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S&P Global
China Ratings

China's Photovoltaic Industry: Deep Restructuring Amid Efforts to Curb Overcapacity and Disorderly Competition

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Key points

- China's PV manufacturing sector is mired in a cyclical trough, with oversupply and cutthroat price competition replacing technology and resource constraints as core challenges. Severe supply gluts, plummeting product prices, and homogeneous competition have led to industry-wide losses and mounting pressure on margins. While long-term demand is supported by global decarbonization, overseas markets will drive incremental growth amid slowing domestic expansion. However, effective April 1, 2026, the 9% VAT export tax rebate will be eliminated for major PV products, raising export costs and accelerating the exit of inefficient capacity.
- Policies are driving the structural transformation of China's PV industry, urging upstream and midstream manufacturers to reduce subsidy reliance and compete through technological upgrading, cost control and demand analysis. Since the PV sector is dominated by private companies, curbing disorderly competition requires a combination of policy guidance, industry self-regulation and market-based restructuring. Meaningful capacity reduction has been constrained by persistent supply-side rigidity and demand-side uncertainty.
- Enterprise divergence has widened sharply. Leaders with integrated operations, global footprint, and stable cash flow show relative anti-cyclical resilience, yet nearly all face profit compression and capacity utilization of just 40%–70%. Hengdian DMEGC, JA Solar stand out in EBITDA margin, return on capital, and earnings stability.
- The PV industry is set to undergo deep restructuring through 2025–2026, with widening credit divergence and cash flow resilience as key to survival. Financially robust players such as Daqo New Energy and DMEGC boast low leverage, stable EBITDA, positive operating cash flow and prudent capex. By contrast, companies including EGing PV, Aiko Solar, Risen Energy and GCL Integration are burdened with relatively high financial leverage, largely stemming from aggressive expansion and R&D investment in prior periods. Coupled with weakened profitability and cash flows amid the industry downturn, these firms face intensified debt repayment pressure.

The global photovoltaic (PV) industry entered a phase of rapid expansion in 2007. Post-2010, it witnessed leapfrog development fueled by robust policy support in China, a highly complete supply chain, and pronounced manufacturing cost advantages. China has since established a dominant position in the global PV value chain, achieving near-monopoly status across polysilicon, wafers,

cells, and modules by 2020. Today, China's global market share exceeds 80% in each segment, and surpasses 95% in certain links such as silicon wafers.

Nevertheless, the fast-paced capacity expansion has also led to deep-seated issues including structural overcapacity, homogeneous competition, and compressed profitability. The PV industry is now undergoing a profound new round of adjustment. Domestically, policy reforms are accelerating the marketization of electricity pricing, bringing an end to guaranteed feed-in tariffs. On the other hand, rising global trade barriers, rapid technological shifts, and tightening grid absorption capacity are collectively driving the industry into a new round of consolidation.

We selected 17 representative entities in the PV manufacturing sector. This report focuses primarily on the manufacturing segments of polysilicon, wafers, cells and modules; thin-film PV modules and PV inverters are excluded from the scope of analysis. Applying the relevant methodologies of S&P Global (China) Ratings, we conducted desktop research based on public information and formed preliminary views on the credit quality of these entities. The full names and abbreviations of the sample entities are listed in Appendix 1.

Reading Notes

Standard & Poor's Credit Rating (China) Co., Ltd. ("S&P Global (China) Ratings") has selected a number of entities for this desktop research based on criteria including asset size, regional representativeness and adequacy of public information. Analysis in this commentary is conducted in accordance with the methodologies of S&P Global (China) Ratings, whose approaches are China-specific and differ from those of S&P Global Ratings. Accordingly, the views expressed herein are those of S&P Global (China) Ratings and shall not be deemed or presented as views of S&P Global Ratings, nor be relied upon as such.

This research is based solely on public information and applies the non-financial entity methodologies of S&P Global (China) Ratings. Using its relevant approaches, the Company has analyzed public information and formed preliminary views on the entities' potential credit quality. It is emphasized that these views are based exclusively on public information. S&P Global (China) Ratings has not engaged in any rating-related contact or communication with any of the subject entities. The views in this report do not constitute and shall not be presented as credit ratings, nor be construed as final credit ratings for any entity. They represent only preliminary opinions on potential credit quality derived from this analysis. No monitoring or surveillance activities are involved in this research. The views in this report shall not constitute or be regarded as recommendations to invest in, hold or sell any securities or to make any investment decisions, nor do they address the suitability of any securities.

Analysis for this desktop study was conducted on an individual entity basis, while analytical conclusions are presented on an aggregated group basis. In presenting statistical and performance data for each group of entities and the overall market across sections of this report, we have employed indicators that we generally consider most illustrative of relevant conditions under the methodologies of S&P Global (China) Ratings.

As this analysis is a desktop study based on public information, we have not conducted interviews or any other form of interaction or communication with any entity. Where relevant information is unavailable, we have made certain assumptions. We have also sought to consider the potential for entities to receive group support, government support, or other forms of external support in forming views on potential credit quality. S&P Global (China) Ratings shall not be liable for any losses arising from reliance on any content of this report.

Part 1 Industry Risks

1. Industry Overview

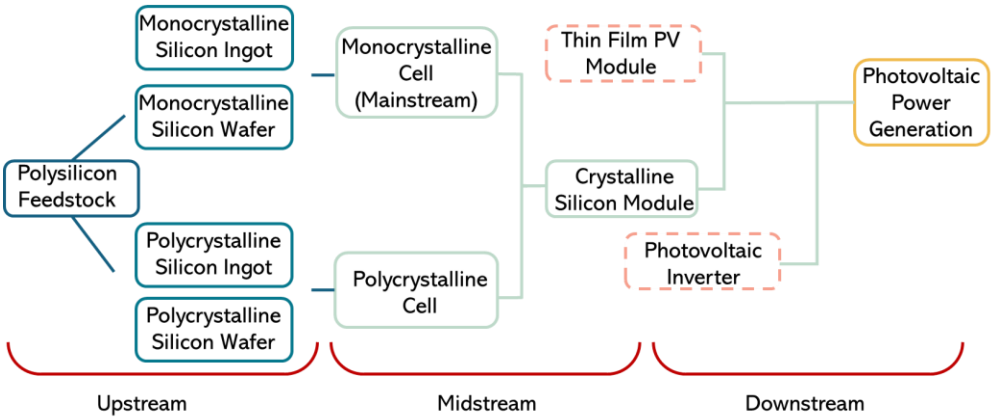
We believe China's PV industry exhibits significant strong cyclical characteristics, with the primary contradiction shifting from early-stage technical barriers and resource constraints to the current widespread overcapacity and intense price competition. Although upstream raw material supply is ample and leading companies maintain strong technological iteration capabilities, the profit margins in the manufacturing segment are being severely squeezed, and the industry as a whole has entered a phase of deep consolidation and structural adjustment.

The PV industry is typically cyclical. The PV industrial chain can be divided into three segments: upstream (polysilicon, wafers), midstream (cells, modules), and downstream (power station construction and operation). The supply-demand dynamics in each segment show significant

differences. The asynchronous changes in supply and demand lead to considerable volatility in the prices of related products.

