



CLIMATE ENERGY FINANCE

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**Renewable Energy &
Critical Minerals
Superpower**

**ANU 2023 Rare Earth
Conference**

15 November 2023

Embodied Decarbonisation: How renewables can supercharge Australia's value-add critical minerals boom

1. The Global Energy Transition
2. Energy Transition: China leads the world; and this is a global technology and investment race
3. The US IRA Changes Everything – A race to the top
 - South Korea re batteries
4. The Australia-US Compact: Climate change, critical minerals and clean energy is the third pillar of the Australia-US alliance; Australia's Critical Minerals Strategy; Australian Exports – Embodied Decarbonisation
5. Stock market examples of Energy Transition

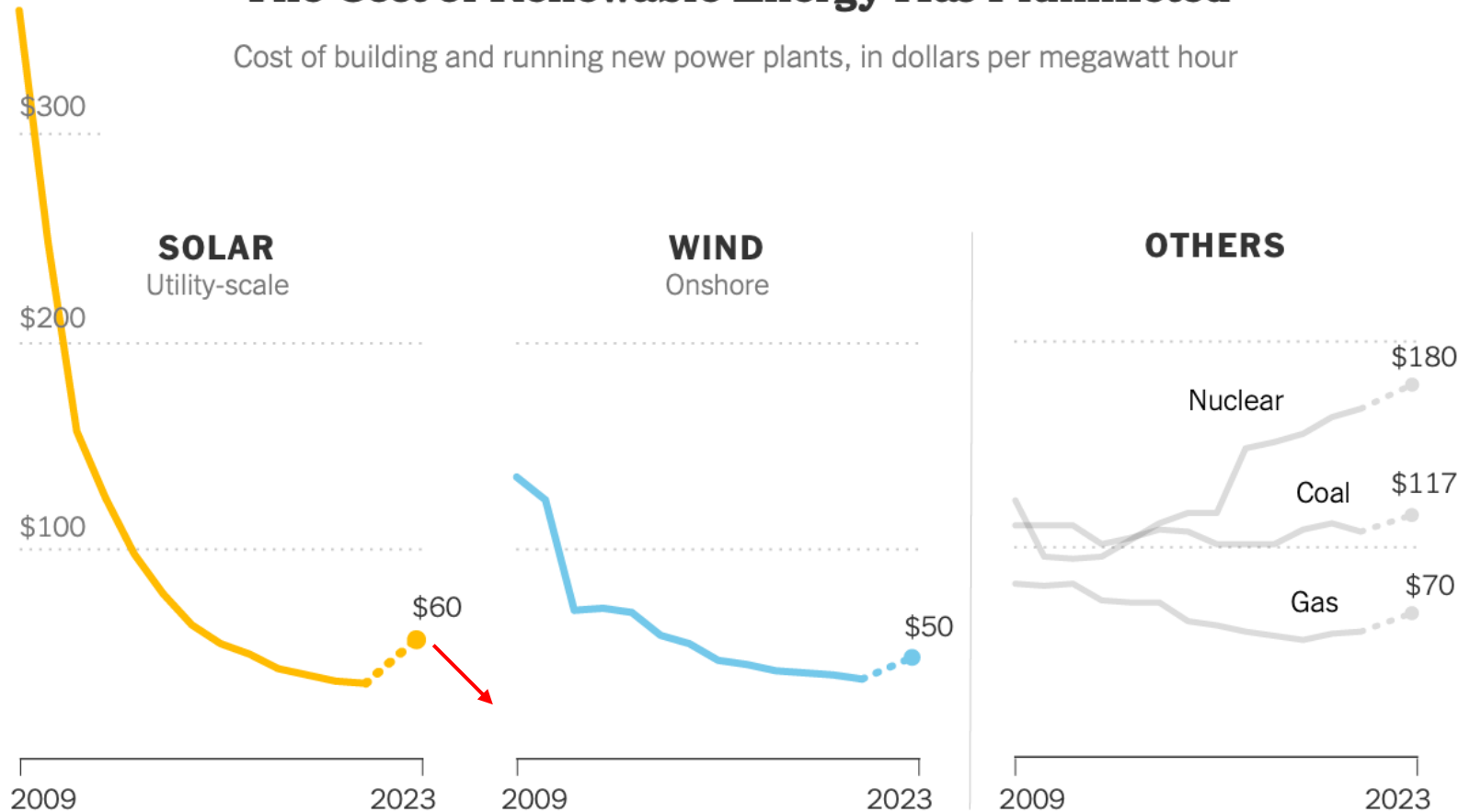
Australia needs another \$100bn of public strategic capital to crowd-in \$200-300bn of private capital

1. The Global Energy Transition

The move to zero emissions renewable energy is deflationary, in absolute terms, and recently relative to hyperinflation of fossil fuel commodities.

