



CLIMATE ENERGY FINANCE

China's Leadership in Cleantech Manufacturing is the Necessary Precondition of COP28 Goal to Triple Global Renewable Energy Capacity by 2030

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28 November 2023



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KEY FINDINGS

China's global clean technology manufacturing domination is essential to achievement of a headline COP28 goal – to triple global renewable energy capacity by the end of the decade.

Without China's leadership, there is no plausible path to a tripling of renewables by 2030 nor to limiting global warming to 1.5°C.

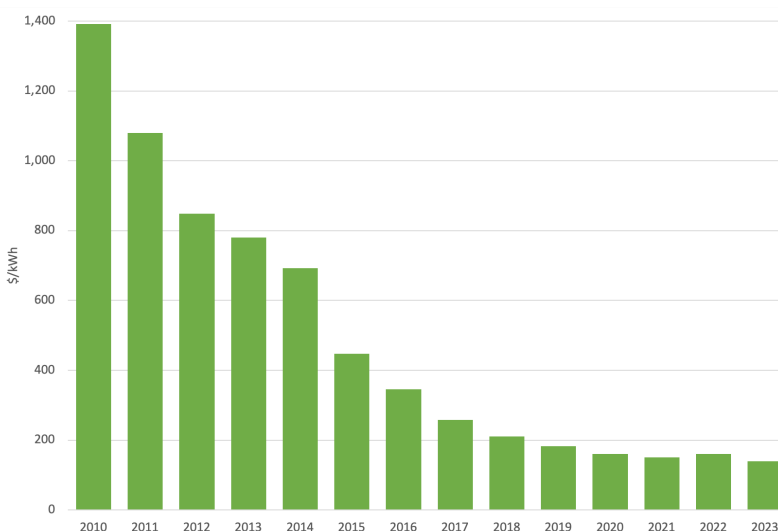
China's decarbonisation ambition has catalysed a surge in the global adoption and installation of low-cost, high-quality technology critical to decarbonising national grid systems and abating inflationary, high-emission fossil fuels.

Domestically, In the first ten months of 2023, China has installed a record 20GW of new wind and solar every month, more than 100% year-on-year (yoy) growth, and five times the installation rate evident in the US by comparison.

In terms of global impact, underpinned by massive investment, the companies we sketch in this briefing are manufacturing and exporting the key components of renewable transition – batteries, solar modules and wafers – at ever greater scale and in ever greater volumes, triggering a massive deflation in prices and accelerating global transition momentum.

Over calendar 2023, for example, as a direct result of the massive increase in manufacturing capacity in China, prices of solar modules, the panels of photovoltaic cells that convert the energy from sunlight into electricity, have [declined by over 40%](#). Likewise, the scaling of production capacity for lithium-ion batteries used in electric vehicles and stationary storage systems has led to a further 14% price decrease in 2023. The weighted-average battery price has [fallen by 90%](#) since 2010.

Figure: Lithium-ion Battery Price Deflation (Source: BloombergNEF)



Note: Values are averages across passenger EVs, commercial vehicles, buses, two- and three-wheelers and stationary storage. Includes cell and pack.

The case studies of companies in this briefing exemplify a bigger phenomenon with dramatic implications for the viability of the world's collective effort to transition to zero-emission energy sources at a scale and pace that aligns with the climate science.

China's speed and scale of cleantech manufacturing investing combines with record research and development (R&D) investment to underpin and facilitate delivery against the world leaders' commitments to renewables growth, economy-wide emissions reduction pathways and fossil-fuel abatement.

This imperative is in sharp focus at the flagship UN climate conference COP28 this month, where a key policy initiative to [triple renewables globally by 2030](#) is [taking centre stage](#).

There is consensus from the International Renewable Energy Agency (IRENA) and the International Energy Agency (IEA) that, in order to maintain the 1.5 degree pathway set out in the Paris Agreement, a tripling of renewables capacity to 11,000 GW by 2030 is required.¹ According to the IEA, it is the single most important driver to keep 1.5C within reach.² 90% of the renewable capacity growth would be from solar and wind, with wind capacity rising threefold from 2022 to 2030, and solar capacity fivefold.³

Reuters has reported that more than 60 countries have backed the pledge, with negotiations with China and India "advanced".⁴ China is on track to deliver on its 1,200GW of renewables by 2030 pledge six years early.

The last [trebling of renewable energy capacity](#) took 12 years from 2010 to 2022. Achieving the ambition of COP28 to triple capacity again, will require the deployment of 11,000 GW of renewable energy capacity in less than 8 years.

