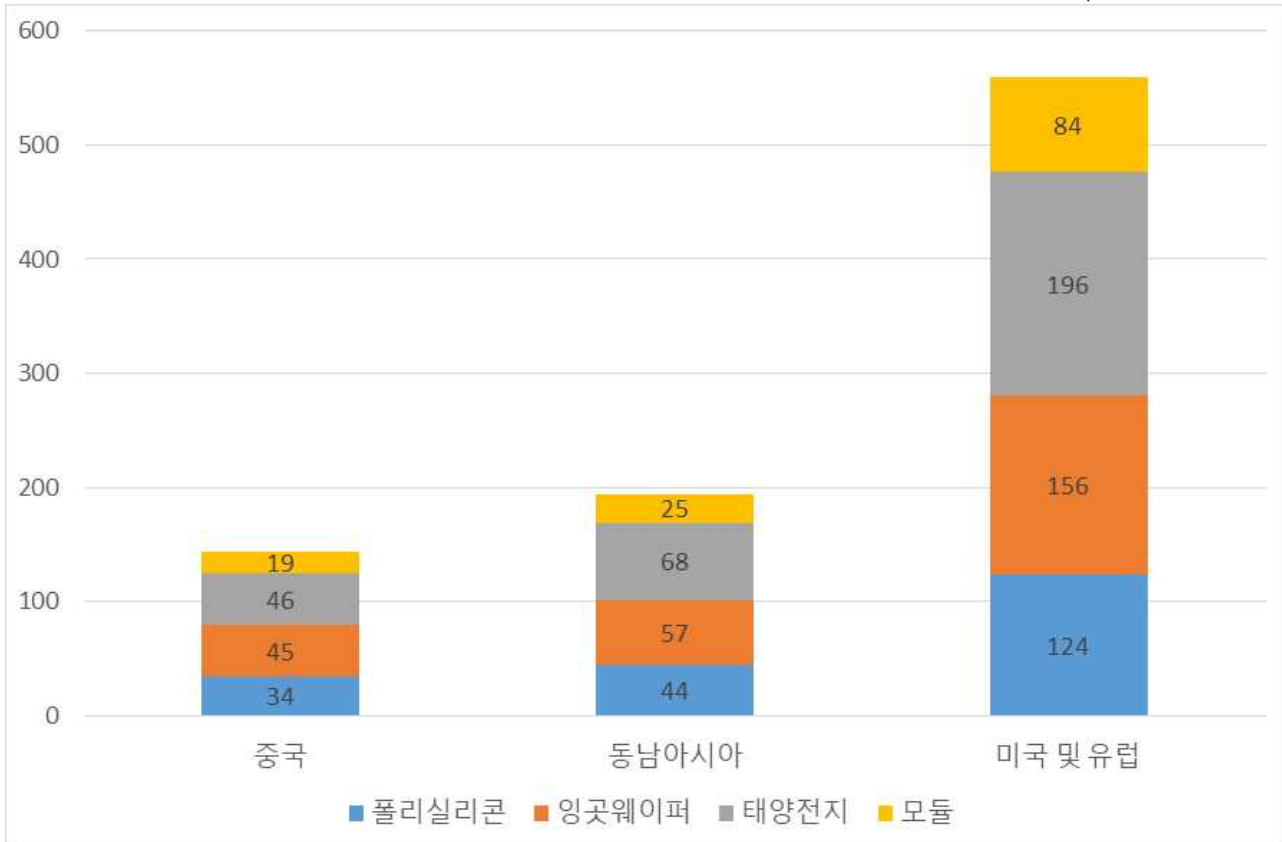
☞ China's industrial competitiveness in next-generation photovoltaic technology is also at a high level, and Chinese companies' leadership in the global photovoltaic industry is expected to be maintained for a considerable period of time.

In order to increase the efficiency and price competitiveness of next-generation solar cells, large-scale wafer supply is essential.

