



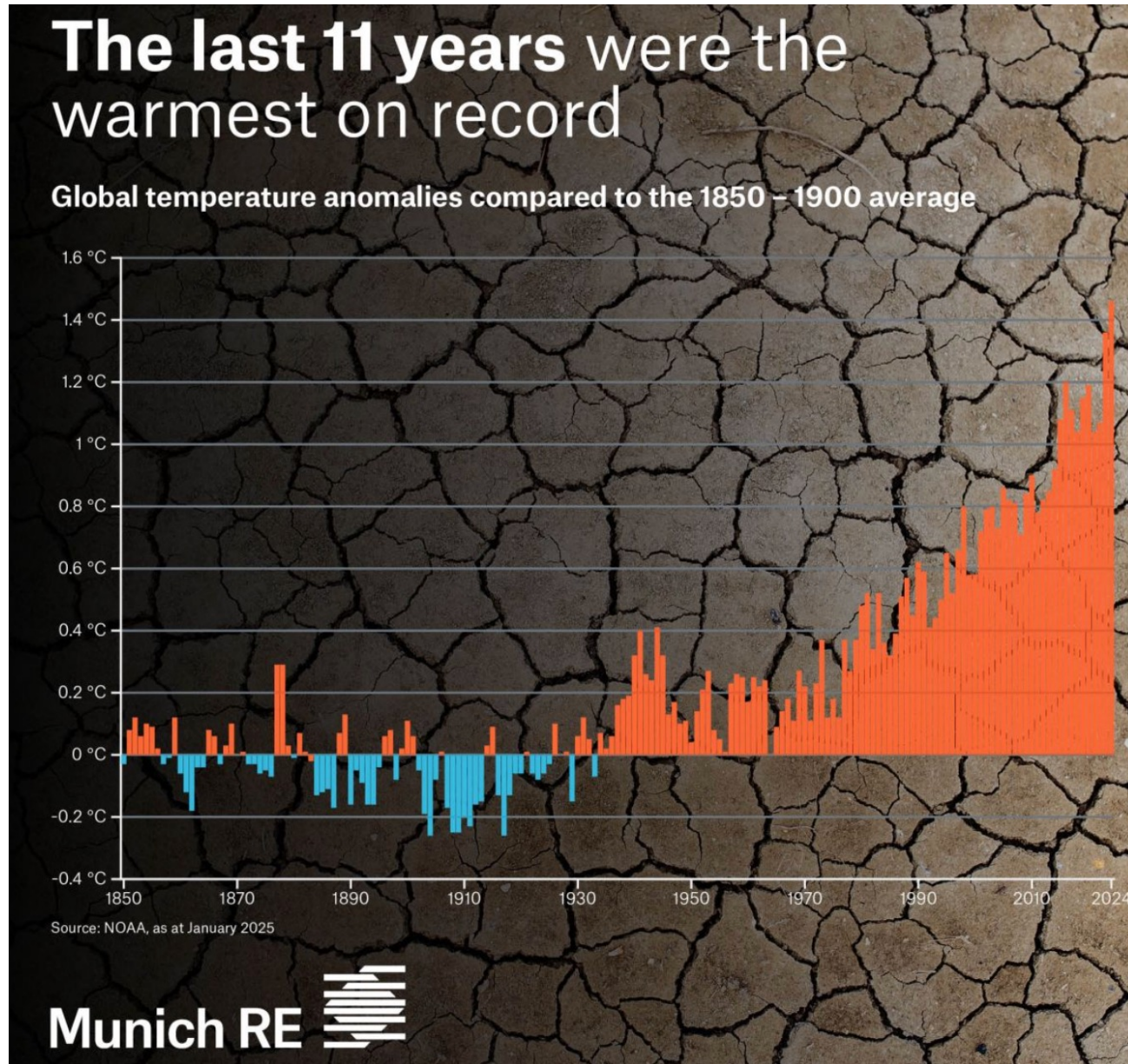
Tim Buckley, Director CEF
tim@climateenergyfinance.org

