



PV Price Forecasting Report Q2 2022 Report Sample



PV Price Forecasting Report

Supply shortages, higher production costs, and logistical challenges, along with rising energy demand and geopolitical conflicts, have led to dramatic changes in the solar industry in recent years. To remain competitive, companies must anticipate and plan for future price increases - which is why Clean Energy Associates created the **PV Price Forecasting Report**.

Published quarterly by CEA's research team, the report uses a specially developed modeling system to provide independent market intelligence on changes in global supply chains and accurate forecasts for supply price scenarios based on technologies, materials, manufacturing regions and target markets, as well as supply and demand forecasts and analysis.

The PV Price Forecasting Report is essential reading for managers looking to make informed supplier sourcing decisions to stay ahead of the curve in the highly dynamic solar industry.

In the report you will find:

- Multiple pricing scenarios based on different supply-demand imbalance forecasts and manufacturing regions
- A breakdown of supply and demand by major global regions
- A breakdown of each price scenario with diagrams
- Cost and component factors for each PV module material
- Timely, accurate, and detail-oriented information

TABLE OF CONTENTS

EXECUTIVE SUMMARY	2
1. MARKET TRENDS	6
1.1 Upstream Market Conditions (Polysilicon Capacity Growth)	7
Silicon Metal	7
Polysilicon	7
1.2 Midstream Market Conditions (Ingot to Module Production)	8
Ingot and Wafer	9
Cell	11
Module	12
1.3 Downstream Market Conditions (Installation Outlook)	13
Global Installations	14
1.4 Supply and Demand Balance	14
United States	18
Europe	18
India	19
2. PRICE FORECAST	19
2.1 International Price Outlook	20
Forecast	20
Cost to Price Stack	21
Retrofit Analysis	21
2.2 United States Price Outlook	22
Cost to Price Stack	24
Retrofit Analysis	25
3. COST AND COMPONENT FACTORS	26
3.1 Silicon Metal	27
Cost to Price Factors	27
Policy / Environment Factors	28
3.2 Polysilicon	28
Cost to Price Factors	28
Policy / Environment Factors	30
3.3 Ingot and Wafer	30
Cost to Price Factors	30
3.4 Cell	30
Cost to Price Factors	30
3.5 Module	31
Cost to Price Factors For United States Destined Modules, \$/W	31
Cost to Price Factors For Europe Destined Modules, \$/W	31
3.6 Cell and Module Materials	32
Crucible	33
Glass	33
Frame	34
Backsheet	34
Encapsulant	35
Junction Boxes And Other Cell Materials	36
4. SUPPLY CHAIN AND TECHNOLOGY CONSIDERATIONS	37
4.1 Logistics	38
Sea Freight	38
Inland Freight	38
4.2 Exchange Rates	39
Exchange Rate Tracking	39
4.3 Technology Roadmaps	39
Power Bin Roadmap	40
Form Factor Considerations	40
5. METHODOLOGY	42
6. APPENDIX	43
6.1 How To Read Pricing Guide	44
6.2 Table Of Key Events	45
Policy Overview	46

Executive Summary

Market Trends

China holds more than 80% of the end-to-end global solar manufacturing capacities, including upstream (silicon metal and polysilicon) to midstream (ingots/wafers, cells, and modules) material and component production. Since late 2020, polysilicon shortages have plagued the solar industry, and manufacturers have focused on developing new factories.

However, the long lead times needed for new polysilicon plant development have created an environment that has allowed polysilicon pricing to increase for the past two years continuously. More than 285 GW of available polysilicon capacity is expected to be online by the end of 2022. This capacity will be sufficient to meet anticipated global installations of around 244 GW in 2022.

Domestic polysilicon production totaled over 340,000 tonnes (over 126 GW) in the first half of 2022, with an additional 25,000 tonnes of polysilicon (over 9 GW) expected from non-China suppliers. As a result, polysilicon prices are forecast to drop throughout 2023 as sizable manufacturing capacities continue to come online.

As prices continued to escalate throughout 2022, the Chinese government announced its intention to intervene in the polysilicon market to meet renewable installation objectives, and the solar industry may expect steeper polysilicon price drops if government action materializes.