Put simply, this goal would be out of reach absent China's massive green industrialisation of the last decade, the unprecedented acceleration of which underpins the financial viability of, and the market conditions to make possible, the global renewables revolution we need to see by 2030 if we are to avert the worsening climate crisis.

In other words, without China's leadership, there is no plausible path to a tripling of renewables by 2030 or to limiting global warming to 1.5°C.

¹ Ember, [Tracking National Ambition Towards a Global Tripling of Renewables](#), November 2023

² IEA, [Tripling renewable power capacity by 2030 is vital to keep the 1.5°C goal within reach](#), July 2023

³ IEA, [Net Zero Roadmap](#), A Global Pathway to Keep 1.5 degrees within reach, @023 Update.

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<https://www.reuters.com/sustainability/climate-energy/over-60-countries-back-deal-triple-renewable-energy-this-decade-officials-2023-11-10/>

1. BACKGROUND: DECARBONISATION IN CHINA

In September 2020, President Xi Jinping announced China's national climate target to peak CO₂-e emissions before 2030, and achieve carbon neutrality before 2060.⁵ Despite coal-fired generation capacity still continuing to expand in China into 2023, deployment of zero emission generation has significantly outpaced fossil fuels in capacity ratio of 4:1.

By 10MCY2023, China added 206GW of zero emission generation capacity, accounting for 83% of all new installations YTD.⁶ Variable renewable energy now accounts for 33% of total national installed capacity as of October 2023. As a result of China's massive renewable scaling up, China could possibly peak its emissions as early as this year, then plateau, significantly ahead of the 2030 target.⁷

The accelerated growth of China's domestic cleantech manufacturing has catalysed record renewable energy generation installs and deployments of grid-firming battery systems, as well as world-leading adoption of electrified transport.

In 2022, global EV sales exceeded 10.6 million, and reached 9.6 million in the 9MCY2023, with 58% of global sales in China.⁸ Of the top 10 EV manufacturers globally, 6 were from China. BYD is the largest global manufacturer of EVs in 2023, with a 20.6% global market share.

EV battery production grew 44% globally in 9MCY2023 to 486GWh. The top 2 EV battery producers globally, China's CATL and BYD, held a collective 52.6% market share of all sales. Of the top 10, 6 Chinese firms produced 63% of all EV batteries globally in 2023.⁹

Across the solar PV value chain, China dominates global solar manufacturing capacity, which has led to drastic price drop for solar power materials including polysilicons and solar modules.^{10 11} By the end of 2022, China has a capacity of 381GW polysilicon, 536GW wafer, 493GW cell and 504GW of modules, representing a global market share of 80%, 97%, 85% and 75% respectively.

A report by OPIS indicates that the price for solar module export has been driven down 40% in 2023, to a record low.¹² In 2023, the IEA forecasts capacity additions of 344GW polysilicon, 237GW wafer, 435GW cell and 249GW of modules.¹³ Chinese solar module exports grew 34% yoy in 1HCY2023 to 114GW, equivalent to the entire installed capacity of the US (113GW).¹⁴

As of the end of October 2023, China has installed wind capacity of 404GW, a 16% yoy increase.¹⁵ China also dominates the global wind turbine manufacturing industry. In 2022, of the

⁵ IEA, [An Energy Sector Roadmap to Carbon Neutrality in China](#), September 2021

⁶ CEF, [Monthly China Energy Update September 2023](#), 30 October 2023

⁷ Carbon Brief, [China's emissions set to fall in 2024 after record growth in clean energy](#), 13 Nov 2023

⁸ SNE Research, [Jan-Sep 2023 Global EV Deliveries](#), 8 October 2023

⁹ SNE Research, [Jan-Sep 2023 Global EV Battery Usage Posted 485.9GWh](#), 7 October 2023

¹⁰ CEF, [Solar pivot: A massive global solar boom is disrupting energy & speeding the transition](#), 14 June 2023

¹¹ PV Magazine, [Solar module prices may reach \\$0.10/W by end 2024](#), 23 November 2023

¹² PV Magazine, [China module prices hit new record lows, operating rates estimated at 60%](#), 21 Nov 2023

