

A journey through China's solar sector

Recounting my experiences and observations from a two-week trip to Beijing, Shanghai area and Xinjiang province.



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At Mackenzie Greenchip we have long been investors in the Chinese solar supply chain. And, while we haven't invested directly in other Chinese companies, we have always followed economic and political developments in China closely, as most of the global industries that pertain to the energy transition are heavily influenced – if not dominated – by the industrial manufacturing juggernaut that is China.

In the early days of our Chinese solar investing, I went to a solar trade fair in Shanghai in 2017, and last year John Cook, the Greenchip Team Co-Lead, joined a group of investors meeting some of China's largest participants in the burgeoning EV and battery sectors. Since my Shanghai visit, the global (mostly Chinese) solar sector has expanded nearly fivefold. But, after enjoying commensurate strong performance through 2021, it has been hard times in the stock market for most Chinese solar companies, ours certainly included. The sector is under political and economic pressure even as demand continues to grow. It seemed like it was time to go to China again, visit our companies directly, and at least attempt to add some personal experience as context for the broad political allegations that have been leveled against the sector and the country by western politicians, academics and media.

Kicking the tires – site tours and Q&A with management of Mackenzie Greenchip's Chinese solar holdings

The Chinese solar sector has had to contend with the consequences of breakneck capacity growth that has, at times, exceeded even the dramatic growth in demand. This has been evident over the past 12-18 months. Even though demand has nearly doubled between 2022 and 2024, the total module production capacity estimated by Bloomberg NEF is nearly double that of demand, at over 1 TW of rated DC power. Prices of products in the solar supply chain have dropped in response to this surging supply, and inventories have grown despite demand growth of greater than 30% this year.

Adding to the challenges for Chinese producers is political and economic resistance from major export markets, led by the United States, but followed by other Western nations. Accusations of dumping and unfair trade have extended to the Chinese companies' offshore manufacturing operations in Southeast Asia, and new tariffs are currently in the American administrative process. There are also allegations of forced labour of largely Islamic populations in the supply chain linked to polysilicon production in Xinjiang province, and banning of any imports that can't traceably prove alternate polysilicon sourcing.

I visited each of the three Chinese solar companies that have been important parts of Mackenzie Greenchip's portfolio for many years: Jinko Solar, Canadian Solar and Daqo New Energy. In visiting manufacturing sites for solar panels, solar cells, utility-scale battery systems and polysilicon, I saw first-hand the scale and modern manufacturing processes that the most recent wave of solar sector investment has created. Jinko's cell plant that I visited is a nine-stage process with lines 500 metres long and near complete automation. At their newest plant, in Shanxi province, fully integrated lines that go from ingot to wafer to cell to module are three kilometres in length! The plant manager was proud of the fact that the most recent automation systems came entirely from Chinese suppliers, where even five years ago much of the equipment would have been from Japan or Germany. As a result of the increased automation, Jinko is reducing its production workforce from 57,000 to 40,000 this year even as its volumes are expected to grow by more than 20%.

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The Canadian Solar plants I visited were of earlier vintage than Jinko's, smaller scale, retooled, but originally built around the founding of the company in 2006/07. They have created their own cost-saving solutions by internally sourcing module parts like busbars and wire spools. One of these plants has been converted to assembling battery systems housed in 20-foot shipping containers for use at utility-scale solar-plus-storage plants. Canadian Solar is an early leader in this important space for developing solar potential, with its own manufacturing, a large R&D effort, and even some solar-plus-storage developments in its growing independent power producer (IPP) arm, Recurrent Energy. Seeing these battery systems in the making, it was hard not to be impressed by the enormous volume and weight of the metals that are consumed. This underscores the importance of efficient system design and broader electricity grid management to minimize the cost and quantity of the needed storage capabilities.



Boots-on-the-ground due diligence. Site tours of Canadian Solar plants in China.