In the mid-stream manufacturing segment, there remains a lack of ingot and wafer manufacturing capacity outside China. Only 13 GW of ingot and wafer capacity is expected outside China by the end of 2022, with this limited manufacturing predominantly located in Southeast Asia. Nonetheless, India's domestic solar manufacturing policies have spurred manufacturers' plans to potentially develop over 12 GW of ingot/wafer capacities over the next several years, with more capacity possible because of additional manufacturing subsidy applications. In addition, policy changes in the United States have encouraged some Chinese

suppliers to expand ingot and wafer production in Southeast Asia, with new capacity becoming available in 2023.

Inside China, rapid expansions in ingot and wafer manufacturing from industry mainstays such as Zhonghuan and industry entrants such as Gaojing have created additional competition for polysilicon with more suppliers needed to move polysilicon materials into strategic inventories, and the limited volume of unbooked capacity over the next few years as contributed to polysilicon's high price.

While Southeast Asia accounts for significant portions of cell and module manufacturing capacities outside of China, limited growth in this market is expected due to potential anti-dumping and countervailing duties on United States destined cells and modules. On the other hand, India is expected to be a high-growth market, doubling its current manufacturing capacities to bring online 36 GW of cell and 52.6 GW of module capacities in 2025. In China, many established suppliers are already starting to convert PERC lines to TOPCon or ramp up multi-GW capacities for TOPCon products. With the increased availability of TOPCon products in China, an indicative price forecast has been added, but capacities are still too small to create a robust supply chain for TOPCon cells.

Global solar installations are expected to reach 244 GW in 2022, a sizable increase from last year's 168 GW. In the first half of this year, China installed more than 30 GW, a year-on-year increase of 137%. However, in the United States, policy headwinds have caused a dip in expected solar installations with ongoing detentions of imported products creating supplier delivery backlogs and the temporary threat of new antidumping and countervailing duties causing short-term procurement and delivery disruptions. In addition, despite ambitious goals for energy independence and domestic manufacturing incentives in Europe and India, these nations are likely to remain import-dependent until 2025 as new suppliers take time to develop their manufacturing capacities.

Price Forecast

Module prices for international markets are constant in 2022 due to substantial European purchase volumes, far more than previously expected, and still limited polysilicon supplies. Pricing in 2023 and onwards is forecast to fall in tandem with expected polysilicon price reductions. Large format, double glass bifacial modules ordered today for delivery in Q4 2022 and Q1 2023 are predicted at \$■■■■/W FOB China and \$■■■■/W FOB China, respectively, as suppliers are hesitant to factor in polysilicon price declines into offers. Pricing from China will fall to \$■■■■/W by the end of 2023, but CEA recommends only procuring modules around two to three quarters from delivery as the current market environment will impact future long-term orders. TOPCon modules are appearing from several tier 1 suppliers. CEA's cost structure analysis for TOPCon finds TOPCon cells are just over \$0.01/W more costly to manufacture than PERC cells. Indicative TOPCon module pricing from supplier guidance puts average TOPCon module prices at around \$0.015/W higher than PERC module pricing, with variance in pricing typically within \$0.020/W.

Module prices for the United States have increased considerably from the last forecast as the threat of anti-dumping and countervailing duty extension to several Southeast Asian nations caused non-impacted module prices to rise above \$■■■■/W until the Biden Administration invoked an executive order to stay the duty until mid-2024. However, capacities remain at risk of future rates, which has impacted many suppliers' Southeast Asia expansion plans and reduced the outlooks on Southeast Asian cell and module expansion. In addition, high prices borne by buyers during the period of anti-dumping and countervailing duty uncertainty has given suppliers input on what prices can be accepted, and the mid-2024 end to the potential duty-free period has encouraged many buyers to secure their pipelines out to 2024, creating additional buying pressure in a consolidated period.

Finally, implementing the Uyghur Forced Labor Prevention Act has brought new shipment detentions with some of the industry's largest suppliers, causing concerns that module availability for the remainder of 2022 may be more limited than previously thought. Many top-tier suppliers are already fully booked into the end of 2023, and many are accepting orders for H1 2024 delivery.