Chart 1

PV Value Chain Structure



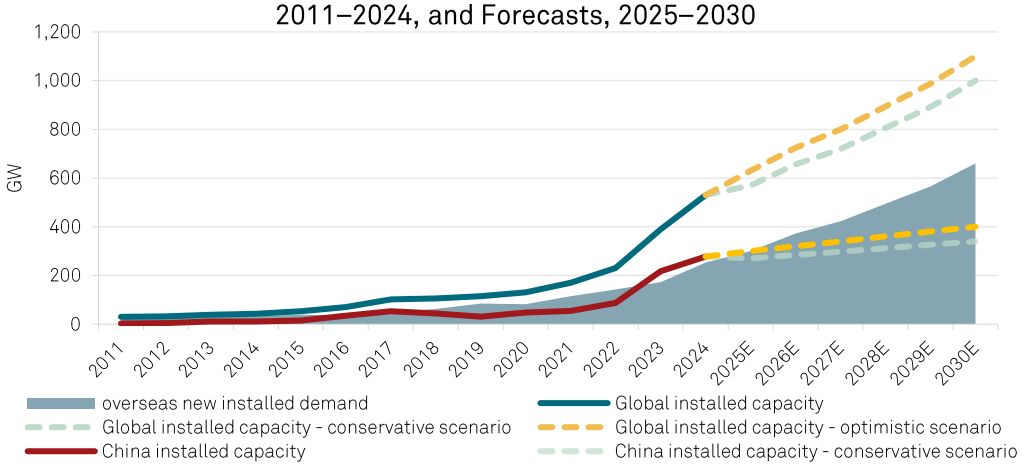
Note: This report mainly focuses on the manufacturing processes of polysilicon materials, silicon wafers, batteries and modules. Thin-film PV modules and PV inverters are not within the scope of this report's study.

2. Growth Potential for PV Industry Demand Lies Primarily in Overseas Markets; Growth Room in the Domestic Market is Limited

Driven by the global consensus on carbon emission reduction, PV, as the core of renewable energy, has a positive long-term demand outlook, but the Chinese market has become relatively saturated with limited growth potential. According to our projections, overseas installed capacity will gradually surpass that of China starting in 2025, becoming the primary source of incremental demand for PV manufacturers. Industry growth going forward will be largely driven by overseas markets.

Chart 2

Global and China Annual New Photovoltaic Installed Capacity, 2011–2024, and Forecasts, 2025–2030

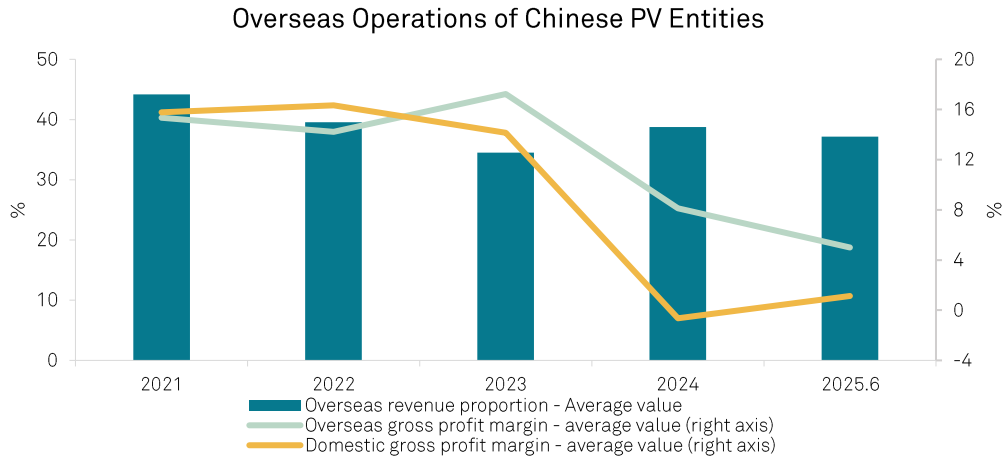


Note: Projected installed capacity for 2025–2030 is based on forecasts by the China PV Industry Association (CPIA); overseas new installed demand is estimated on a conservative basis. Data for China in 2025 has been updated in line with the latest figures released by the National Energy Administration.
Source: China Photovoltaic Industry Association (CPIA), complied by S&P Global (China) Ratings.

Intense competition stemming from domestic supply-demand mismatches has emerged as a key challenge for the PV industry, driving companies to pursue global footprints to capture growth opportunities in overseas markets and forcing a shift from "scale-based competition" to "globalization competition."

Chinese PV entities have continuously strengthened their competitiveness in overseas markets. Since 2021, overseas revenue has accounted for over 30% of total revenue for Chinese PV companies, with gross margins notably higher than those in the domestic market, making it a major contributor to profit growth.

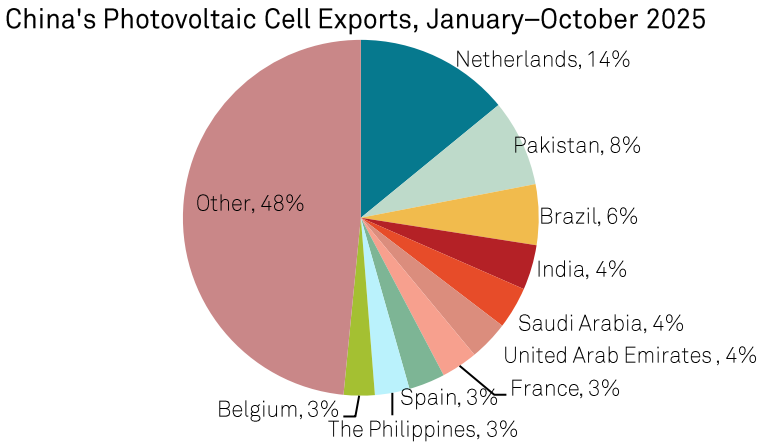
Chart 3



Note: Represents the average of sample entities with available data during the period under review.
Source:Sample enterprise annual reports, publicly available data, iFinD, etc., complied by S&P Global (China) Ratings.

However, overseas production and sales face numerous uncertainties and risks, including international political relations, legal and regulatory requirements, and challenges from various countries promoting the localization of PV supply chains.

Chart 4



Note: The product code is 854143. Including Cells Mounted in Modules or Assembled into Blocks.
Source: General Administration of Customs

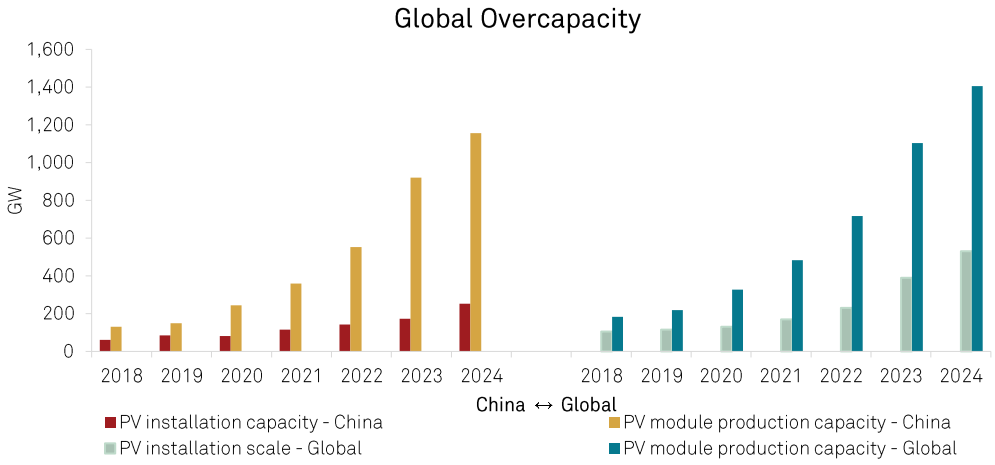
Faced with mounting internal and external pressures, Chinese PV companies are advancing their globalization strategy from the 1.0 model of "product exports" toward the deeper 2.0 model of "glocalization." To mitigate trade risks and explore new markets, their capacity deployment is shifting from concentrated layouts in four major Southeast Asian countries to more diversified destinations including Indonesia, Laos, and other economies in the region, as well as Middle

Eastern markets with ambitious energy transition plans such as Saudi Arabia and Oman. Their overseas expansion model has also evolved from the traditional "Made in China, sold globally" model, with single-segment investments, to a "Made globally, sold globally" approach involving coordinated deployment of the entire industrial chain.