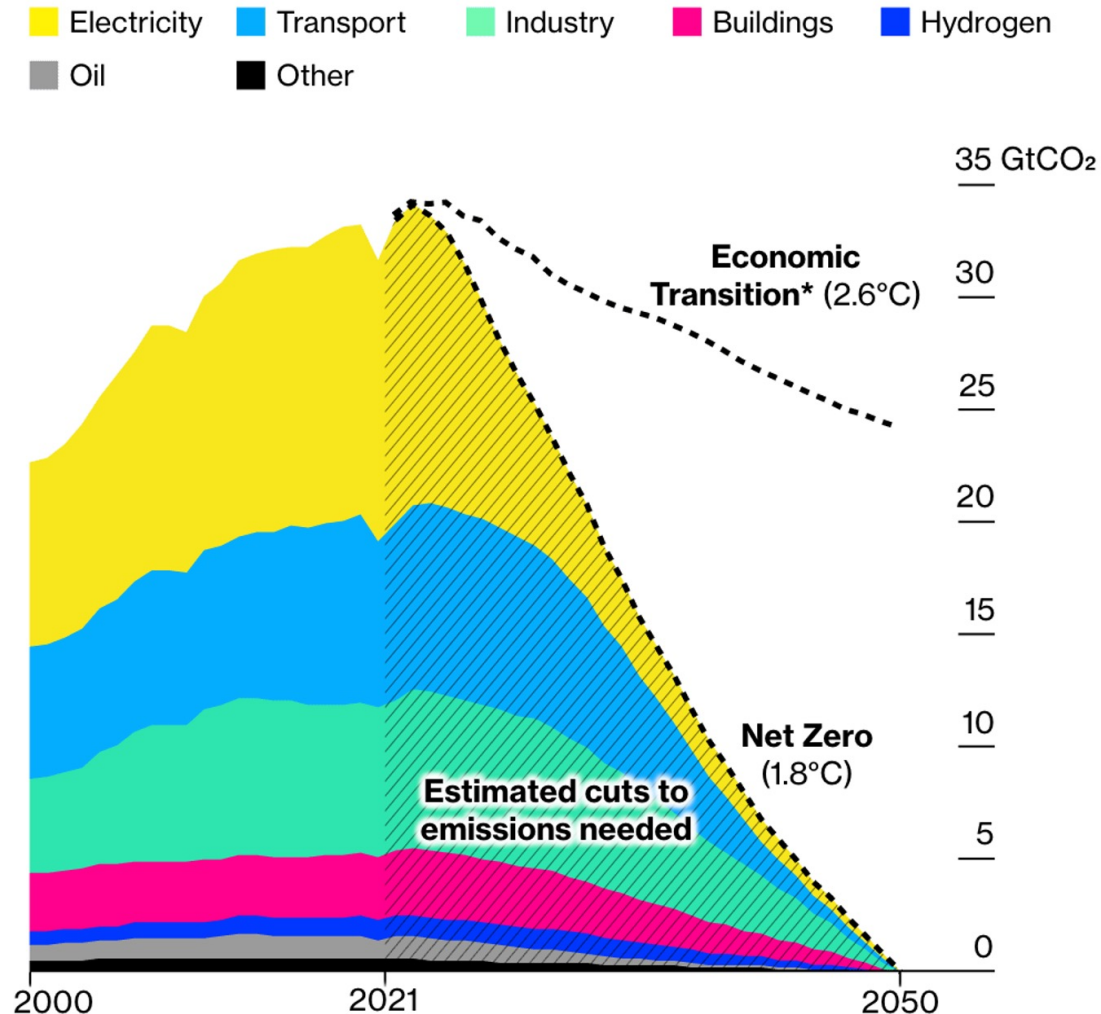
The Cost of Renewable Energy Has Plummeted