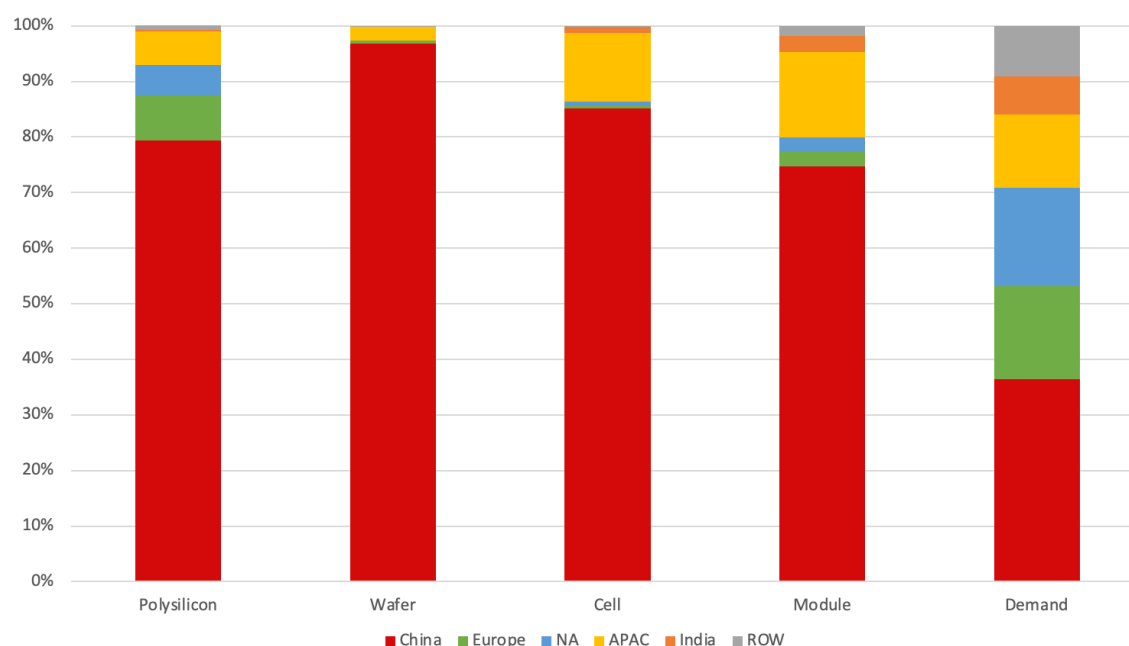
¹³ IEA, [Solar PV Manufacturing Capacity by Component in China 2021-24](#), 24 May 2023

¹⁴ Ember, [Solar Exports from China Increase by a Third](#), 14 September 2023

¹⁵ NEA, [National Energy Administration Releases National Power Industry Statistics](#), 20 November 2023

top 10 global producers, 6 were Chinese firms. China's Goldwind was the largest wind turbine manufacturer in 2022, producing 12.7GW, 15% of wind turbines commissioned globally. Chinese domestic installations accounted for 90% of Goldwind's installs.

Figure: China's Leadership Across Solar PV Value Chain, 2021:



Source: IEA Global Solar PV Supply Chains ¹⁶

A tripling of renewables capacity in China by 2030?

Domestically, China installed 20 GW per month of wind and solar in the first ten months of 2023, a growth rate of over 100% yoy. This means China is on track to deliver on its targeted 1,200GW of RE installs 5-6 years earlier than 2030.

China currently sits at 940GW of RE as of October 2023. Adding 20GW per month takes this to 1,220GW by end 2024. Assuming China continues to increase its install growth rate, a tripling of renewables capacity by 2030 is possible – noting China is working off a high base.

This has profound implications for lower coal use in China well before 2030. While China is adding 50GW of new coal power plants in 2023 alone, CEF's expectation is that their utilisation rate will progressively decline, shifting their role from baseload to RE firming. This in turn has major implications for global decarbonisation.

Elsewhere, we report that [China's CO2 emissions could well fall in 2024](#) with the record increase in installation of zero-emissions energy sources and a recovery in hydropower, combined with China's enormous gains in electrification of transport and electric vehicle (EV) adoption, prefiguring a structural plateauing in China's emissions profile well before the formal target of a peak before 2030.

¹⁶ IEA, [Global Solar PV Supply Chains](#), 5 July 2022

2. CHINA'S CLEANTECH LEADERS

While the growth of China's domestic manufacturing capacity is supporting the burgeoning deployment of zero emission technology in China, China's corporate leaders are also decarbonising global economies by providing world-leading, low-cost cleantech exports at scale. This is a key enabler of a worldwide surge in renewables.

Below, we briefly sketch the efforts of 4 companies that have taken a global leadership position.