UTS Finance Honours

**The Global Energy System
Transformation**

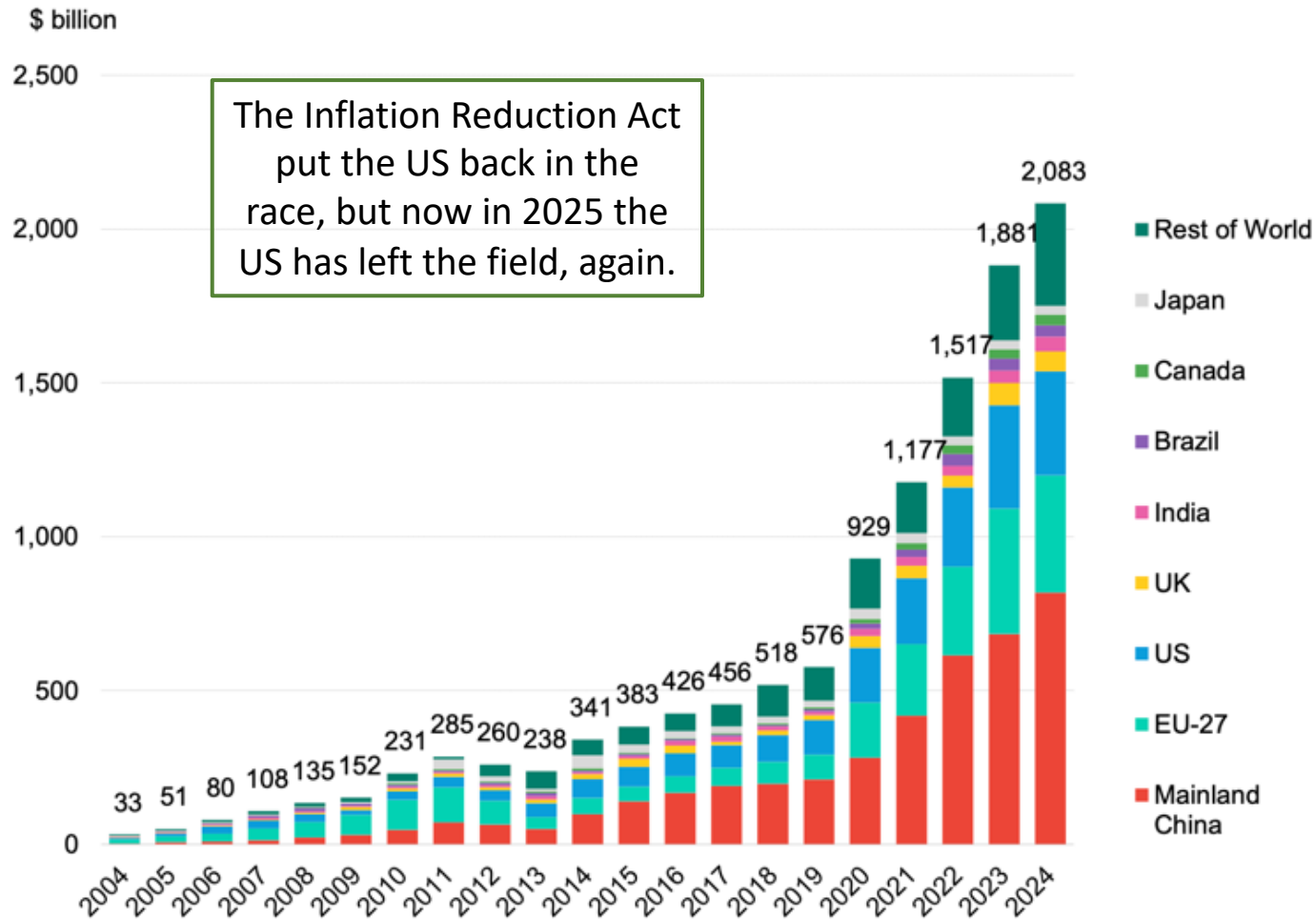
16 May 2025

CEF acts on the basis of the climate science



Global Cleantech Investment Dominance

The world invested US\$2.1 trillion in cleantech in 2024, +11% yoy

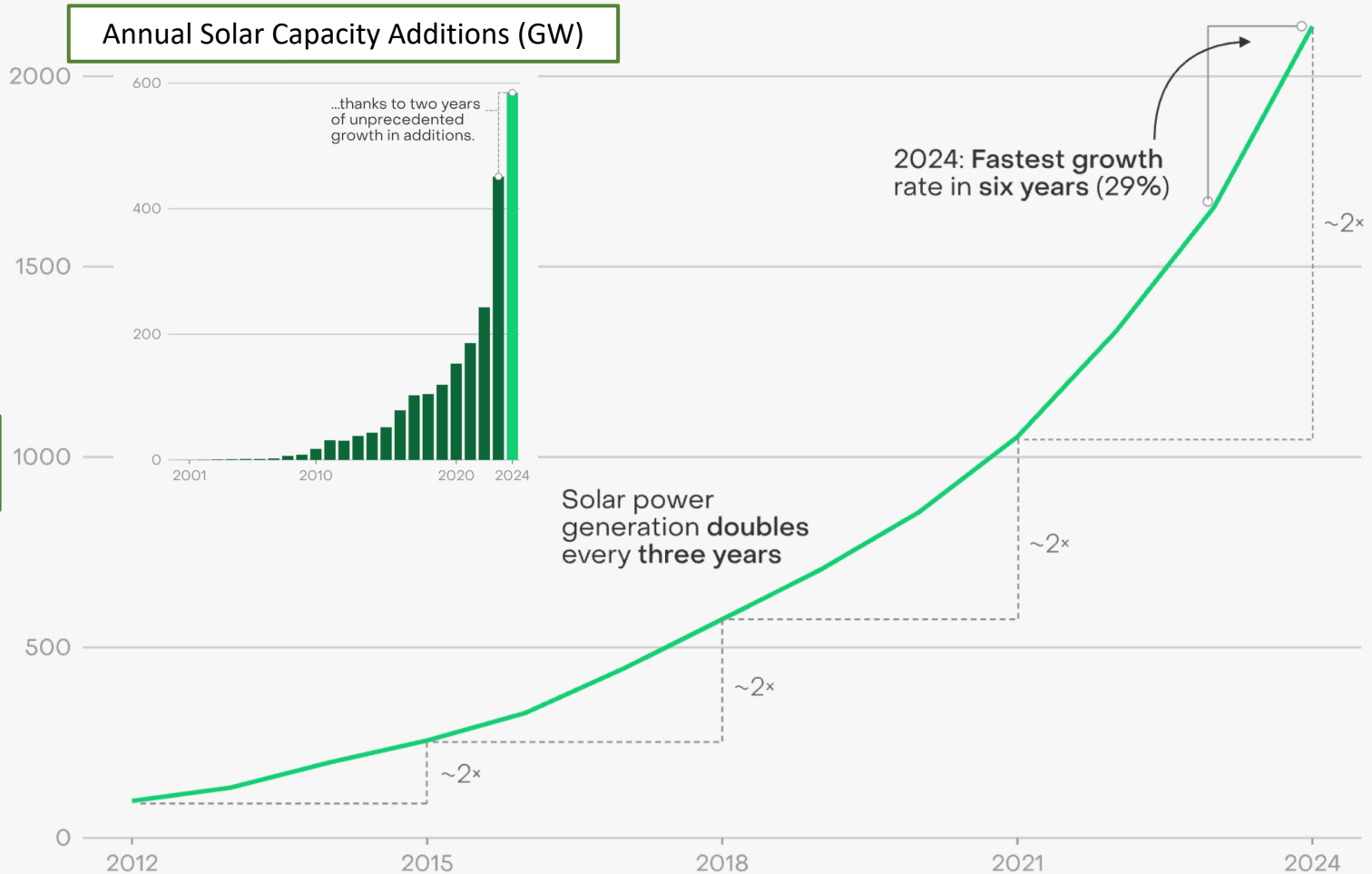


Source: BloombergNEF. Note: Start-years differ by sector, but all sectors are present by 2020. The step-change in 2020 is caused in part by the addition of power grids into the scope from that year onward.

Cleantech Investment Dominance

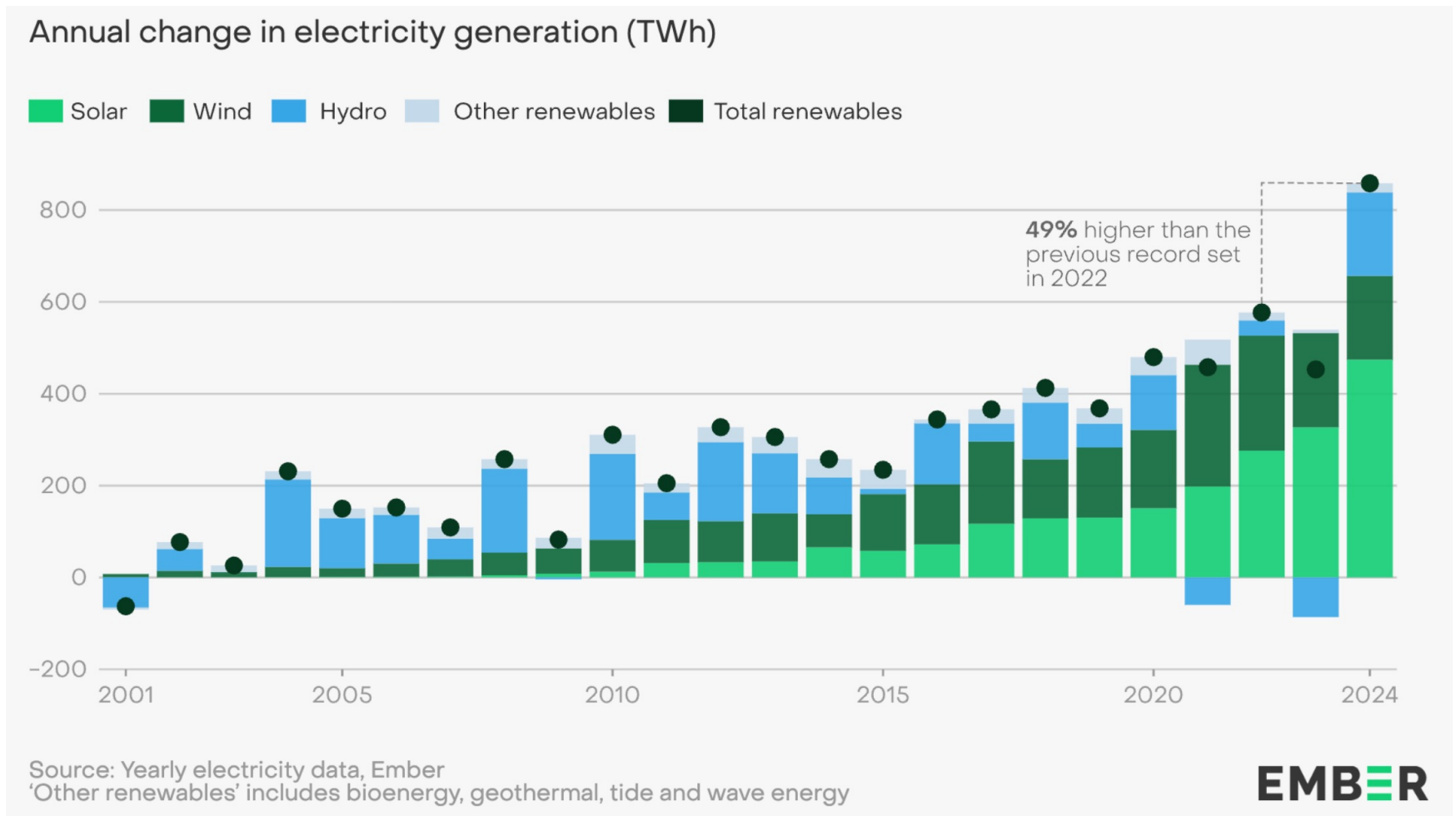
Global solar power is doubling every three years.

Electricity generation from solar power (TWh)