Cost of building and running new power plants, in dollars per megawatt hour



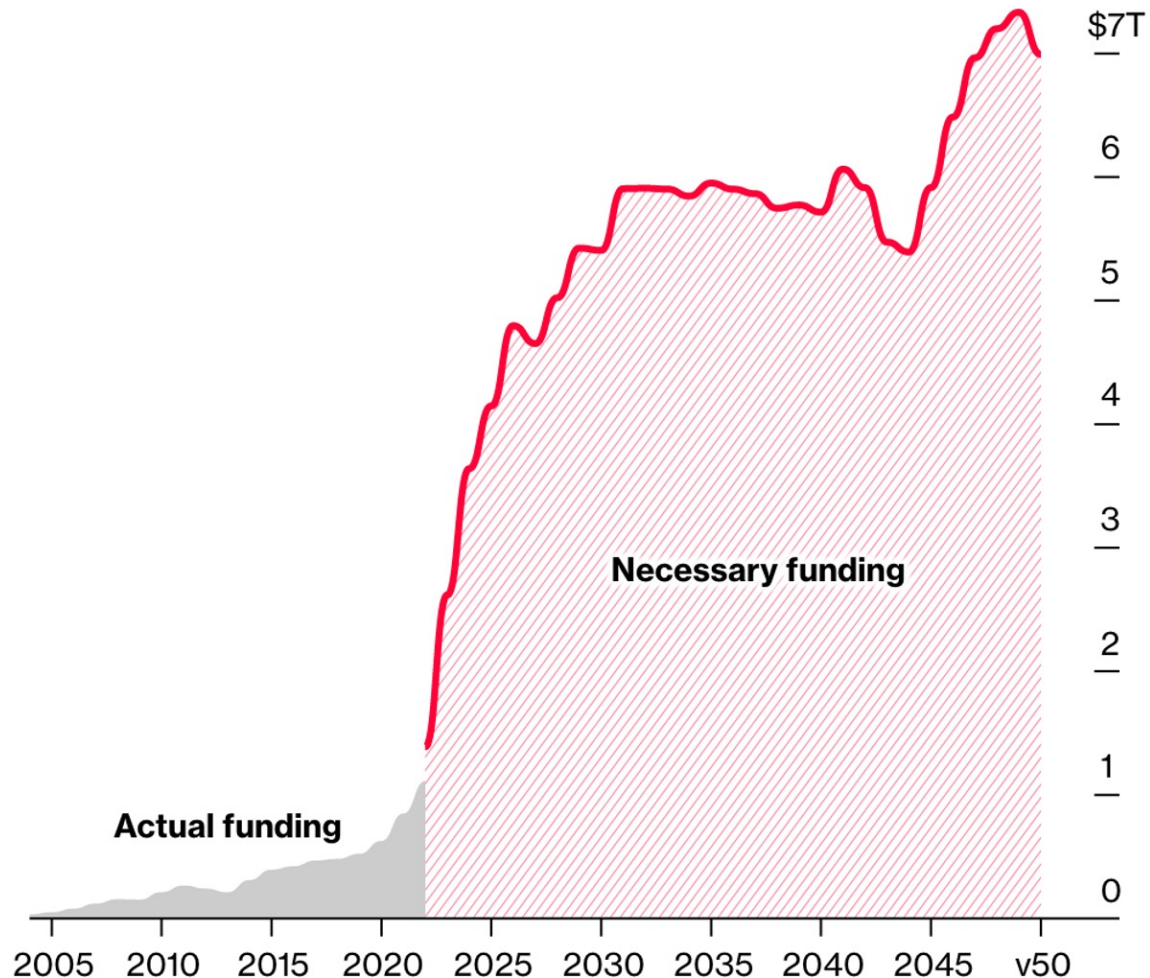
1. The Global Energy Transition

Emissions must fall to zero by mid-century to meet global target



1. The Global Energy Transition

Global Investment Needed to reach Net Zero by 2050



1. The Global Energy Transition

EU ETS – World leading, but yet to be replicated. The Australian Safeguard Mechanism is a good start. We need a CO₂ pollution price.