Importantly, these companies are also decarbonising their own operations at a pace that outstrips the rest of the world, meaning China is embedding "embodied decarbonisation" in its exports, thereby helping to decarbonise global supply chains.

i. Contemporary Amperex Technology Ltd. (CATL)

Investment, manufacturing and export

CATL (300750.SZ) remains the largest supplier of batteries in EVs and energy storage (ESS) globally in 2023, with a 37% global EV battery market share YTD September 2023, and 43% global ESS market share across 2022.¹⁷ In 2022, CATL had a consolidated annual capacity of 390GWh, producing 325GWh, a 100% rise from 2021. CATL's sales rose 117% to 289GWh.¹⁸

CATL has continued to invest at speed and scale to bring new products and capacity online to facilitate the global decarbonisation of transport and energy grids. In October 2023, CATL's new US\$960m 30GWh Guiyang production base (phase 1) was commissioned.¹⁹ CATL invested a staggering US\$2bn into Research & Development (R&D) in 2022, with 18,000 research staff.²⁰

Embodied decarbonisation

CATL has committed to achieving carbon neutrality in core operations (net zero Scope 1 + 2 emissions) by 2025, with full supply chain decarbonisation by 2035. In 2022, CATL's emissions profile was 451.8kt CO₂-e Scope 1 (2.7%), 1.98Mt CO₂-e Scope 2 (11.6%), and 14.63Mt CO₂-e Scope 3 (85.7%). Purchased electricity accounts for 81% of operational emissions as of 2022.²¹

In 2022, CATL's operational GHG intensity declined by over 28% to 9.99t CO₂-e/MWh of lithium-ion batteries produced.²² Carbon intensity reduction in CATL's battery manufacturing has been driven by increasing penetration of self-generated solar PV. In 2022, CATL generated over 58.4GWh from solar, a 23% increase from 2021, abating 44,677 tCO₂-e from displaced fossil-fuel generation. Across the consolidated CATL group, renewable energy accounts for 26.6% of electricity demand in 2022.

¹⁷ SNE Research, [Battery Sales for EV and ESS 2022](#), 2 March 2023

¹⁸ CATL, [Annual Report 2022](#), 10 March 2023

¹⁹ CATL, [CATL's Guiyang Plant Put into Operation](#), 29 October 2023

²⁰ FT, [Can Anyone Challenge China's EV Battery Dominance](#), 28 August 2023

²¹ CATL, [Carbon Accounting Report](#), 2022

²² CATL, [Carbon Accounting Report](#), 2022

In 2022, 3 production bases are powered from 100% renewable energy in China, including the major 15GW Yibin, Sichuan (CATL-SC) facility.²³ In October 2023, CATL received certification of its fourth zero-carbon factory in Chengdu, Sichuan (CATL-XJ).²⁴

ii. LONGi

Investment, manufacturing and export

LONGi (601012.SS) is the largest solar PV wafer manufacturer in the world, producing 85GW monocrystalline wafer sales in 2022, up 21.5% from 2021. LONGi's module shipments also grew by 21.4% in 2022 to 46.8GW, continuing as the largest module producer globally for the previous 3 consecutive years.²⁵

In 1HCY2023, LONGi produced 52GW of monocrystalline wafers, up 31% from 1HCY2022, with 23GW external sales. Over the same period, module shipments grew 55% to 30GW.

In January 2023, LONGi announced a planned investment of RMB 42.5 billion (US\$6.7bn) into an integrated solar manufacturing hub, with 100GW of wafer capacity and 50GW of cell capacity in Shaanxi province.²⁶ LONGi has signed an investment agreement with the local government of Xixian New District, with commissioning expected by 2025, generating more than 15,000 jobs. In 2022, LONGi invested RMB 7.14 billion (US\$1bn) into R&D, 5.5% of revenue.²⁷

Embodied decarbonisation

LONGi has committed to a 60% reduction in operational emissions by 2030, relative to 2020. In 2022, LONGi's emissions profile was 158kt CO₂-e (Scope 1), 2.93Mt CO₂-e (Scope 2) and 29.75Mt CO₂-e across the value chain. Currently, Scope 2 accounts for 95% of operational GHG emissions.²⁸

LONGi simultaneously joined the RE100 and EV100 climate initiatives, committing to achieving 70% of energy demand sourced from renewable energy by 2027, and 100% by 2028. The EV100 initiative is the aim to install EV charging facilities across 100% of operational sites by 2030. In 2022, renewable energy accounted for over 47% of LONGi's electricity demand, a 17% increase in penetration from 2021 (40%). LONGi's Baoshan manufacturing base is powered by 99% renewable energy in 2022, with the aim to operate as a zero-carbon plant in 2023.