3. The PV Industry is Experiencing the Current Cyclical Trough, Supply-Demand Imbalance is Difficult to Reconcile, and Prices Remain at Historically Low Levels

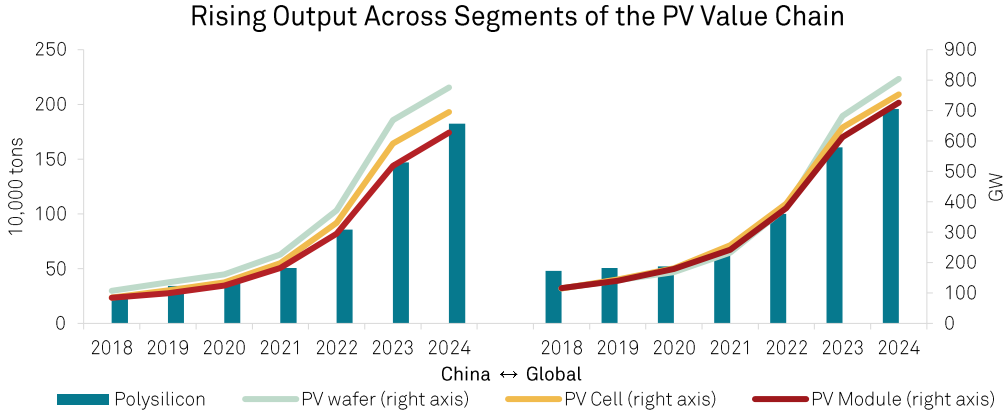
The industry-wide overcapacity in the PV sector reflects slower demand growth relative to supply expansion and a laggard capacity exit mechanism on the supply side. Amid low entry barriers, industry capacity has expanded rapidly, with Chinese players driving sustained high growth in production capacity across the entire industrial chain. By the end of 2024, China's annual PV module production capacity had exceeded 1,100 GW, far outpacing global actual installed demand of approximately 530 GW, highlighting a deepening supply-demand imbalance.

Chart 5



Source: CPIA, IEA, iFinD

Chart 6

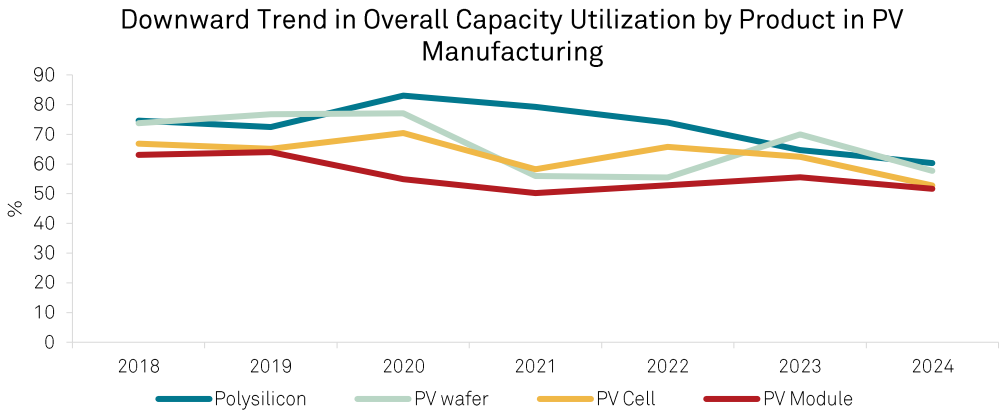


Note: The global data is mainly sourced from IEA PVPS, while the data for China is mainly from CPIA. There may be differences in measurement methods between the two.
Source: CPIA、IEA、iFinD

The continuous intensification of supply expansion has led to a general decline in capacity utilization rates across all segments of the PV industrial chain, with the industry facing increasingly severe risks of structural overcapacity. Notably, the further downstream the industrial chain (such

as PV modules), the greater the number of participants and the lower the entry barriers, resulting in more serious excess capacity. Capacity utilization has long lingered in the range of 50%–60%.

Chart 7

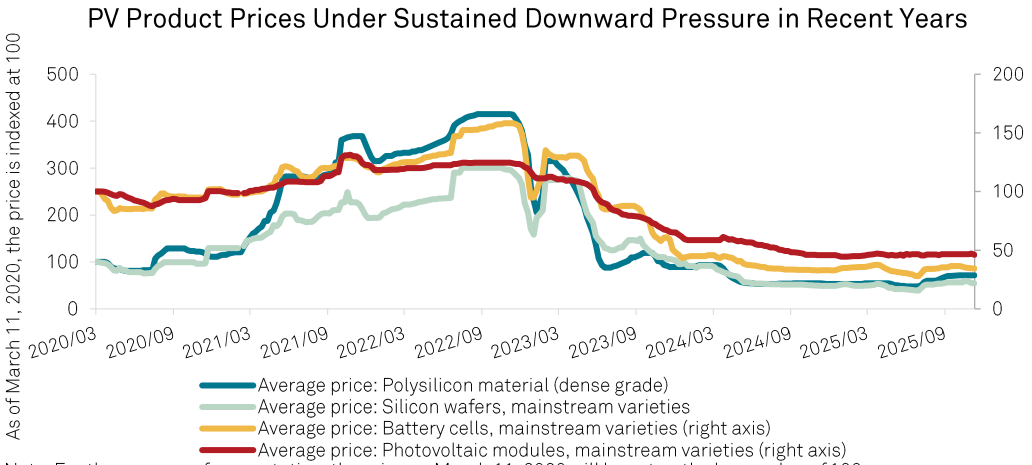


Note: Capacity Utilization Rate = Current-Year Output / Current-Year Capacity
Source: IEA, complied by S&P Global (China) Ratings.

Overcapacity has driven a sustained decline in PV product prices. Since late 2022, massive new polysilicon capacity and accelerated industry-wide expansion have rapidly reversed the supply-demand balance. Severe overcapacity emerged from 2023, with polysilicon prices plunging from a peak of 300 yuan/kg to below 70 yuan/kg, and module prices falling below $0.1/W (around 0.7 yuan/W) in early 2025, below the cost line for most producers, leading to cutthroat competition.

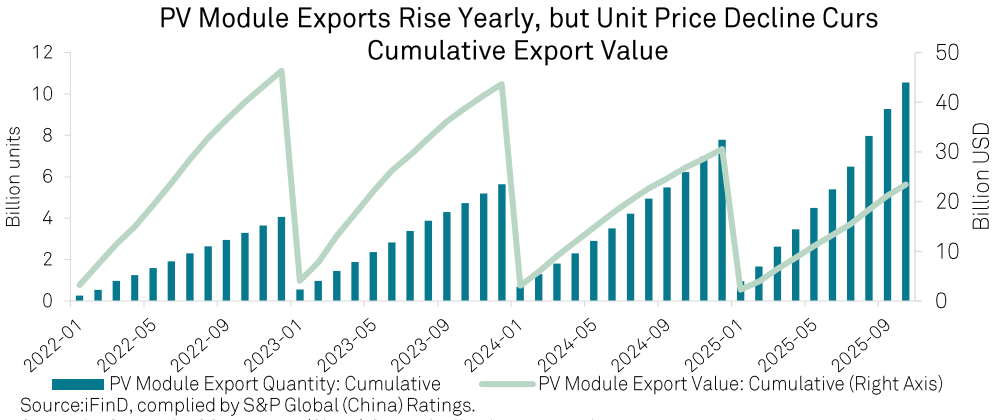
New government regulations have curbed unregulated expansion and pushed the industry to shift from scale-driven growth to technology-focused competition, helping stabilize prices. However, structural overcapacity remains significant: current prices stand at only 30%–70% of 2020 levels, with cells and modules seeing deeper declines, and the industry still trapped in cutthroat competition.