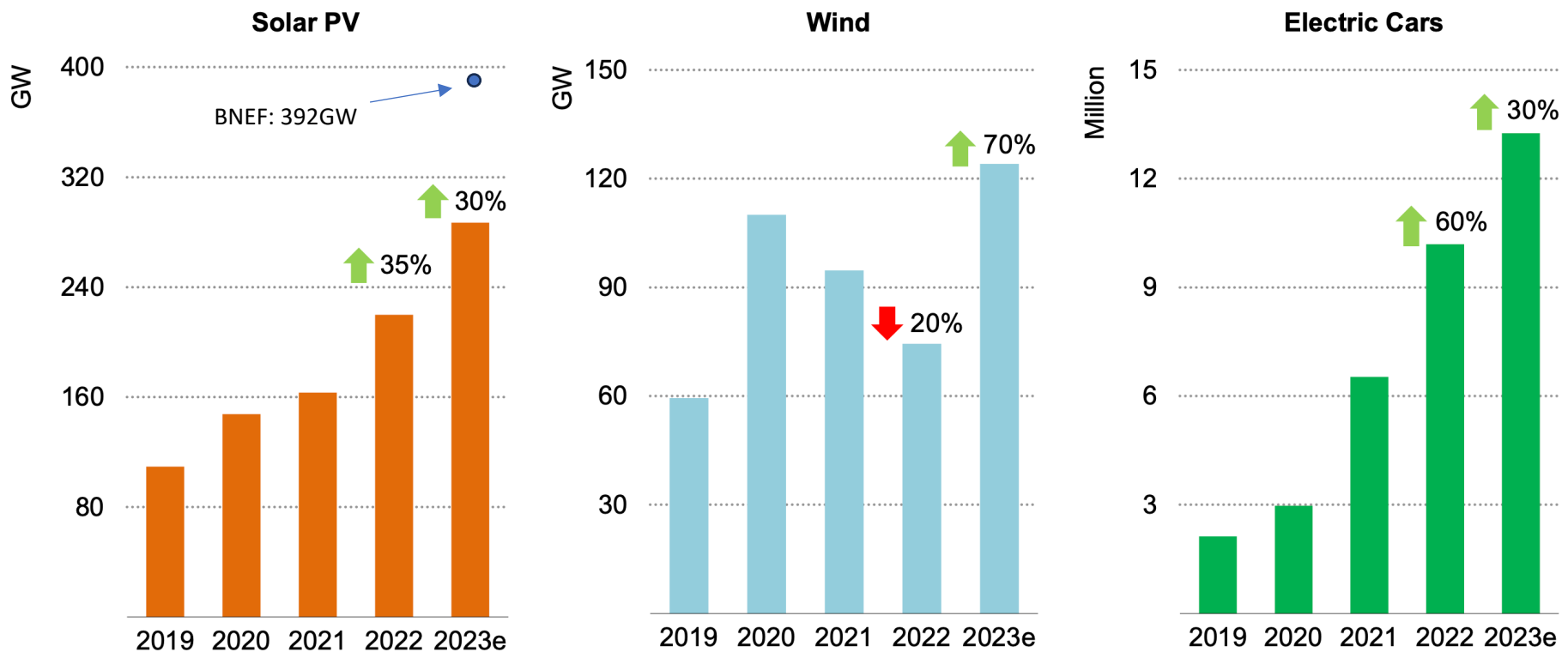


1. The Global Energy Transition

There is nothing slow, orderly or ambiguous about global momentum in the energy transition; but still insufficient yet to align with the science