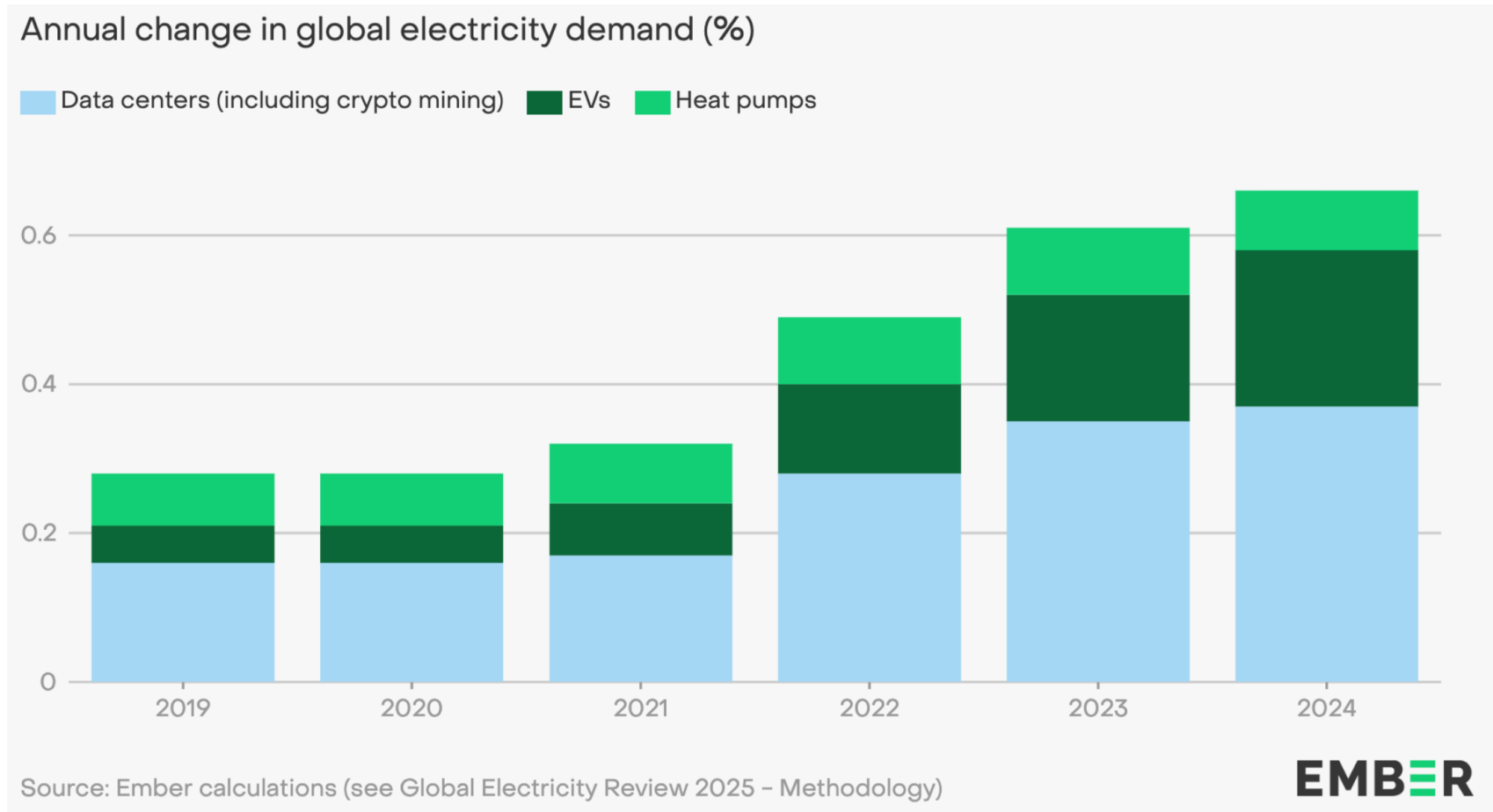
Cleantech Investment Dominance

In 2024, renewable power sources collectively added a record 858 TWh of generation – a 49% increase over the previous record of 577 TWh set in 2022. 2024 renewables met 75% of electricity demand growth globally.



Cleantech Investment Dominance

Electrification of everything is a major driver of global electricity demand, replacing oil & gas demand (e.g. cars). Data centres, EV and heat pumps are contributing twice as much demand growth as they were 5 years ago.

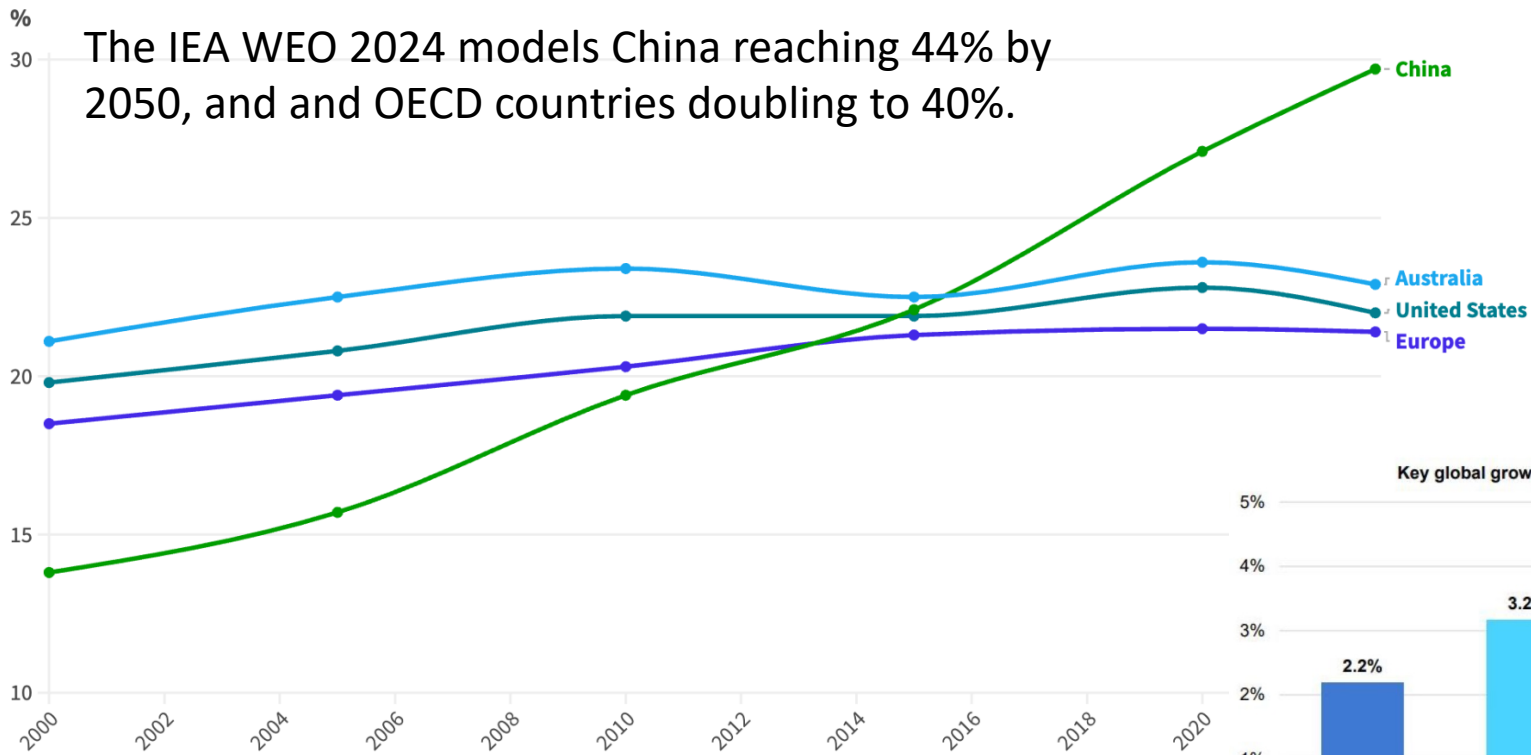


China's Electrification of Everything

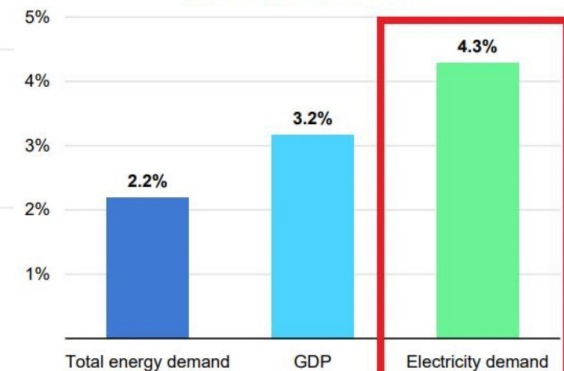
China Leads the world on Progressive Electrification of Everything