Chart 8



Note: For the purpose of presentation, the price on March 11, 2020 will be set as the base value of 100.
Source:iFinD

Chart 9



Source:iFinD, complied by S&P Global (China) Ratings.

4. Persistent Oversupply Has Led to Deep Declines in PV Product Prices, with Some Segments' Prices Falling below Cash Cost Lines for Extended Periods, Triggering Widespread Financial Losses in the Industry

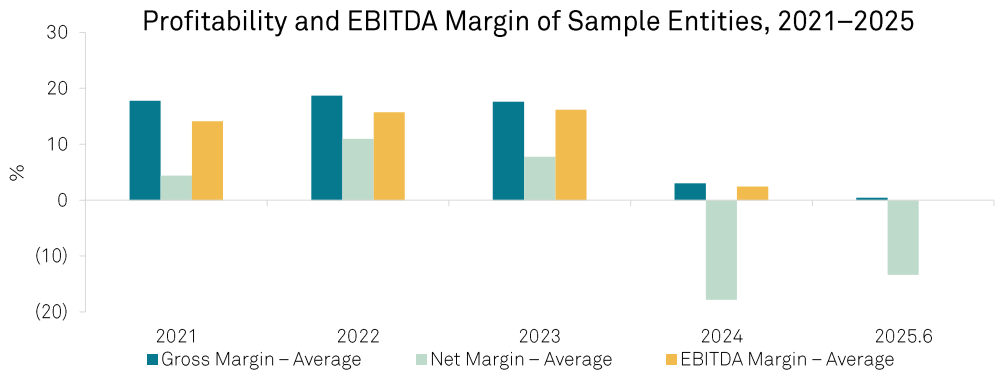
According to the China Photovoltaic Industry Association (CPIA), the minimum production cost of high-efficiency PV modules was around 0.69 yuan/W (US$0.095/W) in late 2024. This figure reflects the basic cost floor for leading manufacturers, excluding depreciation. However, market prices dropped below this level toward the end of 2024, pushing gross margins into negative territory for many companies.

This downturn was quickly reflected in financial performance: most PV companies suffered heavy losses in 2024 with widespread net losses. Firms resorted to volume-based survival strategies, cutting prices amid fierce competition and creating a vicious cycle of further price declines. Our estimates show a sharp deterioration in profitability among sample entities since 2024: average gross margins narrowed drastically, net margins turned negative, and EBITDA margin also slumped substantially. Even stripping out non-cash items such as depreciation and amortization, core operating cash flows barely covered operating costs, with some companies posting negative EBITDA, indicating a material decline in operating quality.

Amid a prolonged market slump, Chinese PV firms have cut output and delayed expansions since H2 2024 to ease supply pressure. Leading companies agreed on capacity discipline via industry initiatives, while policymakers tightened rules to curb cutthroat competition and promote high-quality development.

Although PV prices stabilized and rebounded in Q3 2025 supported by polysilicon cuts and robust overseas demand, module price gains remained limited by weak end-market demand. With all PV power now traded at market rates from 2025, high-cost players are set to exit more quickly.

Chart 10



Source: iFinD, CIQ, complied by S&P Global (China) Ratings.

5. Policies Drive Capacity Reduction and Upgrading: China's PV Industry Undergoes a Deep Structural Transformation Guided by Policies

On the manufacturing side, the Ministry of Industry and Information Technology (MIIT) issued revised PV manufacturing standards in November 2024, raising thresholds for technology, energy efficiency and intellectual property rights to curb blind expansion of inefficient capacity and phase out outdated production lines. Meanwhile, fiscal tightening measures — including a gradual reduction in export tax rebates for PV products, first from 13% to 9% and further to 0% — have squeezed margins for low-price competitors and accelerated market consolidation.

On the downstream application side, policies have shifted toward market-oriented mechanisms. A series of rules issued in 2025 ended fixed feed-in tariffs, promoted market-based pricing, and encouraged better new energy consumption through integrated development. These measures signal a shift away from scale-oriented expansion toward high-quality growth.

We believe this industry restructuring is moving the PV sector from policy-driven, fixed-tariff model to a fully market-based pricing system. This forces manufacturers to reduce reliance on subsidies, improve efficiency and cost control, and accelerates the exit of technically and economically uncompetitive capacity.

However, as China's PV industry is dominated by private companies, regulatory enforcement is weaker than in state-heavy sectors. Anti-cutthroat competition requires a mix of gradual policies, corporate self-discipline and market integration.

Capacity reduction faces two key constraints.

First, supply rigidity: Producers maintain high output to preserve market share and amortize fixed costs, while implicit local government support delays the exit of inefficient capacity.

Second, demand uncertainty: Slowing global growth has dampened investment sentiment, while rising local content protectionism in some countries has squeezed China's export room.

Part 2 Competitive Position Analysis of PV Entities

Given the rapid technological iteration, periodic overcapacity, and high product homogeneity in the PV manufacturing sector, most companies face notable technology and market risks. In this context, we focus on a company's degree of industrial chain integration, technological and R&D capabilities, and global operational strength, supplemented by operational efficiency and profitability metrics.

We view most PV entities as price takers. Amid disorderly capacity expansion and intensified homogeneous competition in 2023–2024, the industry entered a severe price war. Many firms fell into a "higher output, larger losses" predicament, leading to production curtailments, suspensions, or even permanent line shutdowns.

1. Industrial Chain Layout

Capacity leaders across major PV industry segments generally demonstrate the following characteristics:

In the upstream sector (polysilicon, wafers), large-scale producers typically maintain two competitive strengths. First, they consolidate advantages through sound industrial chain integration. Second, such entities benefit from regional resource endowments, by locating close to major polysilicon production bases or energy-abundant regions with low power costs such as Xinjiang and Inner Mongolia, thus achieving distinct advantages in cost and supply security, with Daqo New Energy as a typical example.

In the midstream sector (cells, modules), capacity leaders are mostly global leading PV module manufacturers with extensive overseas market presence in Europe, the Americas, Asia-Pacific and other regions.

It should be noted that in addition to total capacity, production line scale and technological level are equally critical. Capacity assembled by a large number of outdated, small-size and low-efficiency production lines not only restricts cost optimization, but also faces environmental and policy constraints due to high energy consumption and high carbon emissions, which may lead to

accelerated elimination under the background of industry "de-involution" and green trade barriers such as the EU Carbon Border Adjustment Mechanism (CBAM). Therefore, "effective capacity" is gradually replacing "nominal capacity" as the core indicator to evaluate entities' actual competitiveness.