China accounts for 97% of wafer supply, making it impossible to produce next-generation solar cells without China's wafer supply, leading the way in next-generation solar cell technology standards

< As of 2022, the current status of investment expenditures by solar power value chain by region >

(Unit: Million Dollars)



materials : BNEF

Chinese photovoltaic companies have secured cost competitiveness through economies of scale, and achieved vertical integration of the value chain to maximize cost competitiveness.

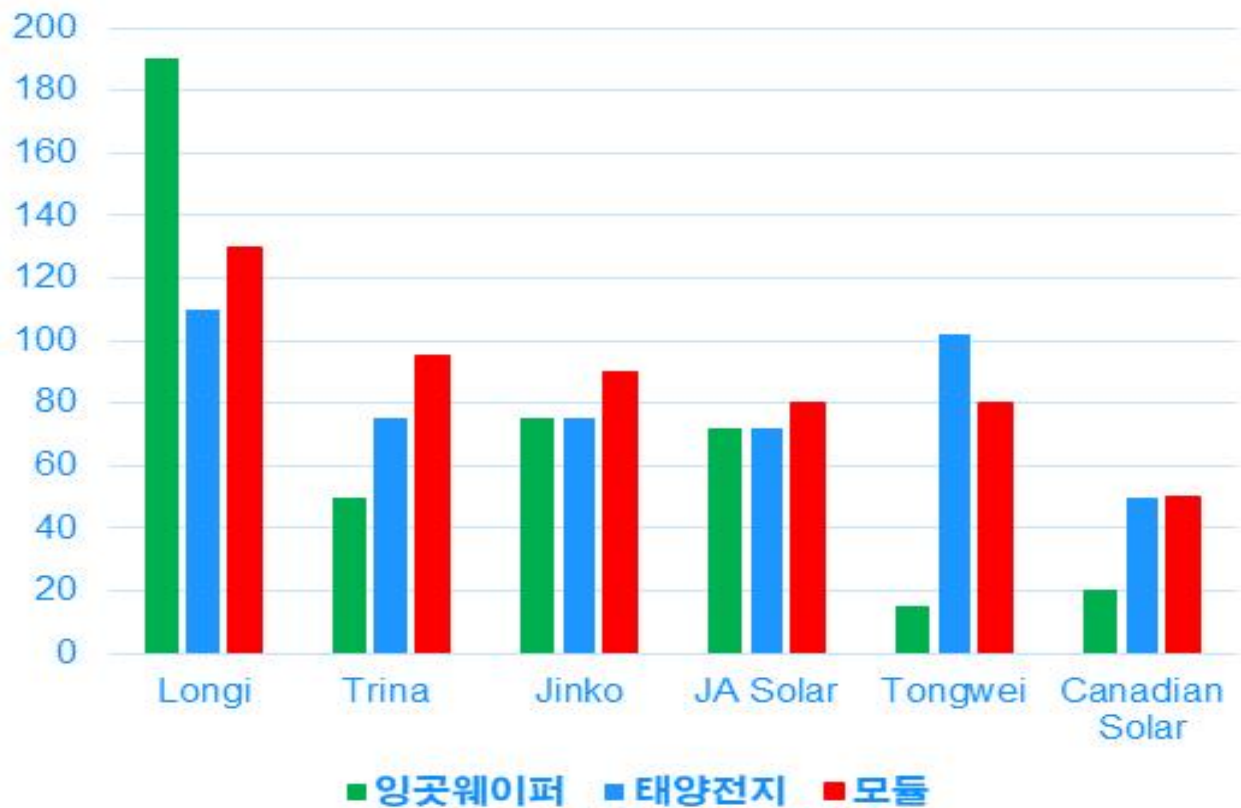
☞ In the past, there have been efforts to secure competitiveness through vertical integration, such as Hanwha Solution, but as the competitive power of each value chain has not secured the highest level in the industry, it acts as a factor that weakens the competitiveness of the company.