Share of final energy from electricity

China has leapfrogged United States, Europe and Australia in electrification



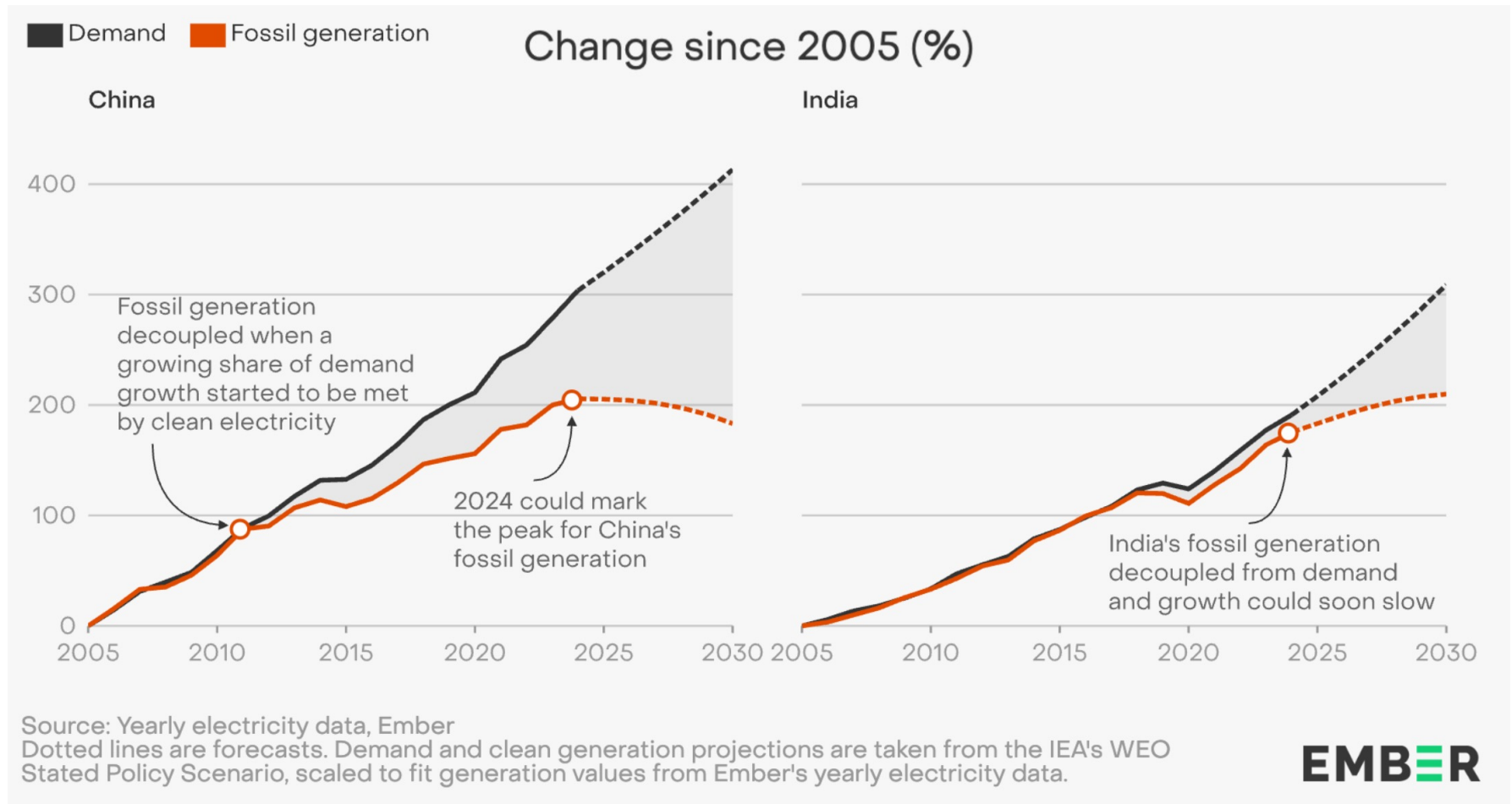
Key global growth rates, 2024



Source: CEF calculations, [Enerdata](#)

Cleantech Investment Dominance

Fossil generation has decoupled from electricity demand growth in China (since 2014) & India (2024/25) due to accelerated pace of clean deployments

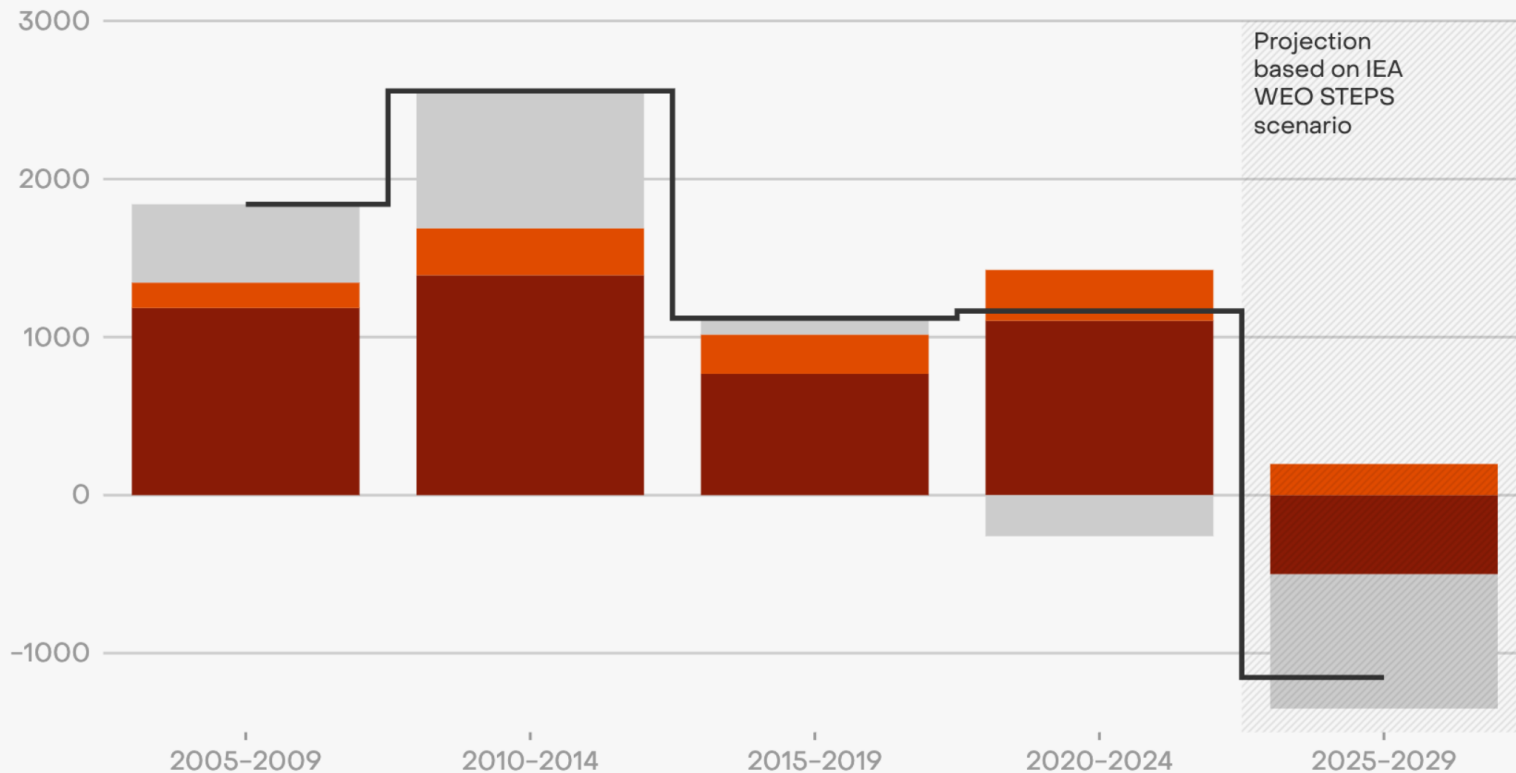


Cleantech Investment Dominance

China & India led global fossil fuel electricity generation in the last two decades, but this is about to change.

Change in annual electricity generation from fossil fuels (TWh) over five-year periods

World China India Rest of world



Source: Yearly electricity data, Ember, IEA Stated Policy Scenario (STEPS)

China is Moving in Decarbonisation, Rapidly

China leads the world in firmed renewable energy globally, by far, adding another 76.5GW of renewables capacity in 1Q CY2025 YTD.

New Capacity Installed in China in Jan-Mar 2025

		Jan-Mar 2025	% Share of new adds	% yoy change	Mar-25	% Share of new adds
Thermal Power	GW	9.3	11%	45%	5.6	18%
Hydropower	GW	2.1	2%	18%	0.8	2%
Nuclear Power	GW	-	0%	0%	-	0%
Wind Power	GW	14.6	17%	-6%	5.5	17%
Solar Power	GW	59.7	70%	31%	20.2	63%
Total capacity added	GW	85.7	100%	23%	32.0	100%
Renewable Energy adds	GW	76.5	89%	21%	26.4	82%
Zero Emissions Capacity Adds	GW	76.5	89%	21%	26.4	82%
YTD power grid investment	US\$bn	13		25%		

Source: National Energy Administration, CEF calculations

China is Moving in Decarbonisation, Rapidly

China is still adding flexible coal power plants, but utilization rates are down to average just 47% in 1QCY2025, balancing ever more VRE!