As a result of these policy factors and subsequent market impacts, large format bifacial module prices ordered today for H2 2023 delivery average around \$■■■■/W to \$■■■■/W, with higher pricing for deliveries earlier in the second half of 2024. Q1 2024 orders are expected to be around \$■■■■/W to \$■■■■/W, with further declines expected for Q2 2024. However, many suppliers are quoting prices in the high \$■■■■s for the entirety of 2024 at this time, given the uncertainty around their cost structures and actual availability as will be dictated by the Department of Commerce's circumvention case and suppliers' ability to clear shipments with the United States Customs and Border Protection.

Cost and Component Factors

Increases in silicon metal prices from October to November 2021 were caused by China's energy curtailments, resulting in supply constraints and higher production costs. In addition, lingering energy price increases continue to contribute to higher-than-expected production costs in 2022 despite the return of stable supply sources.

Polysilicon spot price increases continue to hover around RMB 300/kg or USD 39/kg after accounting for China's value-added tax impact. While long-term contract prices for polysilicon are expected to be less than spot market rates, given there are very constrained volumes outside of long-term contracts, even long-term contract holders are experiencing the pressures of high polysilicon prices. In addition, many polysilicon suppliers announced sudden maintenance activities in June and July following a fire at East Hope's Xinjiang polysilicon plant; prices increased quickly over the past month in part due to changes in production expectations among polysilicon buyers. As a result, prices are expected to remain in the mid-\$30/kg range for large-scale polysilicon buyers until the end of 2022, with the first declines in pricing anticipated in Q1 2023 as the post-market rush in China, coupled with more polysilicon expansion, should tip the polysilicon market on the path toward oversupply.

Cost and Component Factors

Significant expansions among ingot and wafer suppliers are expected to create a competitive market scene when these suppliers can once again source lower-priced polysilicon. In 2023, many suppliers are expected to increase margins after 2022's constrained mid-stream manufacturing environment. However, in 2024 and beyond, the presence of many new merchant wafer suppliers and growing capacities among integrated producers should lead to a much more competitive landscape. As a result, average 2022 wafer prices of \$0.13/W should give way to wafer prices of around \$0.10/W by the end of 2023, with room for further declines depending on how many new wafer entrants can become acceptable alternatives to LONGi and Zhonghuan.

While cell and module capacities greatly exceed upstream stages of production, growing emphasis on a select set of tier 1 and tier 2 suppliers continues to keep prices from well-known suppliers high despite increasing module availability in the industry. Moreover, as the industry increasingly turns to more integrated suppliers, given better bankability qualities and their ability to control and document their supply chains, growing cell and module oversupply is not likely to significantly affect top-tier supplier demand.

While most module materials outside polysilicon are not supply constrained, high energy prices have contributed to keeping many material prices higher than expected after 2021's energy crunch in China. In the future, there is a risk that encapsulant particles and quartz crucibles could become supply-constrained, given limited growth in upstream material input markets. Resin supplies are in demand from many other industries, making mapping supply and demand trends more difficult for suppliers and encapsulant producers. In addition, the rapid scaling of n-type wafer production may create temporary bottlenecks for high purity silicon metal for n-type crucible production. While quartz is commonly found worldwide, high purity quartz supplies are more limited to a subset of quartz and silicon metal producers. As a result, TOPCon availability could be constrained if high purity quartz and silicon metal capacities do not keep pace with high purity ingot demand trends.

Supply Chain and Technology Considerations

Logistics challenges in some markets are easing, but others remain under pressure. For example, China's lockdowns lasting from March to June and resulting decline in outbound shipments have allowed congestion to fall some sea lanes and ports. However, congestion build-up continues in eastern United States ports, and western Europe remains impacted. Overall, container prices have fallen steadily over Q2 2022, and the outlook for freight rates remains positive despite many suppliers pricing more conservatively to guard against sudden upswings in freight rates. For example, suppliers for United States shipments will only offer FOB quotes, with the DDP logistics adder determined closer to the shipment date. In addition, many suppliers are capping their contribution to shipping costs at ~\$0.03/W for west coast shipping, choosing instead to pass additional costs to the buyer should container pricing increase again.