☞ Recently, Chinese companies have been maximizing profits through direct integration by securing the highest level of competitiveness in each value chain through large-scale investments.

☞ Global solar leader Longi is expected to be the largest ingot · We have secured the world's highest economies of scale across each stage of the value chain, including 190GW of wafers, 110GW of solar cells, and 130GW of modules, and are realizing the world's highest operating profit

☞ China's major photovoltaic companies are expected to further strengthen vertical integration to maximize profits, and appropriate investments will continue to be made to maintain the competitiveness of each value chain.

< As of 2023, the vertical integration status of major companies is > (단위: GW)



materials : BNEF

2. IRA 시행 영향

The IRA is the most realistic way to help lower the cost of solar equipment investment through the Advanced Manufacturing Production Tax Credit (AMPC) and the Investment Tax Credit, making U.S. products competitive with Chinese products.

☞ The AMPC policy allows for tax credits ranging from a minimum of \$ 8.1 million to a maximum of \$70 million per 1 GW of polysilicon to modules, with a credit period of 10 years from 2023 to 2032.

☞ Localization of the entire value chain, from polysilicon to modules, provides IRA tax incentives of up to \$0.17 per watt

- 밸류체인별 공제액은 폴리실리콘 0.01 달러 /W, 웨이퍼 0.05 달러 /W, 태양전지 0.04 달러 /W, 모듈 0.07 달러 /W

☞ The deduction for wafer production is \$0.05/W, which provides a higher level of subsidy to promote active investment considering the high cost of wafer production in the U.S.

< IRA Highlights >

type	article	content	period
Installation-related tax credits	Investment Tax Credit (48 revisions)	I Deduct a certain percentage of capital expenditure (up to 30%)	Phase-out after 2032 (extended if carbon emissions do not decrease by more than 75% in 32 compared to 22 years)
	Production Tax Credit (48C Amendment)	I Deduction per power unit production	
Manufacturing Credit	Investment Tax Credit (48C deduction)	I Deduct a certain percentage of the investment amount of production facilities (up to 30%) I \$10 billion in total value	Construction must be completed within 2 years after obtaining a deduction permit from the Authority.
	Manufacturing Tax Credit (45X NEW)	I Tax credit per unit of production - 폴리실리콘: \$3/KG - 웨이퍼: \$12/m2 - 셀: 0,04 \$/W, 모듈: 0,07 \$/W	30 of deductions after 30 years - 30.1.1~ : 75% compared to 29 years - 31.1.1~ : 50% compared to 29 years - 32.1.1~ : 25% compared to 29 years - 33.1.1~ : 0 % compared to 29 years

Source: International Trade Association

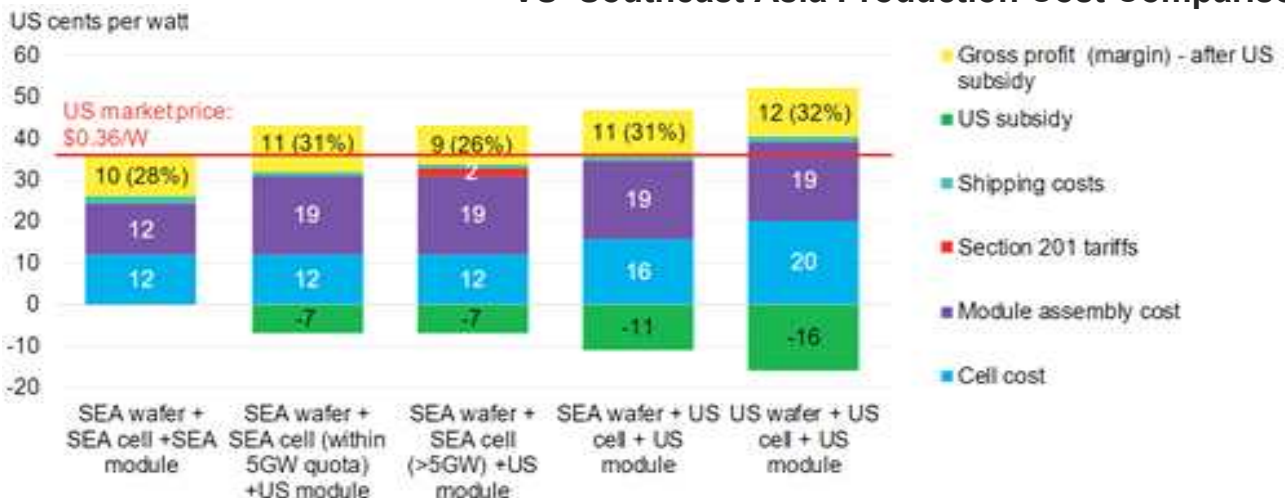
With the implementation of the IRA, the price of solar modules made in the United States is expected to be competitive compared to the price of modules manufactured in Southeast Asia.