Daqo New Energy's operating subsidiary has plants in Xinjiang and Inner Mongolia provinces, with the former being its original location of production and a source of controversy as Western sanctions have targeted Xinjiang. Our research indicates that Daqo has been the subject of third-party audits from their customers, among which is Jinko Solar, and is, in turn, auditing its own suppliers. All suppliers have signed a document asserting that all their labour force is free to leave and there are no financial, legal or physical methods by which they are restrained from doing so.[†]

Stepping away from the social questions in Xinjiang, I noticed similar investments in safety and automation at Daqo's operations that I saw at Jinko's new plant in the east. I was also impressed by how industrial and chemical the process for making green energy is, with enormous storage tanks for hydrochloric acid and distillation towers used to make trichlorosilane gas and then to grow pure polysilicon from that gas, deposited onto seed rods.

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We also discussed at some length the barriers to using the solar energy, that their product is an important part of, to offset the coal that powers their furnaces today. The local state grid company is reluctant to permit behind-the-meter solar development due to its own demand and grid management concerns. This type of development is being permitted slowly through a quota process and accounts for the surprising lack of rooftop solar that I observed from my flights to and from Xinjiang, even though the province has great insolation, and solar is very cheap to deploy. Despite obvious economic benefits, management at Daqo seemed resigned to the barriers, and more focused on developing solar at its newer plant in Inner Mongolia. We will be following up with the company to see if they can proactively work to get more solar energy as part of the mix in Xinjiang.



Xinjiang province, China. Site tours of Daqo New Energy's factories in the region. The large spherical tanks contain hydrochloric acid, while the cylindrical towers are used for distillation, both needed for the production of polysilicon which is the most important material used in solar modules.



A final impression of Daqo, and of the poly and solar industry at large, was the example it provided of how rapidly profits are reinvested in growth in China, sometimes to the detriment of the sustainability of those profits.

During the solar boom years of 2021-2023, Daqo earned operating cash flows of nearly \$5 billion (USD). It used much of this money to rapidly grow capacity, from 50 kT to 330 kT, spending nearly \$4 billion (USD) in the process. Daqo's competitors and even their suppliers, such as Hoshine, did the same, so that total industry capacity quickly grew from 1.4 MT to 2.2 MT and the industry swung to overcapacity. Currently there is excess inventory in the channel, selling prices are lower than cash costs for all players – even cost-leader Daqo – and capacity is being taken offline, sometimes before it ever produced a single ton of material. This is the case for Hoshine's new 200 kT plant, in Urumqi, which cost the company \$3 billion (USD) and apparently had quality issues in addition to not being cost competitive.

The question of overinvestment and overcapacity was a topic of discussion in all my solar visits. While Canadian Solar and Jinko have, unlike Daqo, managed to stay profitable so far, there is distress across the entire solar value chain even as demand continues to hit new records. Easy finance and local government support exacerbated the overbuilding and ultimately caught the attention of the central CCP government.

Financial conditions for the solar sector have become much tighter, due to either policy directives or reduced local government finances, in combination with reduced access to equity and bank debt markets. There have been a handful of medium-sized bankruptcies already this year, and there is speculation that some bigger top tier companies could yet add to the total.

Bankruptcies, combined with cutbacks among solvent operators, have already reduced effective capacity significantly. Jinko has mothballed the final two phases of its Shanxi plant (total 28 GW integrated), Daqo has reduced production by 50 kT annual rate, and Canadian Solar has reduced its capex budget by more than \$500 million (USD). Other major players, such as Trina or Tongwei, have made still greater reductions. Added to mothballed capacity are some plants that are technologically obsolete, such as p-type or mono PERC solar cells. Overall, my impression was that the industry is going through the most severe rationalization cycle since the early 2010s, and that behaviour was likely to become more disciplined. Prices and margins, while still close to recent lows, are likely in a bottoming process and should improve significantly next year.



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Despite this mixed picture of industry developments in China, I left convinced that the companies we own were among the best financial performers, with a cost advantage and attractive niche exposures, like solar-plus-storage for Canadian Solar and a presence in manufacturing and solar development in the Middle East for Jinko. Anti-China sentiment and weak industry performance due to overcapacity have led to share prices that indicate very favourable risk/reward in these companies, according to our modeling and assumptions. The potential for a recovery from the current cyclical low will determine the accuracy of this thesis.

[†] Source: Daqo new energy labor due diligence report; 2023 Daqo ESG report.

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