Table 1

Top 5 Global Manufacturers by PV Cell & Module Production and Shipment Volume, 2024

Rank	PV Cell Production (GW)		PV Module Production (GW)		PV Module Shipment Volume (GW)	
1	Tongwei	89.1	JinkoSolar	89.8	JinkoSolar	92.9
2	JinkoSolar	81.3	JA Solar	72.1	LONGi Green Energy	75.8
3	JA Solar	70.4	LONGi Green Energy	70.2	JA Solar	74.2
4	LONGi Green Energy	60.8	Trina Solar	66	Trina Solar	70.5
5	Trina Solar	59.4	Tongwei	50	Tongwei	45.7

Source: IEA, complied by S&P Global (China) Ratings

Table 2

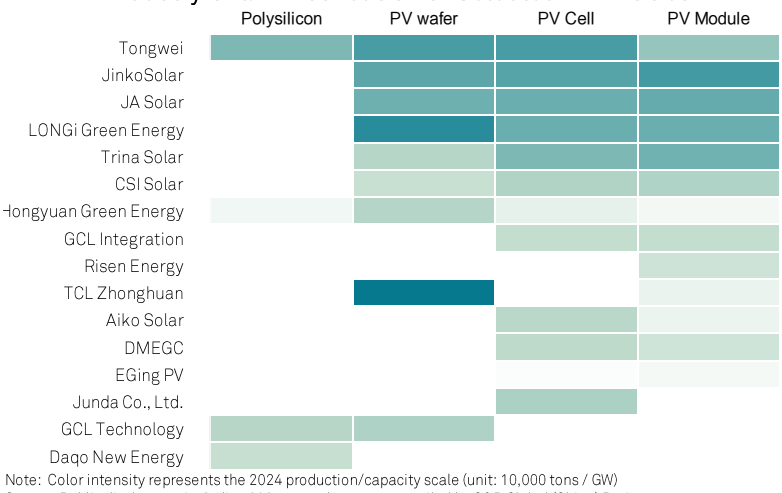
Disclosed Production Capacity of Selected Listed PV Entities

Polysilicon Capacity (10,000 tons)		Wafer Capacity (GW)		Solar Cell Capacity (GW)		PV Module Capacity (GW)	
Tongwei	90	LONGi Green Energy	194	Tongwei	150	LONGi Green	156
GCL Technology	48	TCL Zhonghuan	190	JinkoSolar	103	JinkoSolar	143
Daqo New Energy	31	JinkoSolar	135	Trina Solar	95	Trina Solar	125
		JA Solar	82	JA Solar	72	JA Solar	100
		Trina Solar	58	CSI Solar	48	Tongwei	90
		Hongyuan Green Energy	35	Junda Co., Ltc	44	CSI Solar	60
		GCL Technology	35	Aiko Solar	32	Risen Energy	40
		CSI Solar	31	DMEGC	23	GCL Integrati	30
				GCL Integrati	16	TCL Zhonghua	18
						DMEGC	17
						Aiko Solar	15
						EGing PV	10

Source: 2024 annual reports and other public disclosures, compiled by S&P Global (China) Ratings

Chart 11

Industry Chain Distribution of Selected PV Entities



Note: Color intensity represents the 2024 production/capacity scale (unit: 10,000 tons / GW)
Source: Public disclosures including 2024 annual reports, compiled by S&P Global (China) Ratings

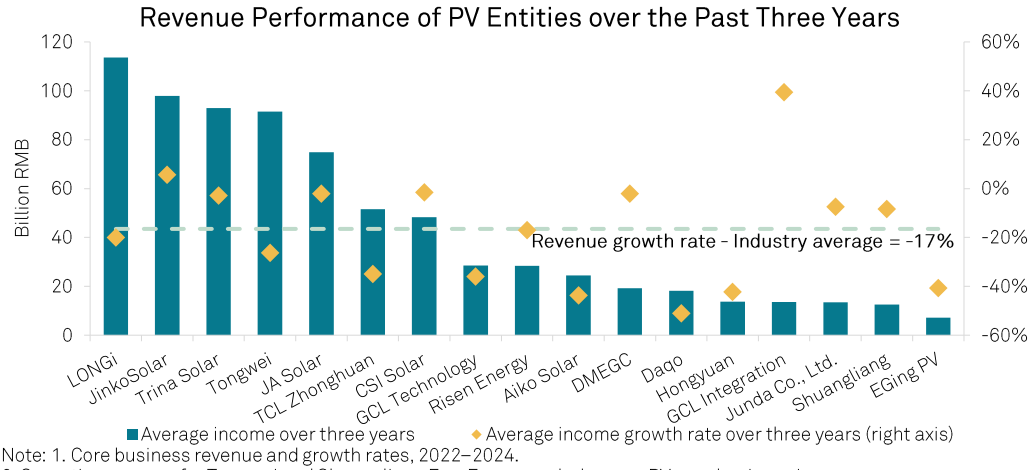
2. Business Scale and Revenue Level

We hold that scale expansion enables PV manufacturers to fully capitalize on economies of scale, effectively reducing unit energy consumption, depreciation charges and production costs, while strengthening their bargaining power in upstream and downstream transactions including polysilicon procurement, equipment pricing and module sales.

However, since 2023, industry overcapacity has become increasingly pronounced, and the government has strengthened capacity regulation, rendering the pure expansion model unsustainable. We expect that leading entities will increasingly pursue high-quality growth in scale through technological upgrading, vertical integration, or overseas localized development, rather than engaging in blind capacity expansion.

According to our analysis, PV manufacturing companies experienced profound structural adjustments during 2022–2024. The compound annual growth rate (CAGR) of total operating revenue for the sample entities stood at approximately -17%, notably lower than that recorded in the previous high-growth period.

Chart 12



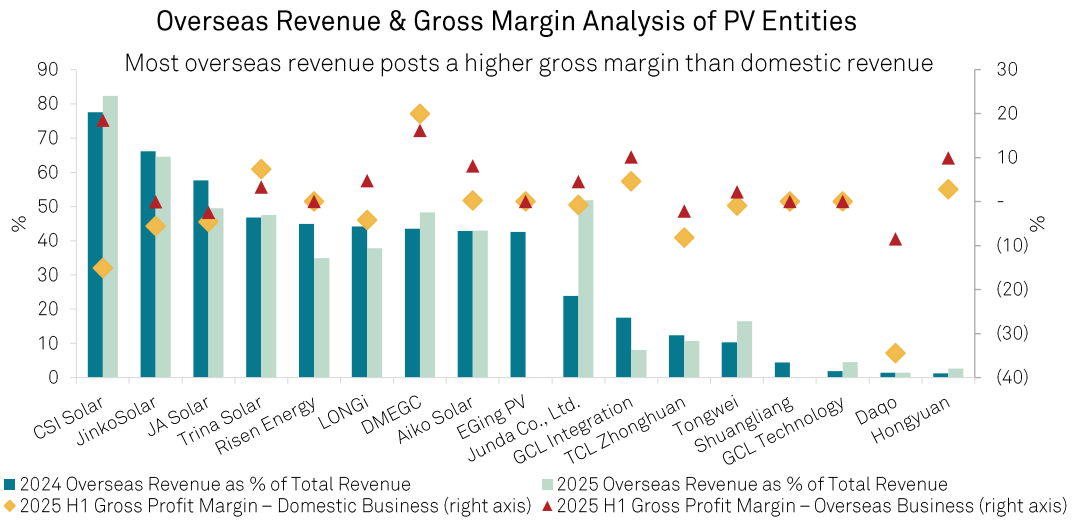
Note: 1. Core business revenue and growth rates, 2022–2024.
2. Operating revenue for Tongwei and Shuangliang Eco-Energy excludes non-PV core business income.
3. TCL Zhonghuan exhibits strong synergy between semiconductor wafers and PV technology & production; its business revenue is included in the calculation.
Source:iFinD

3. Global Production and Sales Capability

We believe that diversified sales markets and globalized production bases are also important strategies for PV manufacturers to mitigate geopolitical risks, trade barriers and regional demand volatility. Amid weak domestic demand growth, overseas markets have become a key battleground for industry participants.

Overseas PV downstream demand is highly concentrated in major regions including Europe, the Americas and Asia-Pacific. These markets differ substantially in policy orientation, technical standards, trade rules (such as the EU CBAM and U.S. UFLPA) and customer preferences. Excessive reliance on a single overseas market may expose entities to shipment disruptions and profit pressures triggered by sudden policy adjustments or trade frictions.