Ÿ The manufacturing cost of wafers, solar cells, and modules produced in Southeast Asia is about 24 cent/W , and if wafer to module is produced in the United States through IRA funding, the production cost is estimated to be 23 cent/W, which is more competitive than products produced in Southeast Asia.

Ÿ If the suspended tariffs on Chinese goods circumventing through Southeast Asia are normalized by December 2024, the price competitiveness of U.S. products is expected to increase.

Ÿ The implementation of the IRA for the establishment of solar manufacturing facilities in the U.S . is likely to have a policy effect

< IRA Enforcement in the U.S. VS Southeast Asia Production Cost Comparison >



Source: BNEF

With the implementation of the IRA, Korean solar companies are expected to benefit, and the IRA tax deduction effect will be reflected in the financial statements starting this year.

☞ Hanwha Solutions plans to invest KRW 3.2 trillion to build a solar hub in Georgia, U.S., to prepare for the implementation of the IRA.

- Ingot with an annual capacity of 3.3 GW each · Wafer · Solar Cells · A new plant to produce modules will be built, and the current annual production capacity of 1.7GW will be expanded to 8.4GW through additional production lines.

☞ Ingot from 2025 · Once wafer and solar cell factories start mass production, tax credits are expected to increase from 159 billion won this year to 690 billion won in 2025.

☞ The best strategy to target the U.S. solar market is to supply products through the construction of local factories. As the supply of products through Southeast Asia is also expected to become less competitive due to the imposition of tariffs in the future, the best way to target the US solar market is through a localization strategy.

< > estimate of Hanwha Solutions' tax deduction due to the implementation of the IRA

	2023년		2024년		2025년		2026년	
	생산용량	생산량	생산용량	생산량	생산용량	생산량	생산용량	생산량
모듈	3.1GW	1.9GW	8.4GW	2.7GW	8.4GW	5.8GW	8.4GW	8.4GW
잉곳/ 웨이퍼	-	-	3.3GW	-	3.3GW	2.0GW	3.3GW	3.3GW
태양전지	-	-	3.3GW	-	3.3GW	2.0GW	3.3GW	3.3GW
세제지원 금액	1,590억 원		2,310억 원		6,900억 원		1조590억 원	

materials : 한화솔루션, NH 증권

3. Key Company Performance

Until the first quarter of 2023, the performance of major global photovoltaic companies has not been affected by the price decline of products such as polysilicon, and the performance of major companies improved year-on-year.

☞ Longi, JA Solar, Jinko Solar 등 중국 상위 기업들은 As a major facility expansion has been carried out since 2021, 매출 상승세가 지속되고 있음

- China 's Longi reported revenue in the first quarter of 2023, up 41.2% year-on-year to \$4.14 billion, and the sales of major solar companies such as JA Solar and Jinko Solar in the first quarter of 2023 increased by more than 20%

year-on-year. By the first quarter of 2023, the operating performance of photovoltaic companies is expected to be good, but the price decline will be reflected in earnest. After the quarter, the performance of photovoltaic companies is expected to deteriorate compared to the previous quarter. Sales are expected to increase due to the increase in demand for photovoltaics, but the product margin rate is expected to decrease as the price of photovoltaic products weakens. The profitability of companies in the material sector such as polysilicon, which has recorded high operating profits, is expected to decline significantly, but in the case of module companies, the decline in raw material prices is expected to be greater than the decline in module prices, so profitability is expected to be relatively good.