China's Electricity Generation Mix in Jan-March 2025

		Jan-Mar 25	% Change yoy	Share of generation	Mar-25	% Change yoy
Thermal Power	TWh	1,494	-4.1%	61%	497	-1.7%
<i>Coal</i>	TWh	1,421	-4.1%	58%	473	-1.7%
<i>Gas</i>	TWh	69	-4.1%	3%	23	-1.7%
<i>Other Thermal</i>	TWh	4	-4.2%	0%	1	-1.4%
<hr/>						
Bioenergy	TWh	47	-4.1%	2%	16	-1.8%
Hydropower	TWh	226	7.2%	9%	79	10.5%
Nuclear Power	TWh	117	12.8%	5%	43	23.0%
Wind Power	TWh	307	14.8%	13%	114	14.1%
Solar Power	TWh	254	44.7%	10%	93	31.1%
TOTAL POWER GENERATION	TWh	2,445	3.4%	100%	841	5.3%
Variable Renewable Generation	TWh	561	26.7%	23%	207	21.2%
Zero Emissions Power Generation	TWh	951	17.9%	39%	344	17.5%



Source: National Bureau of Statistics, Ember, CEF Estimates

New Energy Vehicles & BESS

NEV & BESS momentum has accelerated to-date in 2025

- Global EV sales were  29% yoy in 4M CY2025
- EU EV sales were  25% yoy in 4M CY2025
- China EV sales were  35% yoy in 4M CY2025
- North American EV sales were +5% yoy in 4M CY2025

- BYD global NEV sales in 1QCY2025 were 1,000,804 vehicles, +60% yoy.
- Tesla's global sales were -13% yoy 1QCY2025, delivering 336,000 vehicles

- BYD global BESS sales in 1QCY2025 were a record 52.6GWh, up  77% yoy.
- Tesla 1QCY2025 deployed 10.4 GWh of energy storage products,  157% yoy

Solar + BESS => Accelerated Transition

Massive deflation, manufacturing capacity expansion and technology development: Solar + BESS => Accelerated Energy System Disruption



CLIMATE ENERGY FINANCE

International Solar PV and BESS Manufacturing Trends

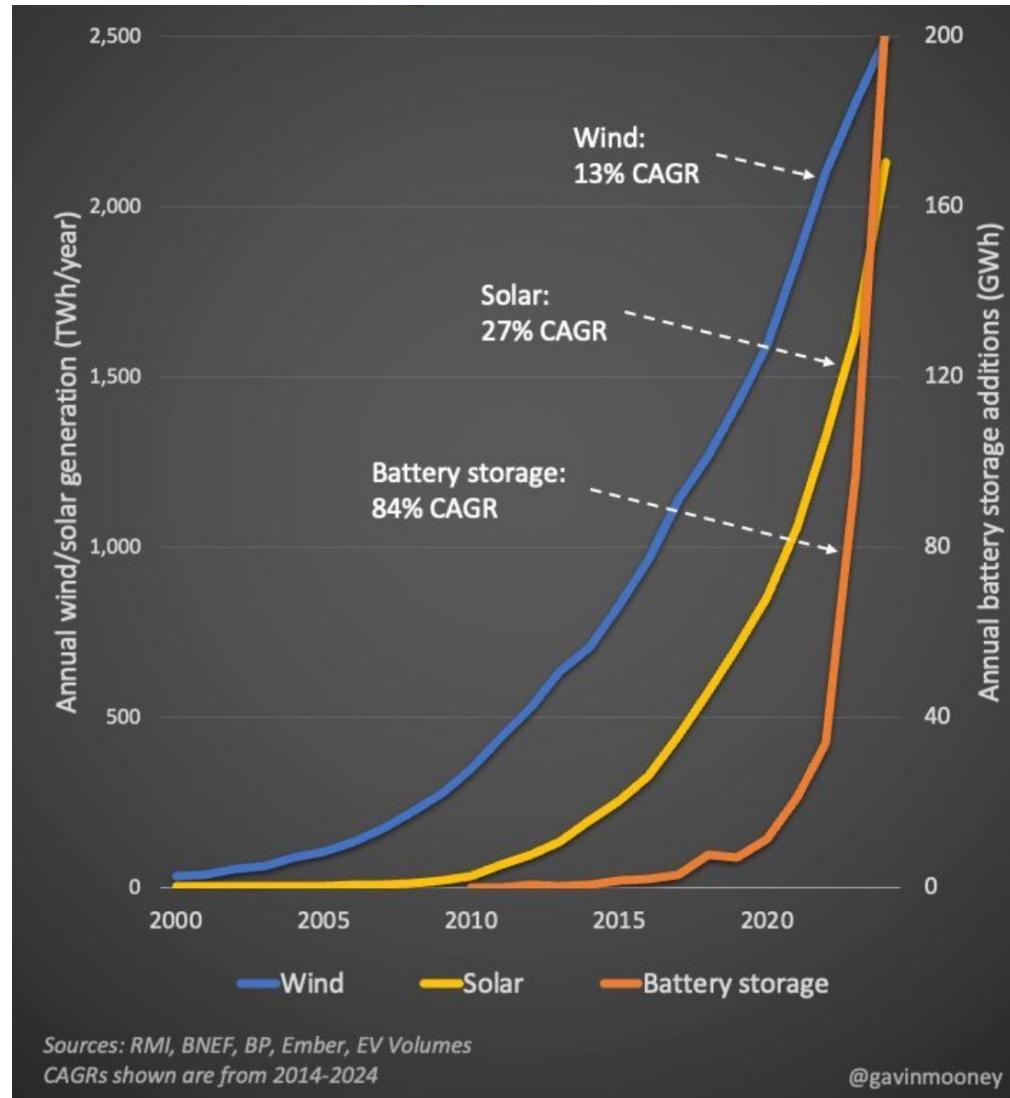
Solar PV's disruption is happening at a speed beyond imagination, turbocharged by BESS firming



Lead author: Harry Martin, Analyst, CEF (harry@climateenergyfinance.org)
Caroline Wang, China Energy Policy Analyst, CEF (caroline@climateenergyfinance.org)
Tim Buckley, Director, CEF (tim@climateenergyfinance.org)

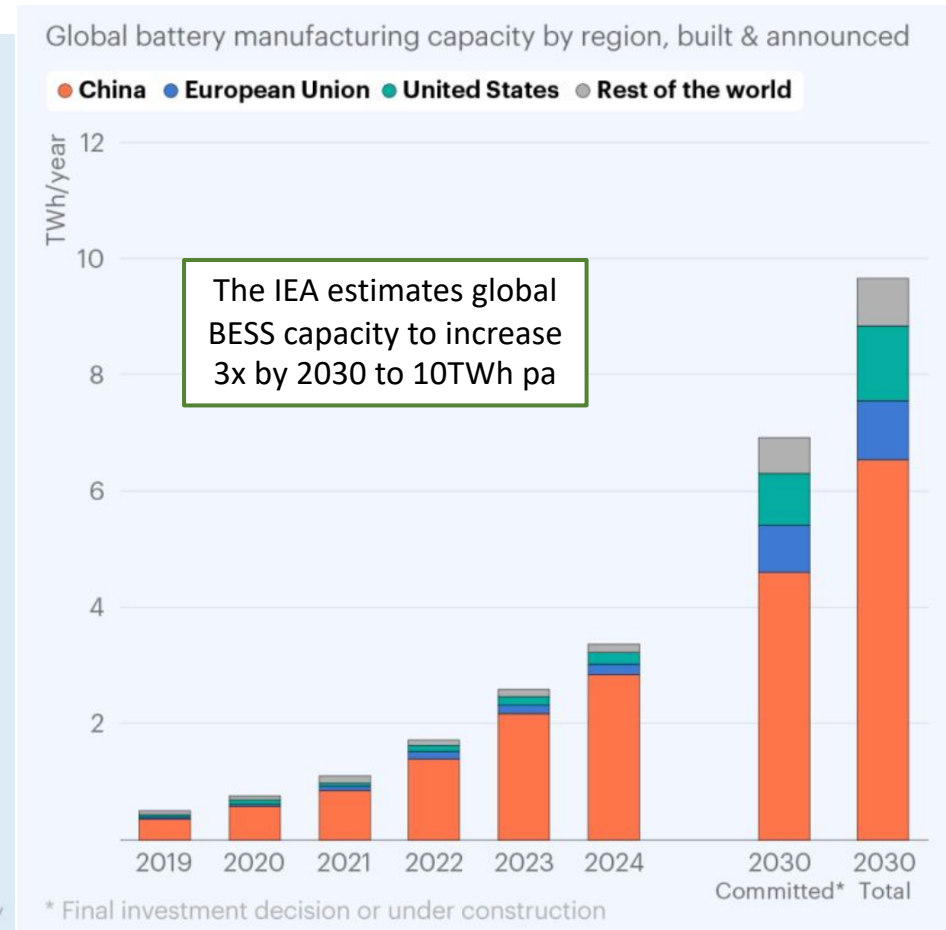
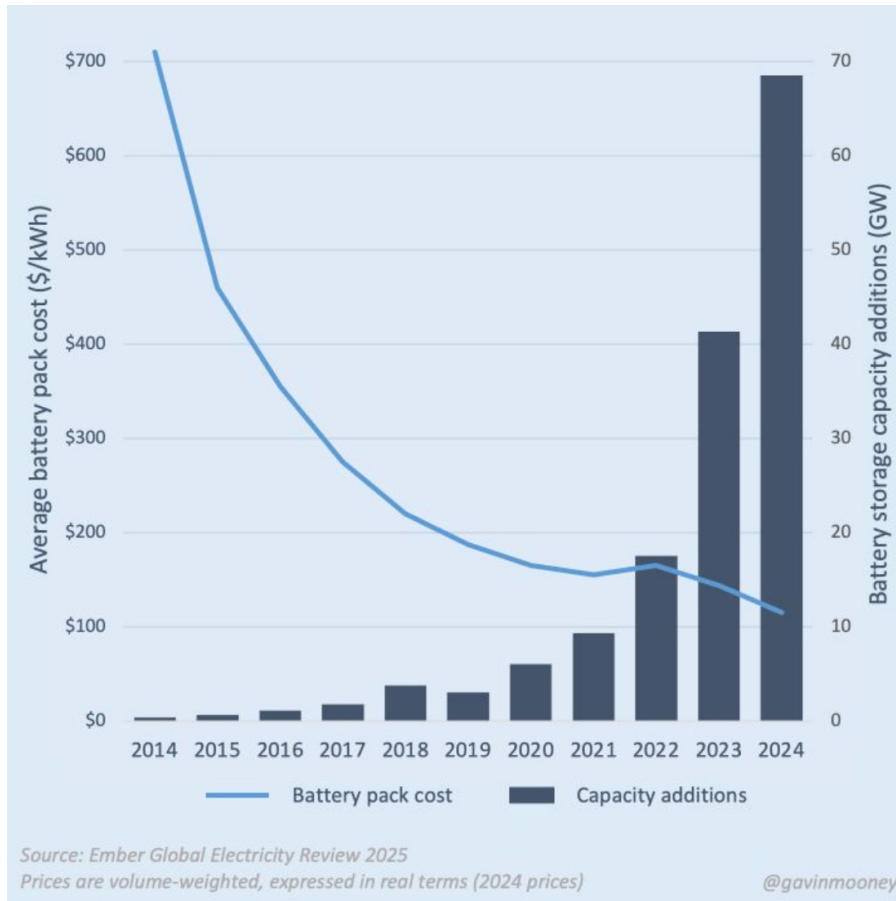
Global Cleantech Investment