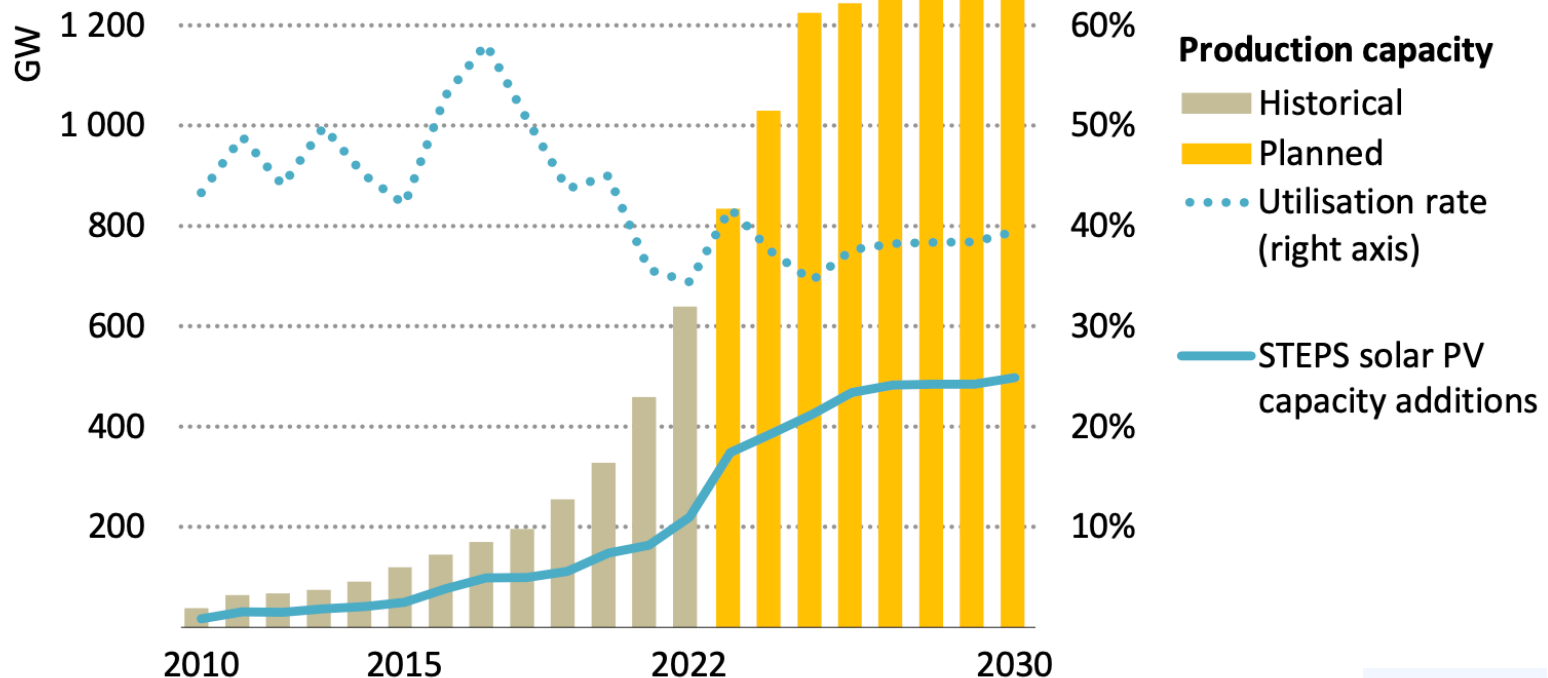
Annual capacity additions for solar PV and wind and electric car sales



1. The Global Energy Transition: Solar

Solar Growth is Accelerating, Globally. BNEF forecasts 392GW in 2023, +56% yoy, and module prices of US\$0.145c/w by end 2023.

Figure 1.10 ▶ Global solar module manufacturing and solar PV capacity additions in the STEPS, 2010-2030



Planned expansion of solar manufacturing outpaces solar PV capacity additions to 2030; its low utilisation rate presents a huge opportunity to accelerate clean energy transitions

2. China Leads the World in Renewable Energy

China installed 178GW of VRE in 9MCY2023 (+109% yoy), and is on track to deliver their 1,200GW by 2030 RE target 6 years early