The performance of photovoltaic companies in the second half of 2023 is expected to be better than that of material companies such as polysilicon.

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<Overseas companies' performance trends> (Unit: Billion Dollars)

2023 Q1 Company	2022	2021	2022	Q1 2022						
	benefit	Sales	benefit	Sales	business Turnover	Profit	business Profit	business Turnover	business Profit	
Length	79.2	14.4	125.5	14.8	191.8	13.1	29.3	4.1	41.4	3.8
SOLAR JA	37.5	3.6	64.0	5.7	108.5	10.1	19.4	1.6	29.9	4.4
Jinko Solar	51,0	3,4	62,9	8,4	122.9	5.3	23.1	0.9	33.8	3.1
Canadian	34.8	2.2	52.8	2.3	74.7	4.2	12.5	0.2	17	1.5
Solar										
Trina Solar	42.7	2.7	69.0	3.7	126.5	7.2	24.1	1.2	31.1	2.2
Tongwei	64,1	5,9	98,4	17,9	211.8	63.1	38.9	11.3	48.6	18.6
Daqo	6.8	1.9	16.8	10.7	46.1	30.4	12.8	8	7.1	4.6
First Solar	27,1	4	29,2	4,8	26,2	-1,4	3,7	-0,5	5,5	0,4

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III. Domestic Photovoltaic Industry Trend

1. Domestic Photovoltaic Market Trend

In 2023, the domestic photovoltaic market is expected to have 2.7GW installed, a decrease of 15% compared to the previous year, and the annual demand is expected to be around 2.5~3.0GW by 2030.

Domestic photovoltaic installations are decreasing with a peak of 5.5GW in 2020, and demand is expected to stagnate within 2.5~3.0GW in the future.

- Domestic solar power installations are expected to stagnate due to changes in government policies, such as lowering the proportion of renewable energy to 21.6% in 2030, abolishing the RPS system and introducing an auction system, and fixing the ceiling on the wholesale electricity price (SMP).

With the rise of the RE100 issue in the global supply chain, the demand for solar power from domestic manufacturers is expected to increase significantly. Global companies such as Apple are demanding domestic companies to produce products using renewable energy, and the demand for producing products using renewable energy is expected to intensify in the future.

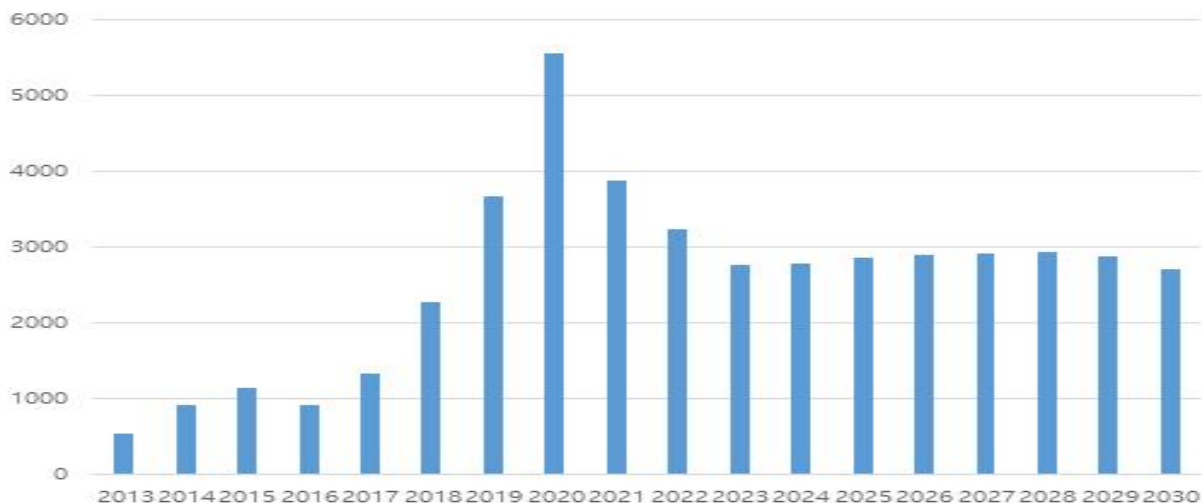
- Demand for solar power generation by domestic companies is expected to play a major role in the demand for solar installations in Korea