Chart 13



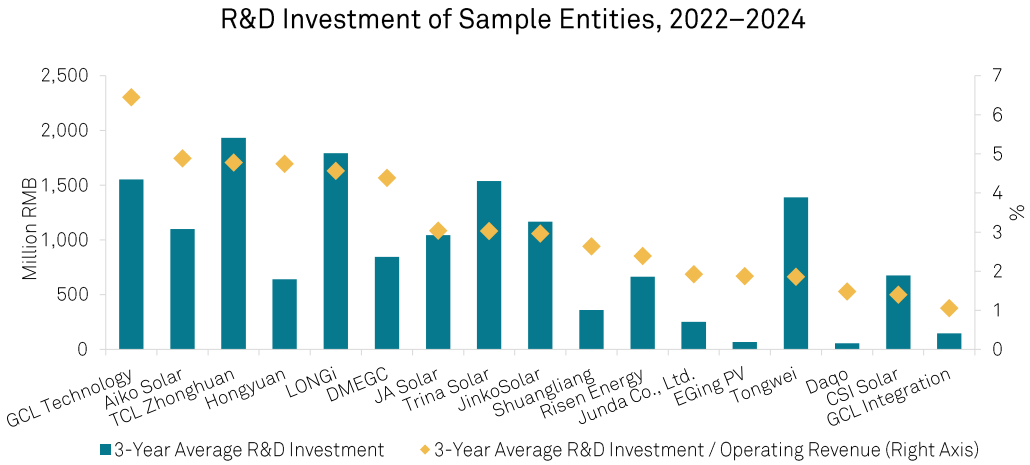
Source:iFinD, public information, compiled by S&P Global (China) Ratings

4. Technology and R&D Strength

The PV industry is characterized by rapid technological advancement. In recent years, new processes and disruptive technologies have emerged continuously across crystal pulling, wafer fabrication, cell manufacturing and module production segments. The mainstream technology in China's PV manufacturing sector shifted from PERC to TOPCon within just two years, while next-generation technologies such as BC and perovskite tandem cells are also accelerating industrial application.

Rapid technological shifts coupled with massive capacity expansion have not only heightened pressure on fixed-asset impairment but also exacerbated industry supply-demand imbalance and cutthroat competition. At present, leading entities are establishing technological barriers through substantial R&D investment. By contrast, entities lacking core technological moats maintain weak R&D spending and face accelerated capacity elimination amid the dual pressures of overcapacity and rapid technological iteration.

Chart 14



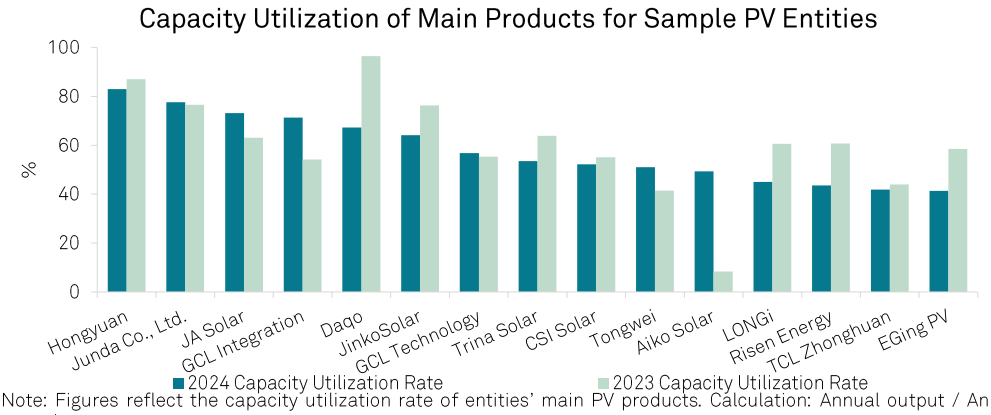
Source:iFinD

5. Capacity Utilization

We have analyzed the capacity utilization rates of key products among the sampled PV entities. In 2024, capacity utilization declined for the vast majority of entities compared with 2023, generally ranging from 40% to 70%, with some falling below 40%.

Policy guidance is also facilitating the industry's transition away from cutthroat competition. Relevant authorities including the Ministry of Industry and Information Technology have introduced measures to curb blind capacity expansion and encourage the optimization of capacity structure, prompting e companies to proactively reduce output in response to industry headwinds. We expect that effective capacity utilization among PV entities will improve in 2025 as market-driven capacity consolidation enters its late stage, supported by continued industry self-regulation and policy guidance.

Chart 15

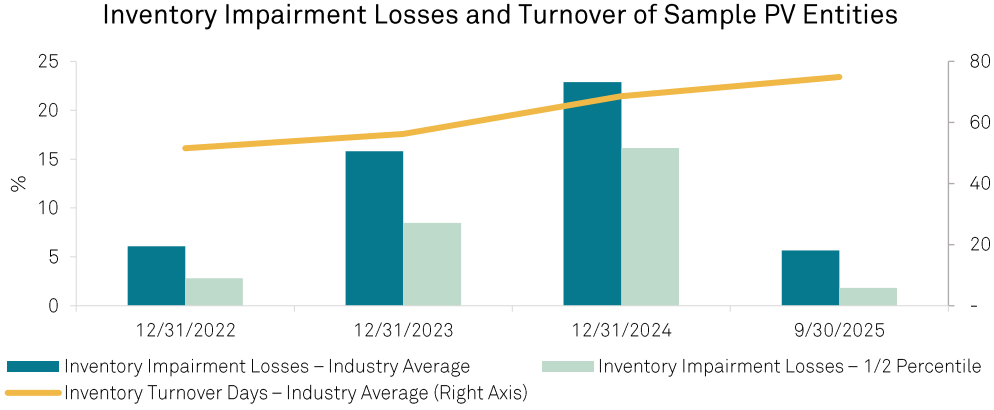


Note: Figures reflect the capacity utilization rate of entities' main PV products. Calculation: Annual output / Annual capacity.
Source: Annual reports and other public disclosures, compiled by S&P Global (China) Ratings

6. Operational Efficiency

Amid the ongoing profound restructuring of the PV industry, inventory turnover efficiency and inventory impairment risk have emerged as key metrics for assessing an enterprise's operational quality and resilience to risks. In recent years, the industry's average inventory turnover ratio has deteriorated notably, accompanied by a substantial rise in inventory impairment losses. Elevated inventory levels not only tie up considerable working capital but also heighten the risk of inventory write-downs directly. As reflected in the annual reports of numerous PV companies for 2023 and 2024, provisions for inventory impairment losses surged year on year, exerting substantial pressure on corporate profitability.

Chart 16



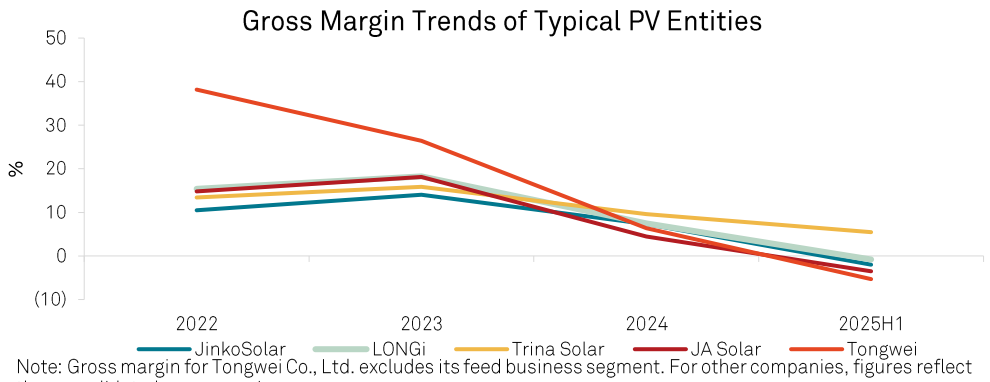
Source: iFinD

7. Profitability and Stability

Given the pronounced cyclical volatility of the PV industry, beyond assessing gross margin, EBITDA margin and return on capital (ROC), we also focus on the stability and resilience of entities' medium- to long-term profitability.