As Battery Prices have Fallen, global Installations have Taken Off
Solar + BESS + V2G => Accelerated Energy System Transformation



Global Cleantech Investment

As Battery Prices have Fallen, global Installations have Taken Off
Solar + BESS + V2G => Accelerated Energy System Transformation



Source: Gavin Mooney

https://www.linkedin.com/posts/gavinmooney_batteries-energy-sustainability-activity-7322389965185712129-ssdP?utm_source=share&utm_medium=member_desktop&rcm=ACoAAAK_xL4BN5TFix7F-X4g0YfwtHJ1QLTvZoQ

Cleantech Investment Dominance

China & India led global fossil fuel electricity generation in the last two decades, but this is about to change.

Reliance Power to build 930 MW of solar with 1.86 GWh of battery storage

Reliance Nu Suntech says it will build a 930 MW solar project with 465 MW/1,860 MWh of battery storage to deliver four hours of peak power daily at a fixed tariff of INR 3.53 (\$0.042)/kWh. The project aims to provide assured supply at competitive rates.

MAY 5, 2025 **UMA GUPTA**

MARKETS

MARKETS & POLICY

ASIA

INDIA

Reliance NU Energies secures 525 MW solar-plus-storage project in SJVN tender

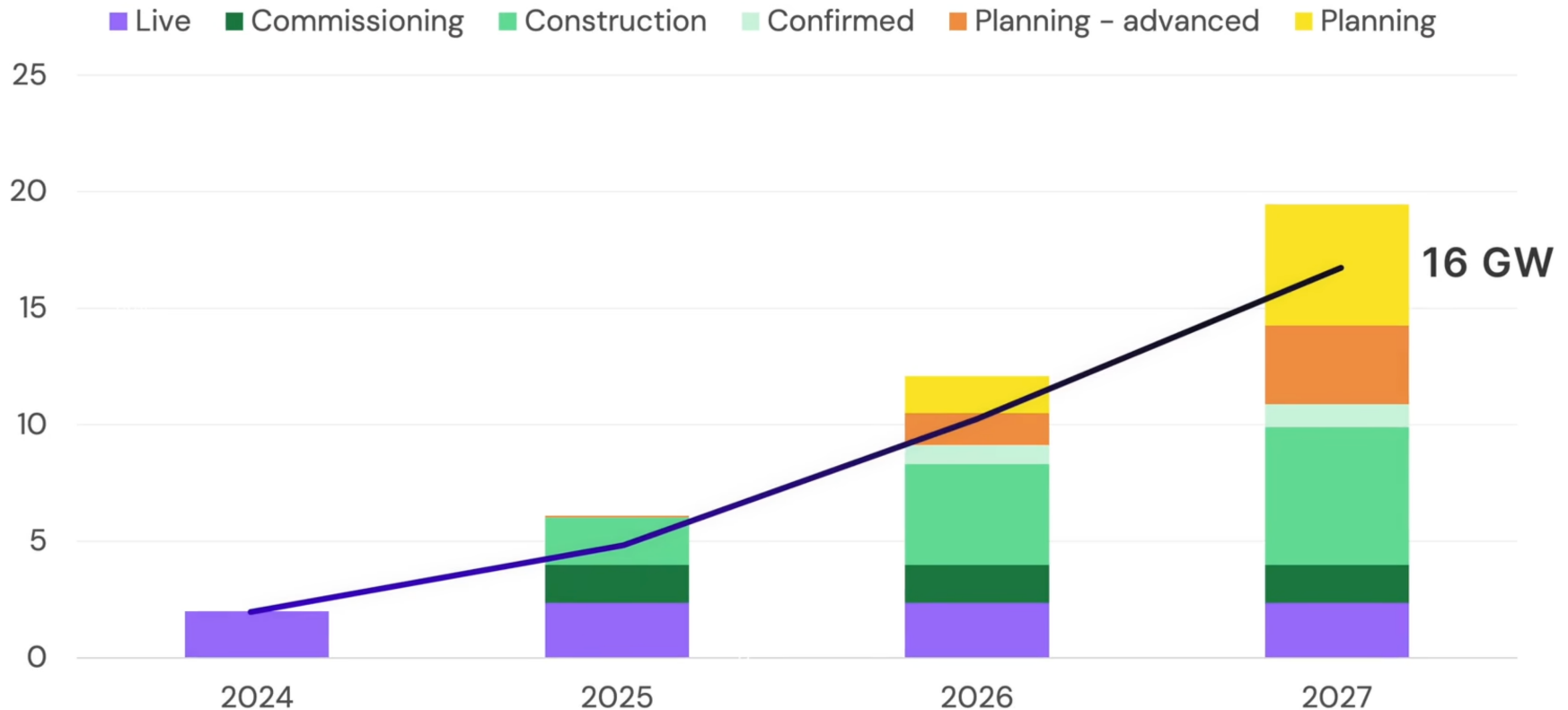
The allocation includes 350 MW of solar generation capacity and 175 MW/700 MWh of battery energy storage system capacity. The tariff for the project has been discovered at ₹3.33 per kWh for a 25-year period.



Global Cleantech Investment

Australian BESS uptake is at record levels, soon to be boosted again by the Federal government's \$2.3bn 30% battery rebate

Cumulative operational and pipeline battery energy storage capacity by current status (GW)



MODOENERGY

Source: Wendel Hortop, Modo Energy 8 May 2025

https://www.linkedin.com/posts/wendel-rhys-hortop_355-mw-of-new-bess-capacity-coming-online-activity-7325278123048984577-91bO?utm_source=share&utm_medium=member_desktop&rcm=ACoAAAK_xL4BN5TFIx7F-X4g0YfwtHJ1QLTvZoQ

China's US\$165bn Cleantech ODFI since 2023

China's response to the growing US anti-China trade barriers: US\$165bn of Outbound Foreign Direct Investment in Cleantech, Globally

China's great green march across the globe

The Middle Kingdom wants to control the global clean-tech sector. Can it save the planet, too?

BY TAN DAWN WEI, DAVID FOGARTY AND WAHYUDI SOERIAATMADJA | PUBLISHED: MAR 22, 2025

THE STRAITS TIMES

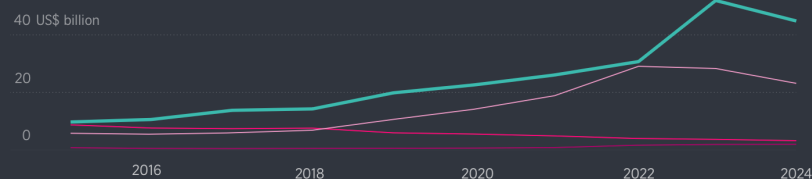
BEIJING/SINGAPORE/JAKARTA – On the outskirts of the Indonesian city of Semarang in Central Java, a new factory is cranking out solar cells and assembling solar panels with the help of robots, while autonomous carts whizz around ferrying parts and components.