New Capacity Installed in China in Jan-Sep 2023

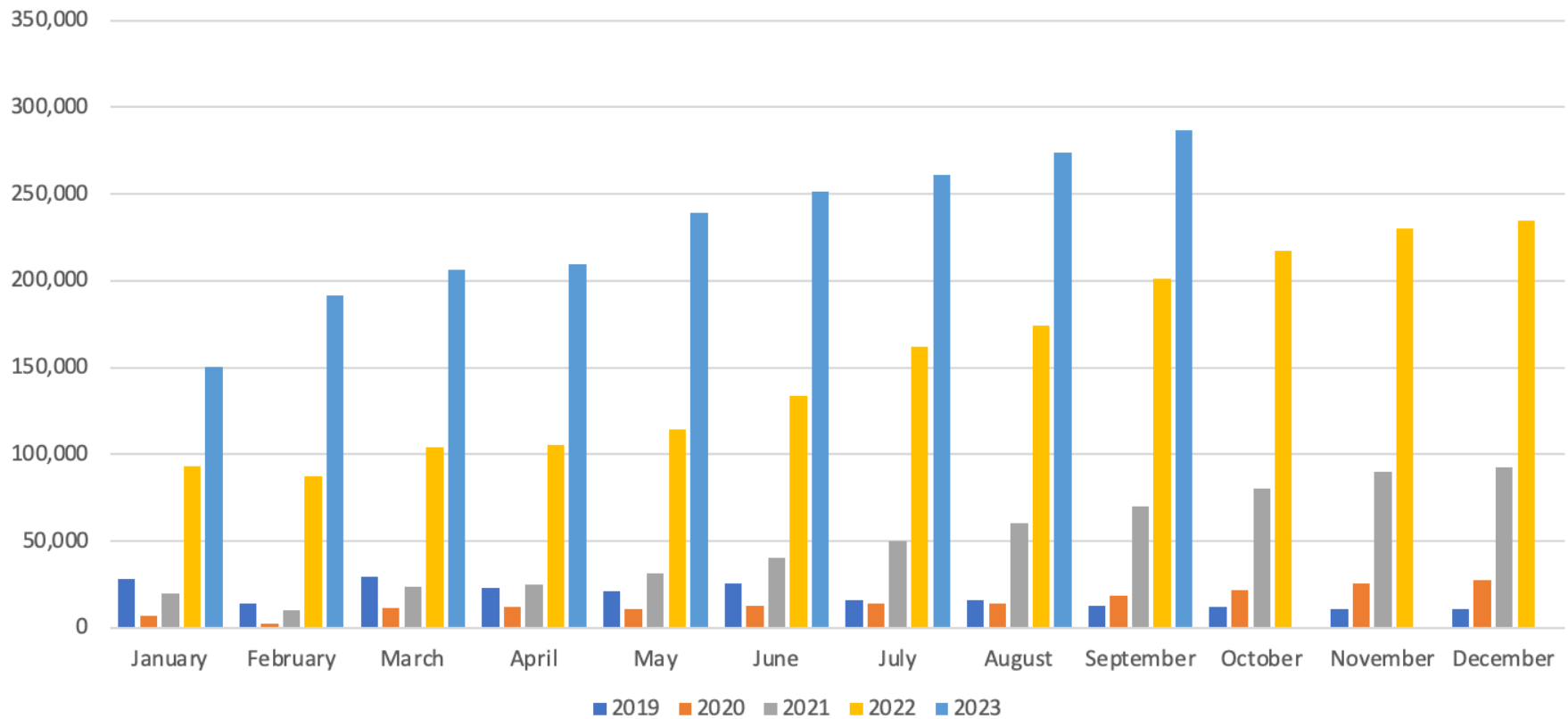
		Jan-Sep 2023	Share of new adds (%)	Change (yoy %)	Sep-23	Share of new adds (%)
Thermal Power	GW	39	17%	67%	5.2	19%
Hydropower	GW	8	3%	-50%	0.7	2%
Nuclear Power	GW	1	1%	-48%	0.0	0%
Wind Power	GW	33	15%	74%	4.6	16%
Solar Power	GW	129	57%	145%	15.8	57%
Other (Biomass, W2E)	GW	15	7%		1.6	6%
Total capacity added	GW	226	100%	97%	27.8	100%
Variable Renewable adds	GW	178	79%	109%	22.0	79%
Zero Emissions Capacity Adds	GW	187	83%	105%	22.6	81%