In recent years, the profitability of the PV manufacturing sector deteriorated dramatically, with even industry leaders falling into substantial losses. This crisis was driven by a combination of severe industry-wide oversupply, a collapse in product prices, and aggressive capacity expansion that outpaced demand growth, leading to widespread price wars. In addition, higher asset impairment provisions driven by technological upgrades, together with losses on investment income from minority stakes in PV entities, have further weakened the financial profiles of some PV companies.

Chart 17

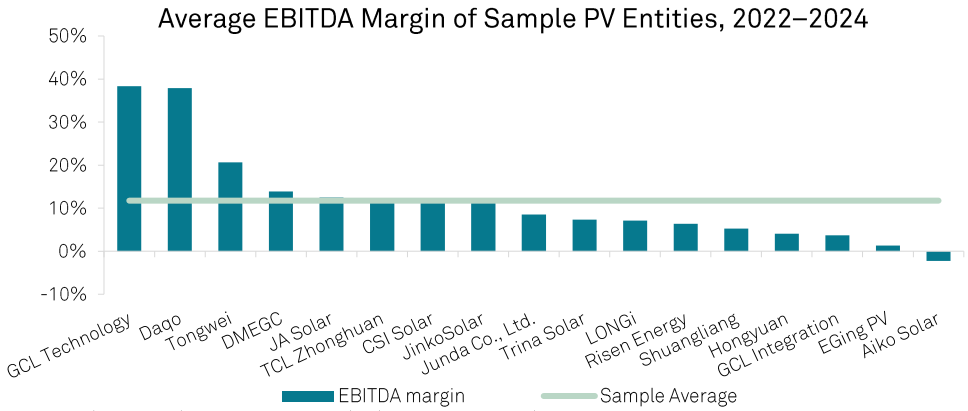


Note: Gross margin for Tongwei Co., Ltd. excludes its feed business segment. For other companies, figures reflect the consolidated gross margin.
Source:iFinD

PV manufacturing is a typical asset-heavy industry characterized by high capital expenditure and high depreciation and amortization. In this context, the EBITDA margin, by excluding non-cash expenses like depreciation and amortization, can more truly reflect a company's core business operating cash generation capability and operational efficiency.

We believe companies with higher EBITDA margins often possess specific cost or structural advantages. Among the sampled entities, GCL Technology and Daqo New Energy benefited from tight supply in the high-purity polysilicon segment during 2022–2023, coupled with continuous price increases for polysilicon and wafers, resulting in very high EBITDA margins. However, these companies have relatively concentrated product portfolios and operate in the upstream industrial chain, leaving their profitability highly vulnerable to fluctuations in raw material and product prices.

Chart 18

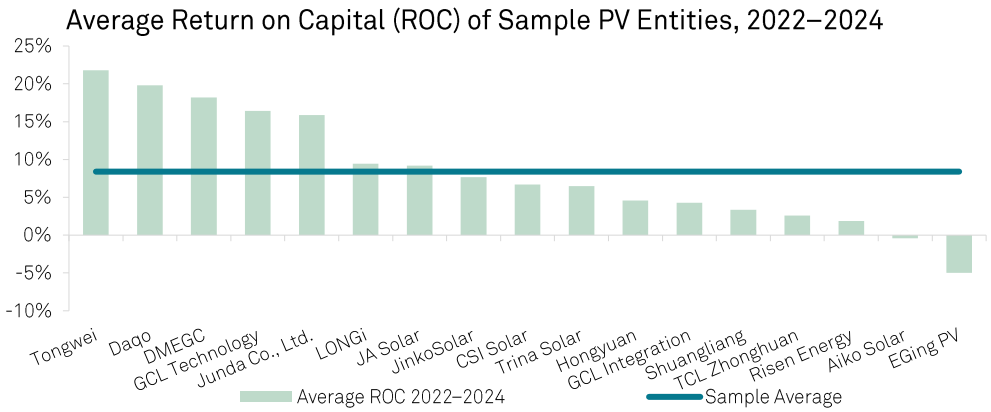


Note: The non-pv business segment also has an impact on the EBITDA margin.
Source:Choice

In terms of return on capital (ROC), Tongwei, Longi and JA Solar outperformed the industry average, supported by overseas markets, diversified revenue and government subsidies. Daqo Energy and GCL Technology benefited from the prior upturn in upstream polysilicon and wafers. DMEGC's PV segment delivered solid returns via differentiated products, global capacity and TOPCon cost savings, complemented by its magnetic materials and lithium-ion battery businesses. Junda Solar posted strong ROC through an asset-light model focused on TOPCon cells.

EGing PV reported negative three-year average ROC, dragged by slow technology upgrades, weak product competitiveness, inefficient capital from early expansion and compressed profitability. Aiko Solar faced similar headwinds: technology transition issues, weak cost control and higher debt from expansion and R&D weighed on its ROC performance.

Chart 19



Note: The non-PV sector also has an impact on the enterprise's capital return rate.
Source:Choice

Part 3 Financial Risk

We believe the PV industry will remain in a phase of deep adjustment and structural optimization from 2025 to 2026. The overall financial profile will stay under pressure, with credit risk differentiation accelerating. Cash flow resilience has become critical to corporate survival. Entities with prudent capital expenditure, low refinancing pressure and modest leverage demonstrate stronger risk resilience.

Financially sound entities typically exhibit the following traits: low leverage (with adjusted debt/EBITDA at a low level relative to the industry), stable EBITDA generation, sustained positive operating cash flow, and disciplined capital expenditure. Representative entities include Daqo New Energy and DMEGC.

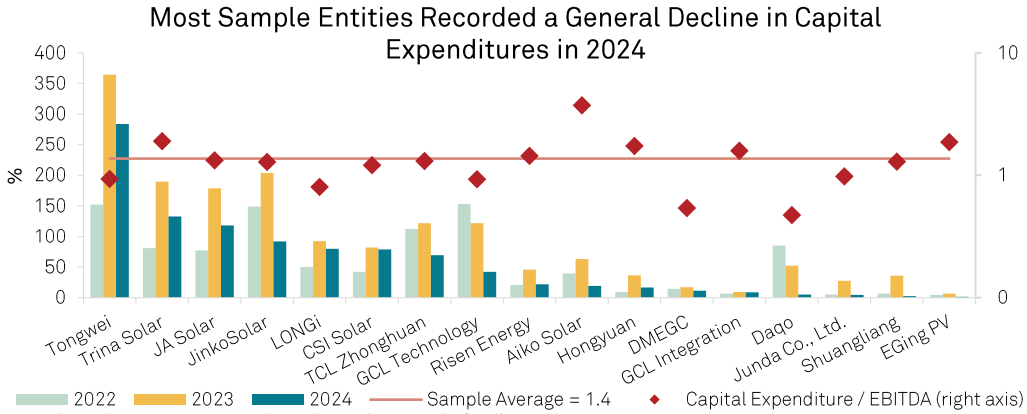
By contrast, financially vulnerable entities are characterized by elevated or even negative adjusted debt/EBITDA, high capital expenditure/EBITDA ratios, and volatile operating cash flow. Typical examples include Aiko Solar and Risen Energy.