Domestic photovoltaic power generation is still recognized as an expensive source of power generation, but due to the continuous decline in module prices, Korea is also imminent in reaching grid parity in solar power generation, and the need for it is increasing as a means to reduce energy dependence on external sources

Barriers to green trade, which require the production of products using electricity produced from clean energy sources such as solar power, are also being strengthened, emphasizing the need for an appropriate combination of solar power generation with other energy sources

<Domestic Solar Installation Status and Prospects>

(단위: MW)



Source: Korea Energy Agency, Export-Import Bank

2. Export Trends

Polysilicon exports in the first half of 2023 were valued at US\$ 29.1 million, down 11.7% year-on-year

Despite the increase since 2018, in 2019, polysilicon companies in Korea have stopped polysilicon exports production facilities due to the sharp decline in polysilicon prices and the larger the deficit the more they produce.

- OCI stopped domestic production and moved its factory to Malaysia to produce polysilicon, and exports have decreased significantly compared to the past

✎ Polysilicon exports in 2023 are expected to be only around \$ 50 million due to a significant drop in polysilicon prices

As exports continue to decline and polysilicon prices turn bearish, exports in the second half of the year are expected to decline more than in the first half of the year.

(Solar Cells & Modules) In the first half of 2023, solar cells and modules exports increased by 50.2% year-on-year to \$680 million.

✎ Looking at the export value by export destination, the United States accounted for 670 million US dollars, accounting for 98.5% of the total solar cell and module exports , almost all of which are exported to the United States.

The reason why exports to the United States account for a large proportion is that the United States · Due to the trade dispute between China and China, the United States is preventing Chinese products from entering the market by imposing high tariffs , and since tax benefits are given for products produced in the United States, the United States is entering the US market through the production of local modules through the export of solar cells

✎ In the case of Europe, where there are no tariff barriers for Chinese products, the export competitiveness of Chinese products is deteriorating every year, and the export value is decreasing.

✎ Except for the U.S. market, which is restricting Chinese products, the competitiveness of domestic photovoltaic products continues to be inferior to that of Chinese products.

There is a need to diversify solar exports, but the current situation is expected to continue until it has a clear technological and price advantage over China.

3. Import Trends

(Wafer) Imports in the first half of 2023 decreased by 20.6% year-on-year to \$210 million

☞ In the first half of 2023, wafer imports have fallen sharply due to the sharp decline in wafer prices, and the import value in the second half of the year is also expected to decline significantly.

☞ Imports from China accounted for 99% of the total imports from China, with imports of \$3 million from Taiwan.

It is fully dependent on wafers from China, and has

(Solar Cells & Modules) Imports in the first half of 2023 increased by 21.7% year-on-year to \$155 million.

☞ In the first half of 2023, the import value of solar cells and modules increased by 21.7% year-on-year, and the main importer was China, which accounted for \$ 150 million of the total import value of \$155 million.

☞ Module cost accounts for about half of the cost of a solar project, so the unit cost of the module is the most important factor in the construction of the project, as the profitability of the project is improved if the inexpensive module is installed.