Source: NBS, CEF Estimates

2. China Leads the World in EVs

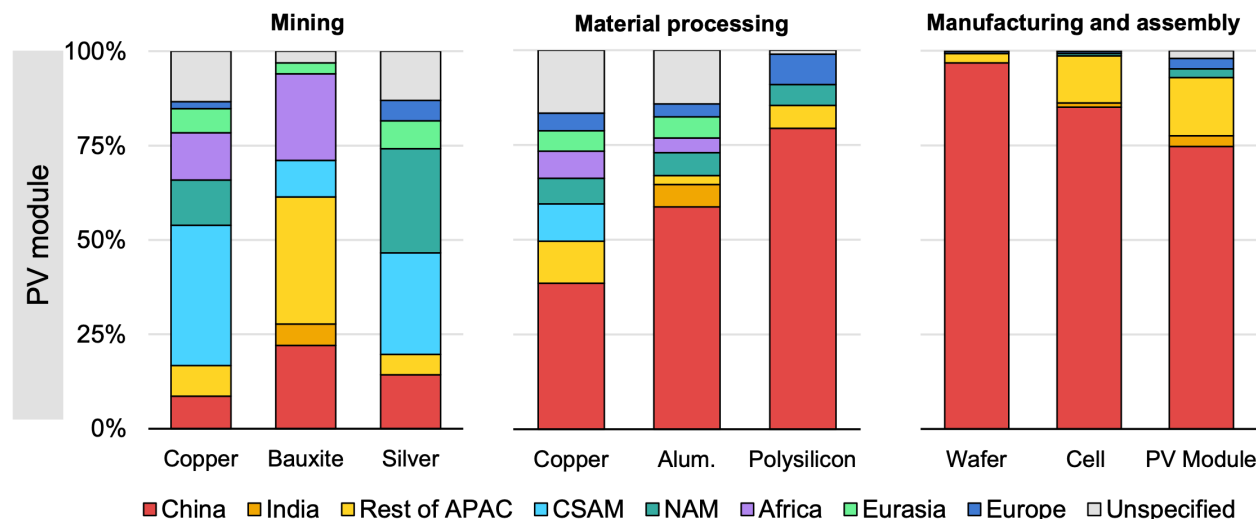
9MCY2023, BYD sold 2.07 million plug-in electric cars, up 76% yoy.

BYD Passenger EV Sales to September 2023

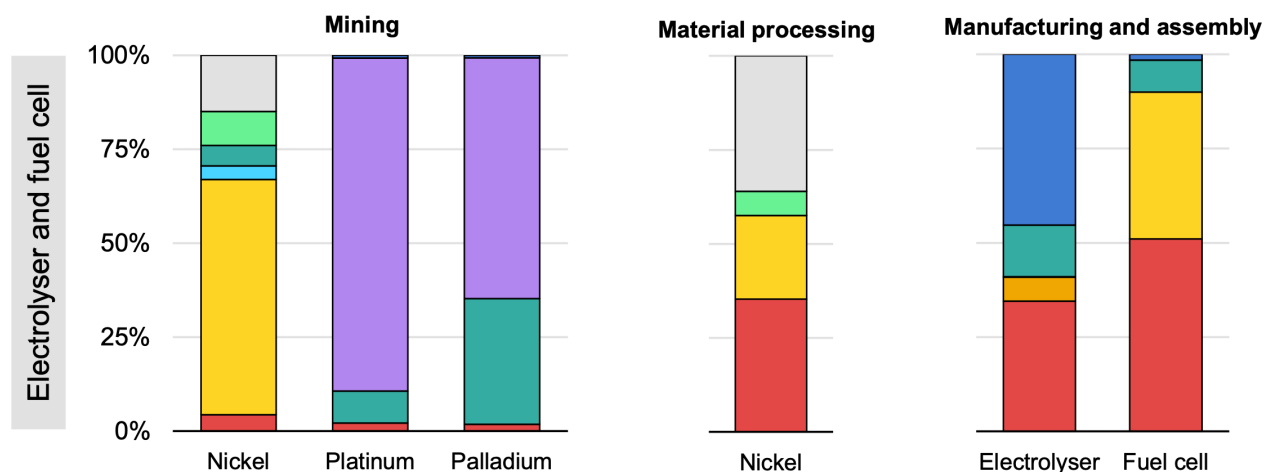


2. China Leads the World on Mineral Processing

Supply chain security, cheap RE and resource ownership means Australia should be leveraging our new competitive advantages to lead the global energy transition