Reaching 100% energy demand sourced from renewable energy by 2028 would abate 95% of LONGi's operational emissions profile by 2028, far outpacing the company's Science Based Targets (SBTi). LONGi has also committed to decarbonising its supply chain, targeting a 52% reduction, per tonne of purchased materials, of Scope 3 emissions by 2030, relative to 2020.²⁹

²³ Note: Yibin production base has received PAS 2060 certification for carbon neutrality since 2021

²⁴ CATL, [CATL Secures its Fourth Zero-Carbon Factory](#), 2 October 2023

²⁵ LONGi, [2022 and 2023Q1 Investor Presentation](#), 28 April 2023

²⁶ PV Magazine, [LONGi Plans New 100GW Wafer Plant, 50GW Solar Cell Factory](#), 18 January 2023

²⁷ LONGi, [Sustainable Development](#)

²⁸ LONGi, [Sustainability Report](#), 2022

²⁹ LONGi, [Sustainable Development](#)

iii. Jinko Solar

Investment, manufacturing and export

Jinko (JKS) is a top 3 global solar module manufacturer, in the 9MCY2023, Jinko produced 52GW of modules, up 83% yoy. It produced 44.5GW of modules in 2022, up 100% from 2021.³⁰

Jinko invests significantly into R&D and capacity expansion each year, lowering the cost of high-quality modules exported globally. In 2022, Jinko invested RMB 5.6 billion (US\$790m) into R&D, 6.8% of the firm's operating revenue.³¹

In June 2023, Jinko announced a US\$7.78bn investment to build a 56GW vertically integrated facility in Shanxi province, a staggering 19 times bigger manufacturing facility than the biggest in construction in the US.³² The production base will be constructed in four phases over two years, with the first two phases set to begin production in 2024.

Embodied decarbonisation

Jinko has committed to a 50% reduction in Scope 1 + 2 emissions by 2032, relative to 2022. Additionally, a commitment to reduce Scope 3 emissions by 58% per MW of modules, cells and wafers produced by 2032, relative to 2022. Jinko announced its commitment in November 2021 to achieving net zero GHG emissions across Jinko's value chain by 2050.

In 2022, Jinko's emissions profile was 59.9 kt CO₂-e (Scope 1), 3.15Mt CO₂-e (Scope 2) and 17.13Mt CO₂-e (Scope 3).³³ Scope 2 emissions were responsible for 98% of operational emissions. Jinko has significantly ramped up its fossil-fuel abatement strategy, targeting 100% renewable energy in all manufacturing plants and global operations by 2025.

iv. Trina Solar

Investment, manufacturing and export

China's Trina Solar (688599.SS) is another leading global solar manufacturer. In 2022, Trina shipped 43GW of modules.³⁴ In the 9MCY2023, Trina produced 45GW of modules, 56% growth yoy, ranking as the second largest manufacturer globally.³⁵

Embodied decarbonisation

Trina has set an ambitious decarbonisation target to reduce Scope 1 + 2 GHG emissions intensity of PV products (cells and modules) by 50% in 2025, relative to 2020.³⁶ LONGi recorded its emissions profile in 2022 at 19.3kt CO₂-e (Scope 1), 1.17Mt CO₂-e (Scope 2) and 17.1Mt CO₂-e (Scope 3).

³⁰ Jinko, [Q4 2022 Earnings Call Presentation](#), 10 March 2023

³¹ Jinko, [Jinko ESG Report](#), 2022

³² PV Magazine, [Jinko to Build 56GW Vertically Integrated PV Factory](#), 16 June 2023

³³ Jinko, [Jinko ESG Report](#), 2022

³⁴ Trina, [Trina Solar Reports Increase of 83% in YoY Revenues](#), 28 April 2023

³⁵ Trina, [Trina Solar Boosts Revenue and Shipments During First Nine Months of 2023](#), 2 November 2023

³⁶ Trina, [Corporate Social Governance Report 2022](#), 12 June 2023

Trina's targets will be achieved by a combination of energy efficiency improvements, and increasing the sourcing of renewable energy. Trina has targeted a 40% decrease in energy consumption per MW of solar PV productions by 2025, relative to 2020. Further, Trina has committed to using 100% renewable energy in global manufacturing and operations by 2030.

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