The Trina Mas Agra Indonesia solar panel plant, operational since October 2024, is a US\$100 million joint venture between China's Trina Solar, Indonesian conglomerate Sinar Mas and Indonesian state utility PLN.

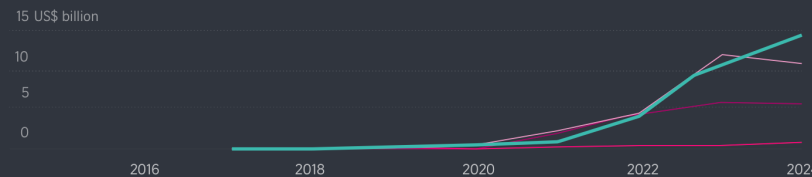
With an annual one gigawatt (GW) total panel capacity that is set to increase to 3GW, the plant is the first and largest integrated solar cell and solar panel manufacturer in Indonesia. It is helping to accelerate a much-needed energy transition in South-east Asia's largest economy, and could in future bring green electricity to Singapore.

The **Global South** has emerged as a major destination for Chinese clean-tech exports, vying with the **EU**, **US** and **UK**.

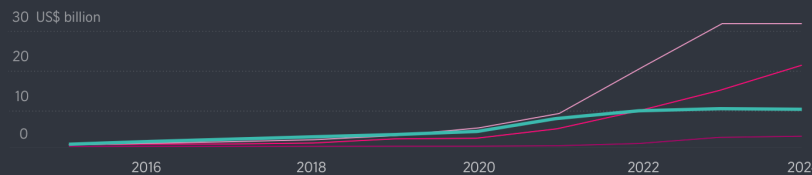
Solar



Electric vehicles



Batteries



Source: CEF Report: **China Outbound FDI, Oct'2024**

<https://climateenergyfinance.org/wp-content/uploads/2024/10/final--CEF-Report-China-Outbound-FDI-2-October-2024-2.pdf>

The Straits Times 22 March 2025: <https://www.straitstimes.com/multimedia/graphics/2025/03/china-great-green-march-globe/index.html?shell>

The World is Responding to US Isolationism

As the US self-isolates and embraces climate science denialism, this opens new options for strategic alliances

China, Japan, S. Korea Renew Free-Trade Call, Vow to Build Ties

By [Yoshiaki Nohara](#) and [Soo-Hyang Choi](#) 30 March 2025 Bloomberg

Trade chiefs from China, Japan and South Korea renewed their call for an open, fair flow of goods and pledged to deepen economic ties, a few days before the Trump administration is set to unleash fresh tariffs on nations around the world.

South Korea's Industry Minister Ahn Duk-geun and his counterparts, Yoji Muto of Japan and China's Wang Wentao, discussed a free trade agreement in Seoul. While they didn't signal significant progress toward a pact, the gathering demonstrated increasing willingness among the three countries to strengthen ties as they face the impact of US tariffs.

"We especially recognized the need for ongoing trilateral economic and trade cooperation to effectively address emerging challenges and achieve tangible outcomes in key areas," the ministers said in a joint statement.

UK and China restart meaningful climate change dialogue

Energy Secretary calls for action and cooperation from China to tackle the climate emergency.



From: [Department for Energy Security and Net Zero](#) and [The Rt Hon Ed Miliband MP](#)

Published 14 March 2025

Joint statement between the people's Republic of China and the French Republic on climate change on the occasion of the tenth anniversary of the Paris Agreement

27 March 2025 The People's Republic of China and the French Republic:

Considering the urgency of responding to the climate crisis and its impact on ecosystem, civil society and global economy, and recognizing the indispensable role of international cooperation in implementing the three Rio Conventions, the Kyoto Protocol, the Paris Agreement, the Kunming-Montreal Global Biodiversity Framework and the United Nations Sustainable Development Goals.

Reiterating the strong commitments to enhance international cooperation on climate change and uphold multilateralism, and the firm support for the Paris Agreement and its temperature goal of holding the increase in the global average temperature well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels.



Source: CEF Oped: [Caroline Wang, April 2025 "If Australia is serious about becoming a renewable energy superpower, China must be part of the answer"](#)

<https://www.lowyinstitute.org/the-interpreter/if-australia-serious-about-becoming-renewable-energy-superpower-china-must-be-part>

The World is Responding to China's Challenge

**The European Commission announced another €100bn
for clean industrial investments**

Europe's clean industrial future

27 February 2025

Yesterday, one of the year's most awaited legislative pronouncements was unveiled, as European Commission President Ursula von der Leyen [presented the EU Clean Industrial Deal](#) — a roadmap to strengthen Europe's industrial competitiveness & accelerate decarbonisation.

Bringing together energy-intensive industries & clean-tech innovation, the **Clean Industrial Deal** sets the course for a climate-neutral and resilient European economy. Landing as a response to geopolitical tensions, economic slowdowns, and increasing global competition, the deal has been labelled a big win for clean-tech manufacturers and industrial decarbonisation aiming to ensure that Europe's industries remain at the forefront of the green transition. Key initiatives are:

- €100+ billion mobilised for clean industrial investments, including a new Industrial Decarbonisation Bank.
- Made in Europe” incentives to ensure EU procurement prioritises sustainable, locally produced clean tech.
- Support for energy-intensive sectors (steel, cement, chemicals) to cut emissions while maintaining competitiveness.
- An [Affordable Energy Action Plan](#) to lower energy bills for industries, businesses and households and speed up the roll-out of clean energy and accelerate electrification and interconnectivity, making the link between security of supply and competitiveness abundantly clear.
- Looser state aid rules to help industries transition to low-carbon production and green manufacturing.
- New Circular Economy & Raw Materials Plan in 2026 to reduce waste and secure key industrial materials.
- Skills & workforce development to create new green jobs in industrial regions.
- Carbon Border Tax (CBAM) adjustments to protect EU industries from carbon-intensive imports.

Australia is Responding to China's Challenge

Strategic public capital is a key facilitator, in the absence of a CO₂ price signal

FMIA, CIS, RTN, NRF, Future Fund, CEFC, ARENA, EFA, NAIF

Capacity Investment Scheme

The Capacity Investment Scheme (CIS) is an Australian Government revenue underwriting scheme to accelerate investment in:

- 23 GW of renewable capacity representing \$52 billion in investment
- 9 GW of clean dispatchable capacity representing \$15 billion in investment.

South Australia

Australian
Associated Press

20 Feb 2025

Troubled Whyalla steelworks gets
\$2.4bn government bailout as hunt for
new owner begins

**“Crucial support:” Federal Labor launches \$2bn green
aluminium production credit scheme**



RENEW ECONOMY

Andrew Brown

Jan 20, 2025

**Rio Tinto says aluminium could run
on renewables and batteries**

FINANCIAL REVIEW

Feb 6, 2025

\$19bn Rewiring the Nation Fund

The \$19 billion Rewiring the Nation (RTN) Fund is a significant expansion of CEFC investment capacity, with a particular focus on facilitating the timely delivery of grid and transmission projects, using CEFC capital to accelerate the benefits of grid transformation to consumers, including helping to lower consumer energy costs.