☞ As the financing cost for project construction rises, it is expected that the preference for cheaper Chinese-made modules will increase further in order to lower the cost of the project

< Exports of photovoltaic industry in Korea · Entrance >									(Unit: Million Dollars)	
2019, 2020, 2021, 2022									Exports June	
	2023	import	export	import	export	import	export	import	export	import
Polysilicon	476.2	26.9	118.7	18.0	95.2	32.3	61.7	6.4	29.1	1.8
	(-36.2%)	(-14.9%)	(-75.1%)	(-33.0%)	(-19.8%)	(79.4%)	(-35.2%)	(-80.3%)	(-11.7%)	(-47.2%)
Ingot	6.4	6.8	0.7	5.3	1.1	19.5	2.0	24.5	0.6	2.8
	(-4.2%)	(94.3%)	(-89.6%)	(-21.3%)	(65.1%)	(265.2)	(77.9%)	(25.7%)	(-9.3%)	(-80.3%)
wafer	20.3	398.0	12.1	343.2	9.0	485.1	7.7	567.7	2.2	210.7
	(-78.4%)	(-30%)	(-40.7%)	(-13.7%)	(-25.5%)	(41.4%)	(-13.8%)	(17.0%)	(-46.5%)	(-20.6%)
Solar Cells	1,592.3	760.0	1,382.1	624.5	1,089.3	647.7	1,547.8	269.9	683.2	154.6
& Modules	(-0.8%)	(192%)	(-13.2%)	(-32.5%)	(-21.2%)	(18.0%)	(43.7)	(-58.3%)	(50.2%)	(21.7%)

Source: Trade Associations, Solar Cells (8541409021) and Modules (8541409022) HS codes incorporated into the 8541430000 2022

4. Domestic Corporate Performance Trend

Led by module companies , the business performance of major domestic photovoltaic companies in the first quarter of 2023 improved year-on-year

OCI Polysilicon sales increased by 11.9% year-on-year to KRW 218 billion, while operating profit decreased by 20.2% to KRW 8.9 billion.

In 2022, sales and operating profit improved significantly due to strong polysilicon prices, but in 2023, operating profit decreased slightly year-on-year due to the bearish reversal of polysilicon prices.

However, due to the tightening of U.S. regulations on Chinese polysilicon, the company is expected to perform better than expected in the second quarter despite the collapse in polysilicon prices due to a premium for polysilicon produced outside of China .

In the first quarter of 2023, Hanwha Solutions' photovoltaic division posted KRW 1.37 trillion in sales and KRW 245 billion in operating profit, up 48.4% year-on-year, and operating profit turned black.

Although there is a widening gap with China's leading companies in terms of economies of scale, the company is securing competitiveness in the U.S. market by investing KRW 3.2 trillion in the U.S. to build a supply chain and become the No. 1 market share in the U.S. market

The 2023 business performance is expected to improve significantly year-on-year due to lower manufacturing costs due to the decline in raw material prices such as polysilicon and wafers, as well as good demand for solar power in the United States.

<Current Status of Domestic Solar Power Company Performance> (Unit: Billion Won)

기업명	2020		2021		2022		2022 1분기		2023 1분기	
	매출액	영업 이익	매출액	영업 이익	매출액	영업 이익	매출액	영업 이익	매출액	영업 이익
OCI (베이직케미칼)	8,520	-77	13,330	4,870	8,651	895	1,948	109	2,180	87
한화솔루션 태양광사업	37,023	1,904	35,685	-3,285	55,685	3,501	9,206	-1,142	13,661	2,450
현대에너지 솔루션	3,944	88	5,932	95	9,848	902	1,761	77	1,408	80
신성 이엔지 RE사업부	1,183	-84	1,041	-130	1,196	47	291	6	200	15

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IV. Implications

In 2023, the global solar installation volume is expected to be more than 20GW more than the forecast at the beginning of the year (320~340GW) due to good demand in the Big2 (China and the United States) region and the rapid growth of the developing market

Ÿ The decline in module prices has led to an improvement in economic feasibility due to the reduction of investment costs in solar projects, which is driving new demand.