In 2020, several large suppliers formed 182 mm or 210 mm cell alliances to standardize module dimensions and reduce component and BOS costs. The results of the standardization transition are slowly concluding, and many modules now share similar sizing and formatting values to support upstream component sourcing and reduce the need for highly specialized material formats. In addition, suppliers of PV components like glass, inverters, trackers, and others are now becoming a part of these alliances, further unifying component supply chains and reducing the risk of supply chain bottlenecks. Because TOPCon shares much of the same equipment and infrastructure as PERC, no changes in module form factors are expected when TOPCon surpasses PERC in availability.

Report Contents: 46 Pages of In-Depth Reporting

CEA's **Price Forecasting Program** is the leading source of price data and analysis in the solar and storage industry. We leverage the expertise of our PV industry experts and analysts, our network of lab partners, independent industry experts and raw material suppliers, and our access to proprietary, trade association and public databases to report on current trends and anticipate changes that will transform the renewable energy landscape.

Purchase the Full Report



The image shows the 'TABLE OF CONTENTS' page. At the top right, it says 'CEA | SERVICE REPORT', 'Price Forecasting Program | PV', and 'Report Number | CEA-PRR-Q2-2022'. The table of contents lists various sections and their corresponding page numbers:

- EXECUTIVE SUMMARY 6
- 1. MARKET TRENDS 7
 - 1.1 Customer Market Conditions (Polysilicon Capacity Growth) 7
 - 1.2 Silicon Wafer 7
 - 1.3 Cell 9
 - 1.4 Ingot and Wafer 9
 - 1.5 Module 11
 - 1.6 Development Market Conditions (Production Outlook) 11
 - Global Installations 14
 - 1.6.1 North and Central America 14
 - United States 18
 - Europe 19
 - India 19
- 2. PRICE FORECAST 20
 - 2.1 International Price Outlook 20
 - Regional 20
 - Central Price Outlook 22
 - North America 22
 - 2.1.1 United States Price Outlook 24
 - Central Price Outlook 24
 - South America 25
- 3. COST AND COMPONENT FACTORS 27
 - 3.1 Silicon Wafer 27
 - Cost by Price Factors 28
 - Policy / Environment Factors 28
 - 3.2 Polysilicon 28
 - Cost by Price Factors 28
 - Policy / Environment Factors 28
 - 3.3 Ingot and Wafer 28
 - Cost by Price Factors 28
 - 3.4 Cell 28
 - Cost by Price Factors 28
 - 3.5 Module 28
 - Cost by Price Factors For United States Domestic Modules, 5/19 31
 - Cost by Price Factors For Europe Domestic Modules, 5/19 32
 - 3.5.1 Cell and Module Materials 31
 - 3.5.2 Glass 33
 - 3.5.3 Silver 34
 - 3.5.4 Backsheet 35
 - 3.5.5 Encapsulant 37
 - 3.5.6 Junction Boxes And Other Cell Materials 37
- 4. SUPPLY CHAIN AND TECHNOLOGY CONSIDERATIONS 38
 - 4.1 Logistics 38
 - 4.2 Freight 38
 - 4.2.1 Exchange Rates 39
 - Exchange Rate Tracking 39
 - 4.2.2 Exchange Rates 40
 - Power Mix Tracking 40
 - Form Factor Considerations 40
- 5. METHODOLOGY 42
- 6. APPENDICES 44
 - 6.1 How To Read Pricing Tables 44
 - 6.2 Table Of Key Events 46
 - Policy Overview 46



Thank you!

Clean Energy Associates

Website: www.cea3.com

Email: info@cea3.com

The information herein has been prepared by Clean Energy Associates, LLC (“CEA”) solely on a confidential basis and for the exclusive use of recipient, and should not be copied or otherwise distributed, in whole or in part, to any other person without the prior written consent of CEA. No representation, warranty or undertaking, express or implied, is made as to, and no reliance should be placed on, the fairness, accuracy, completeness or correctness of the information or the opinions contained herein. The information herein is under no circumstances intended to be construed as legal, business, investment or tax advice. Neither CEA or any of its affiliates, advisors or representatives will be liable (in negligence or otherwise), directly or indirectly, for any loss howsoever arising from or caused by the understanding and/or any use of this document.