**\$200 million investment in critical
minerals to build Australia's future**

15 January 2025

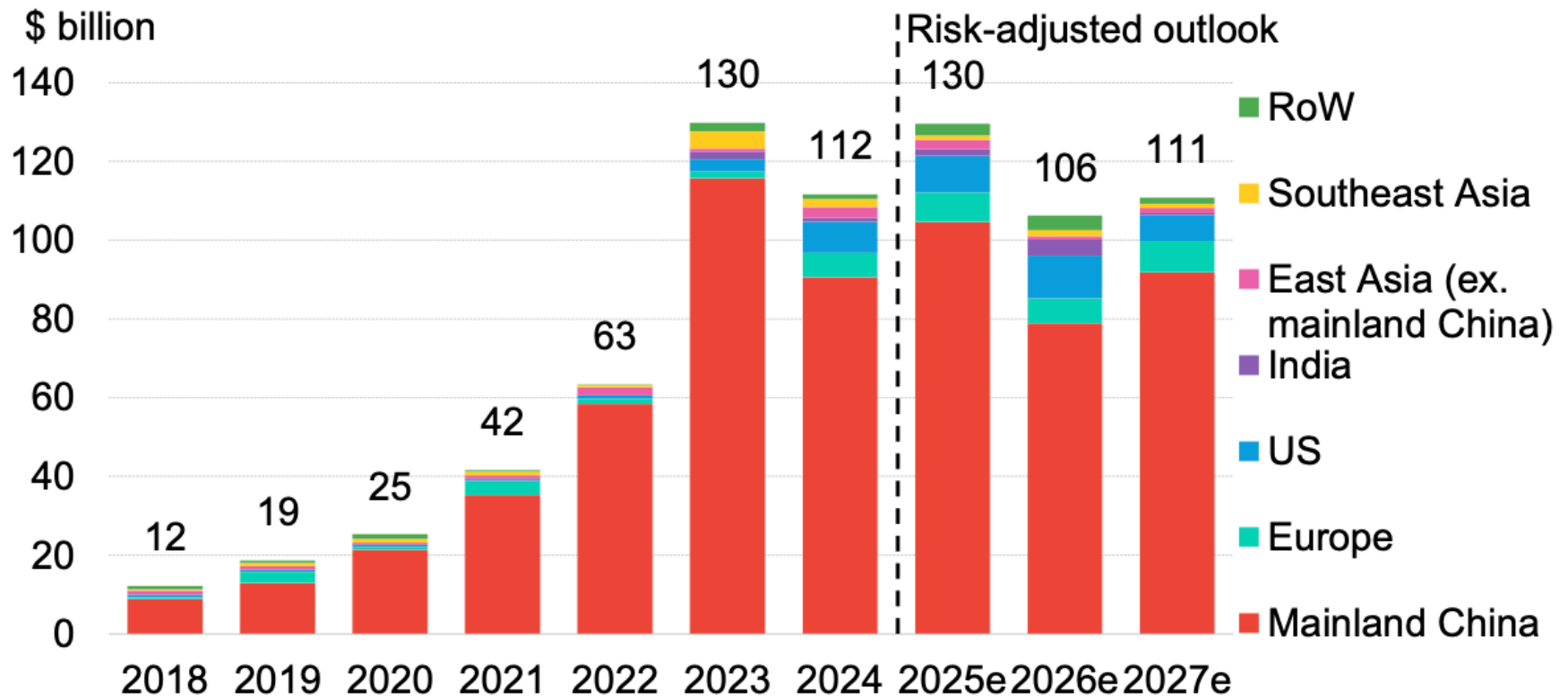
The Hon Ed Husic MP

Minister for Industry and Science

The Albanese Government's National Reconstruction Fund Corporation (NRFC) will invest \$200 million in Arafura Rare Earths to help build Australia's Future.

China's Cleantech Investment Dominance

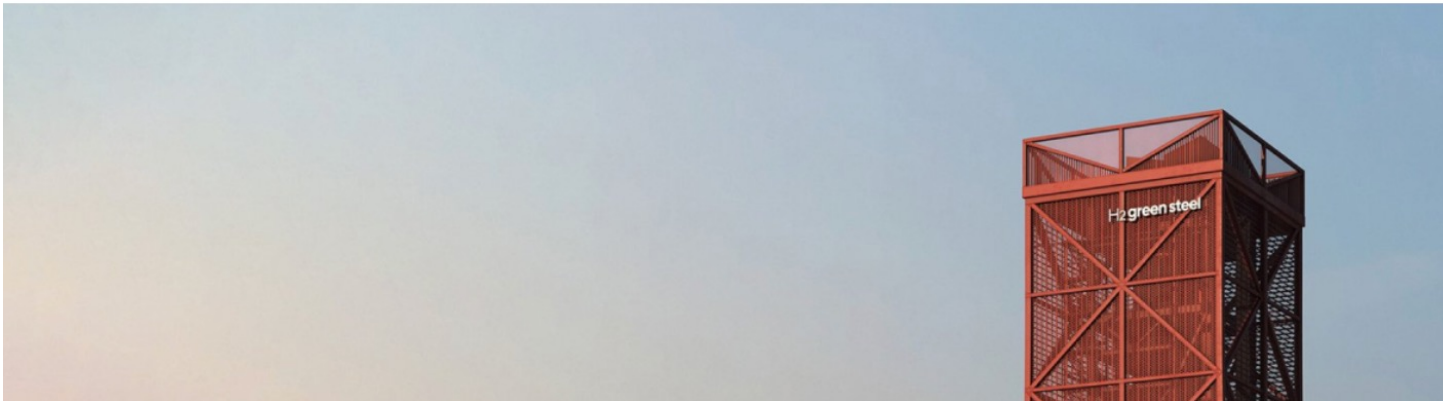
Global clean-tech factory investment by geography



BloombergNEF

Green Metal Statecraft: Forging Australia's Green Iron Industry

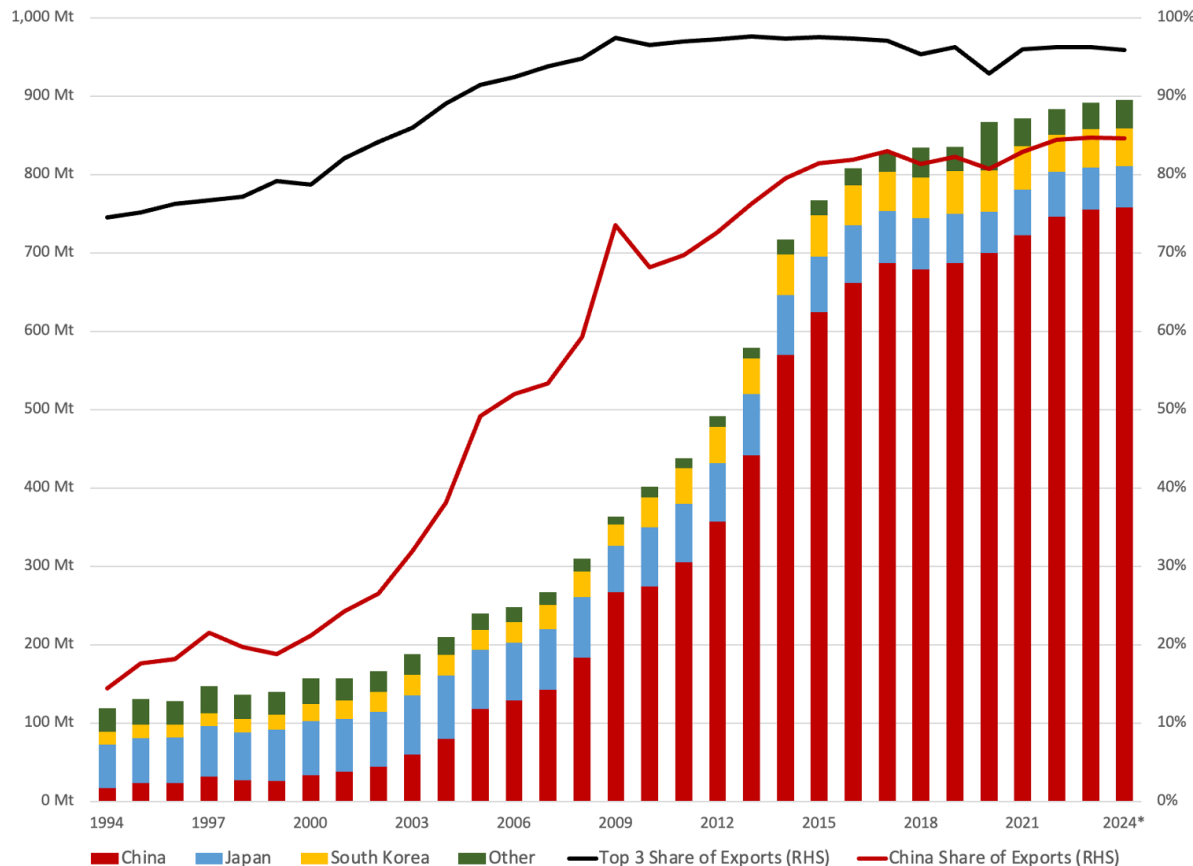
Matt Pollard, Net Zero Transformation Analyst, CEF
Tim Buckley, Director, CEF



https://climateenergyfinance.org/wp-content/uploads/2024/11/CEF_Green-Metal-Statecraft_FINAL.pdf

Australia – a massive economic threat, but also a massive strategic opportunity

Australia's Iron Ore Export Markets



China accounted for 85% of Australia's A\$138bn pa of iron ore exports, having delivered +6% CAGR in volume over the last decade. This has been a key partnership of profound strategic value for Australia.

But Chinese steel production likely peaked in 2020 (China's steel output was -3% yoy in 2024), scrap use is rising, and China is diversifying into Simandou, Guinea (120Mtpa).

Source: Office of the Chief Economist

Note: 2024 is annualised from 1H2024