Ÿ The main factor behind the surge in China's photovoltaic demand in Q1 is the improvement in the affordability of photovoltaic projects due to module prices

Ÿ As module prices are expected to decline further in the second half of the year, solar installations in major regions are expected to increase significantly more than expected.

Ÿ Demand in Europe and the Middle East is also growing rapidly. Global solar installations in 2023 are expected to exceed previous estimates

Global solar demand is expected to accelerate further after 2023, with annual solar demand expected to reach 500 GW before 2027.

Ÿ As the world's new solar installations of 500GW are expected to be achieved by 2027, the need to reduce the use of fossil energy such as coal and gas and expand the use of renewable energy such as solar power is becoming more prominent as the damage caused by global climate change such as droughts and typhoons is rapidly increasing.

As the climate catastrophe caused by global warming is in full swing, efforts to reduce greenhouse gas emissions are expected to accelerate further, and cleanliness of the power generation sector, which accounts for 40% of greenhouse gas emissions, is inevitable.

Ÿ The most realistic way to clean up the power generation sector is to expand the use of renewable energy that secures economic feasibility, which is expected to lead to an increase in demand for solar power.

Ÿ Due to the overlap of many positive factors such as the arrival of grid parity and energy security issues, as well as climate change issues, the era of global solar installations of 500GW, which was expected in 2027, is expected to be realized a little earlier.

Solar power generation is expected to emerge as the most economical energy source from 2022, increasing demand in major countries such as China, Europe, and the United States, as well as accelerating its spread to developing countries in 2023.

With the Russia-Ukraine war highlighting the need for energy self-sufficiency, the combination of these factors is expected to increase global solar installations faster than previously anticipated.

After 2025, the construction of a new U.S. solar supply chain is expected to transform the China-centered solar supply system, which is expected to further exacerbate the oversupply in China.

☛ Chinese companies account for more than 80% of the supply of photovoltaic products, monopolizing the global photovoltaic industry

In order to overcome the current situation, normal competition is impossible, and the United States plans to create and implement legislation to protect domestic companies.

☛ With the implementation of the Inflation Reduction Act in the United States, the country is trying to reduce its dependence on China by building solar power production facilities in the country, and after 2025, domestic facilities will produce products that can meet domestic demand.

☛ If the import of modules from Southeast Asia is banned at the end of 2024, it is likely that Chinese companies will be able to export to the United States through their Southeast Asian production facilities, and although demand from developing countries is increasing, there is too much oversupply for products produced in China to meet the domestic demand.

☛ If the oversupply in China worsens, there is a possibility that the prices of major products such as modules will drop significantly, and in this case, the profitability of Chinese solar companies may deteriorate significantly.

☛ The oversupply situation will lead to a decrease in product prices, but the decrease in product prices is expected to have a positive effect on solar consumers to purchase products at a lower price, leading to an increase in solar demand.

For the development of Korea's photovoltaic industry, it is necessary to develop a market not only in the manufacturing field but also in the field of developing solar power projects, which are growing rapidly.

☛ The reality of the manufacturing sector of the domestic photovoltaic industry is that there is currently no market that can take competitiveness except for the U.S. market, which is blocking Chinese products due to protectionism.

Looking at the export value of solar cells and modules in the first half of 2023, exports to the United States accounted for 98.5%, and almost no exports are made to regions other than the United States

- If the IRA is implemented, more products will be produced in the U.S., which will likely further reduce solar exports.

The way to strengthen the competitiveness of the domestic photovoltaic manufacturing sector is to localize in regions where there is demand, and it is currently limited to the United States

☛ Project development and operation can create more added value than the manufacturing field, and it is possible to enter various markets through program development linked to entering the market of developing countries using EDCF. It is necessary to expand into the field of solar power project development, which forms a larger market than the manufacturing sector, and active financial support is needed for this