Overall EBITDA of the sampled entities has dropped sharply, with some even turning negative, and most are under pressure from weakening cash flows. While the industry's strong upturn in 2023 supported solid EBITDA performance for most entities, EBITDA declined markedly across the sector in 2024 due to overcapacity, falling prices and moderating demand. Several entities recorded negative EBITDA amid a deteriorating cash flow environment.

We assess the sustainability of investment-related cash outlays among sampled entities using the capital expenditure/EBITDA ratio. In 2024, leading entities such as Trina Solar and JA Solar still recorded large absolute capital expenditures. However, supported by ample cash flow accumulated during the previous industry upcycle, their three-year average capital expenditure/EBITDA remained manageable.

By comparison, Aiko Solar's ratio over the past three years has been significantly above the industry average. This largely reflects intensive capacity construction and R&D investment following its strategic focus on BC technology starting in 2021. Coupled with the phase-out of legacy capacity, delayed returns from new capacity, and industry cyclical headwinds, capital investments have not been quickly converted into effective earnings.

Chart 20



Note: The right axis is presented on a logarithmic scale for illustrative purposes.
Capital expenditure / EBITDA is calculated as average capital expenditures for 2022–2024 divided by average EBITDA for 2022–2024.
Source:Choice, corporate annual reports, compiled by S&P Global (China) Ratings

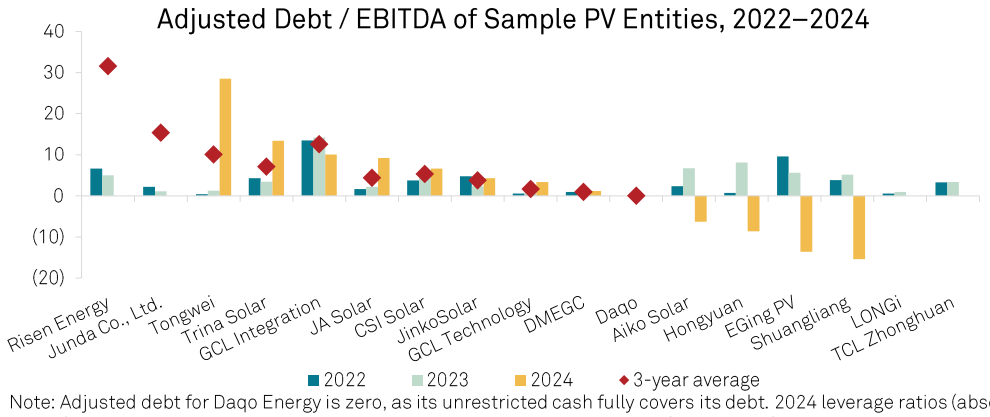
Most entities derive cyclical resilience from cash flow accumulated during industry upcycles and diversified business hedging. We measure PV entities' leverage using the adjusted debt/EBITDA ratio, which shows pronounced divergence across the sector. Low-leverage entities typically display two key traits:

First, they leverage cost advantages and high-margin segments to generate strong operating cash flow during boom periods and actively deleverage. For example, Daqo New Energy focuses on low-cost polysilicon production; its superior cost control allowed substantial cash accumulation during the polysilicon upcycle, enabling active debt reduction.

Second, they maintain prudent financial policies and low leverage supported by diversified operations or stable profitability. DMEGC follows a conservative financial strategy, relying on synergies across magnetic materials, photovoltaics and other businesses to sustain steady earnings and cash flow, while keeping capital expenditure disciplined.

Conversely, highly leveraged PV entities or those with rising leverage often share common features: they pursued aggressive capacity expansion and R&D investment in earlier phases. During the industry cyclical downturn, these companies face weakened profitability, slower receivables collection and strained operating cash flow. Moreover, profitability from newly built capacity often emerges with a lag, leading to higher adjusted debt/EBITDA ratios.

Chart 21



Note: Adjusted debt for Daqo Energy is zero, as its unrestricted cash fully covers its debt. 2024 leverage ratios (absolute values) for Risen Energy, Junda Co., LONGi Green Energy, and TCL Zhonghuan (all above 30) are excluded from the chart.
Source: Choice, compiled by S&P Global (China) Ratings

Part 4 Risk Lessons from Industry Cyclical Adjustments

China's PV industry has experienced multiple cyclical corrections, including the 2011–2013 EU and U.S. anti-dumping and countervailing duty (AD/CVD) investigations against Chinese PV products, as well as the 2018 "531 New Policy" subsidy cut. The industry is now undergoing another round of deep restructuring in 2023–2024.

Firms that struggled or exited during past cycles typically shared common flaws in operational and financial strategy, offering valuable insights for evaluating current industry dynamics and corporate credit risk.

Operational Strategic Errors

1. Blind capacity expansion without core competitiveness

Some companies expanded aggressively without improving technology or cost control. Following the AD/CVD duties, sharp price declines led to heavy losses. Coupled with internal problems such as major shareholder divestment and financial fraud, such firms were eventually delisted.

2. Misjudgment of technology pathways

This includes overinvestment in non-mainstream technologies or falling behind in technological upgrades. Hanergy Group heavily bet on thin-film solar from 2009 onward, which suffered from low mass-production efficiency and high costs and relied on related-party transactions, triggering a liquidity crisis in 2015. Wuxi Suntech Power made poor technology choices and failed to build cost or efficiency advantages in mainstream products, quickly losing competitiveness under trade pressures.

3. Overly concentrated market exposure

Lacking geographic or demand diversification left companies vulnerable. Wuxi Suntech Power, highly reliant on European markets, faced plummeting orders post-AD/CVD duties and went bankrupt in 2013. Yingli Green Energy, with most sales overseas, suffered sustained losses amid duties and the European debt crisis, defaulting on U.S. dollar bonds in 2016 and exiting core markets.

Financial Strategic Errors

Weak financial structures — high leverage, poor operating cash flow, and overreliance on short-term funding or share pledges — severely reduced resilience.

A typical case is Shanghai Chaori Solar Energy: Pursuing aggressive expansion through continuous bond issuance, it faced rapid liquidity depletion from 2012 onward due to delayed overseas receivables and tightened bank credit. In 2014, it became the first onshore bond defaulter in China's A-share market and ultimately underwent bankruptcy reorganization.

This report does not constitute a rating action.

Appendix 1: List of Sample Entities

No.	Company Name	Abbreviations
1	Jinko Solar Co., Ltd.	JinkoSolar
2	LONGi Green Energy Technology Co., Ltd.	LONGi Green Energy
3	Trina Solar Co., Ltd.	Trina Solar
4	JA Solar Technology Co., Ltd.	JA Solar
5	Tongwei Co., Ltd.	Tongwei
6	CSI Solar Co., Ltd.	CSI Solar
7	Hengdian Group DMEGC Magnetics Co., Ltd.	DMEGC
8	Risen Energy Co., Ltd.	Risen Energy
9	GCL Technology Holdings Limited	GCL Technology
10	GCL System Integration Technology Co., Ltd.	GCL Integration
11	TCL Zhonghuan Renewable Energy Technology Co.,Ltd.	TCL Zhonghuan
12	EGing Photovoltaic Technology Co., Ltd.	EGing PV
13	Xinjiang Daqo New Energy Co., Ltd.	Daqo New Energy
14	Hainan Drinda New Energy Technology Co., Ltd.	Junda Co., Ltd.
15	Shuangliang Eco-Energy Systems Co., Ltd.	Shuangliang Eco-Energy
16	Hongyuan Green Energy Co., Ltd.	Hongyuan Green Energy
17	Shanghai Aiko Solar Energy Co.,Ltd.	Aiko Solar

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