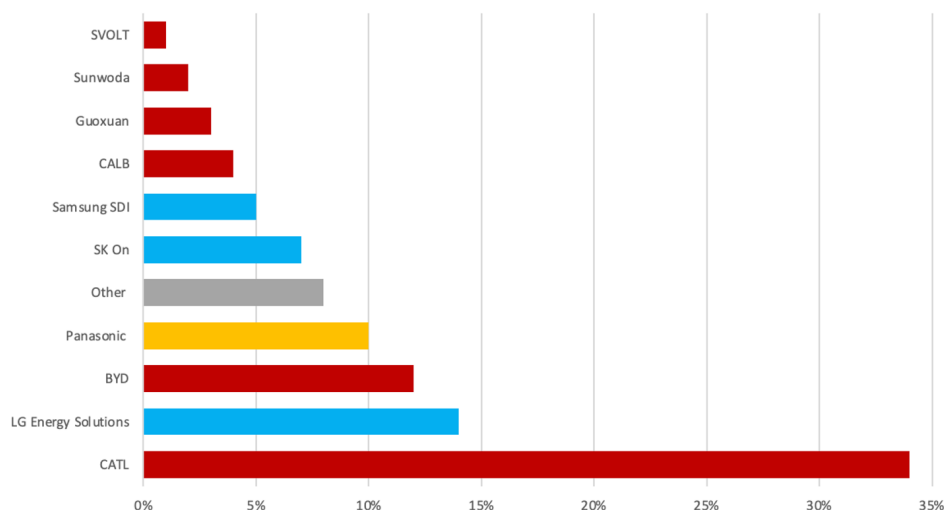
Think
'China +1'



2. China Leads the World in Batteries

China has 6 of the top 10 battery manufacturers

Figure: Global EV Battery Manufacturer Market Share 2022:



Source: SNE Research, CleanTechnica



CLIMATE ENERGY FINANCE

29 June 2023

A VALUE-ADDED CRITICAL MINERALS BILATERAL AGREEMENT FOR AUSTRALIA AND SOUTH KOREA

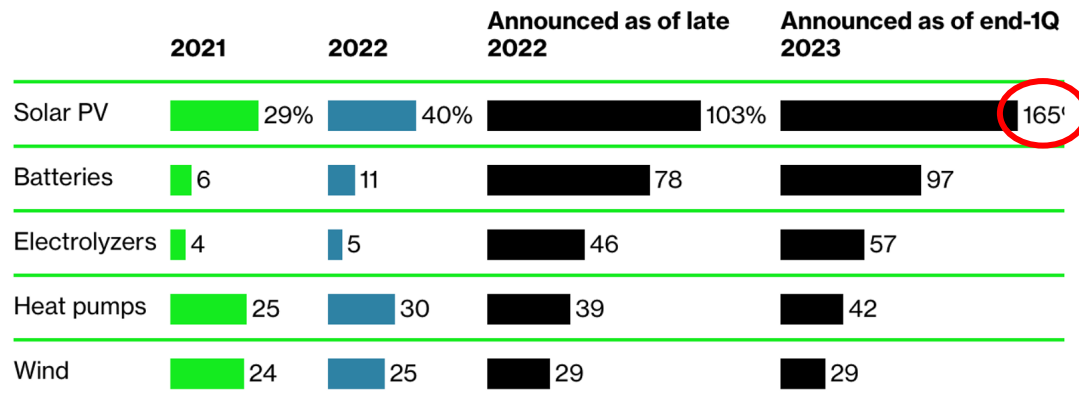
Australia's imperative to create a mutually-beneficial bilateral agreement with South Korea, leveraging the US Inflation Reduction Act to complement Korea's battery industry and value-add onshore.

Matt Pollard, Global EV Supply Chain Analyst, CEF
Tim Buckley, Director, CEF
Dr Annemarie Jonson, Director Communications

2. China Leads the World in Renewable Energy

Solar manufacturing scaling up at unbelievable speed

Installed and announced manufacturing capacity, relative to 2030 levels needed in IEA net zero scenario



Think of ~1,000GW pa of solar installs globally by 2030 whilst IEA APS assumes just 529GW pa 2022-2030



Massive PV Manufacturing Complex In China

JinkoSolar Plans RMB 56Bn Vertically Integrated Solar PV Production Compound In Shanxi

25 May 25 2023 Taiyang News

- JinkoSolar has entered an investment framework agreement for a large scale manufacturing complex in Shanxi
- It will host monocrystalline silicon pull rod, silicon wafer, high efficiency solar cells and modules with 56 GW annual capacity each
- Phase I and II with 14 GW capacity for each of the products are planned to enter commercial operations in Q1 and Q2 of 2024

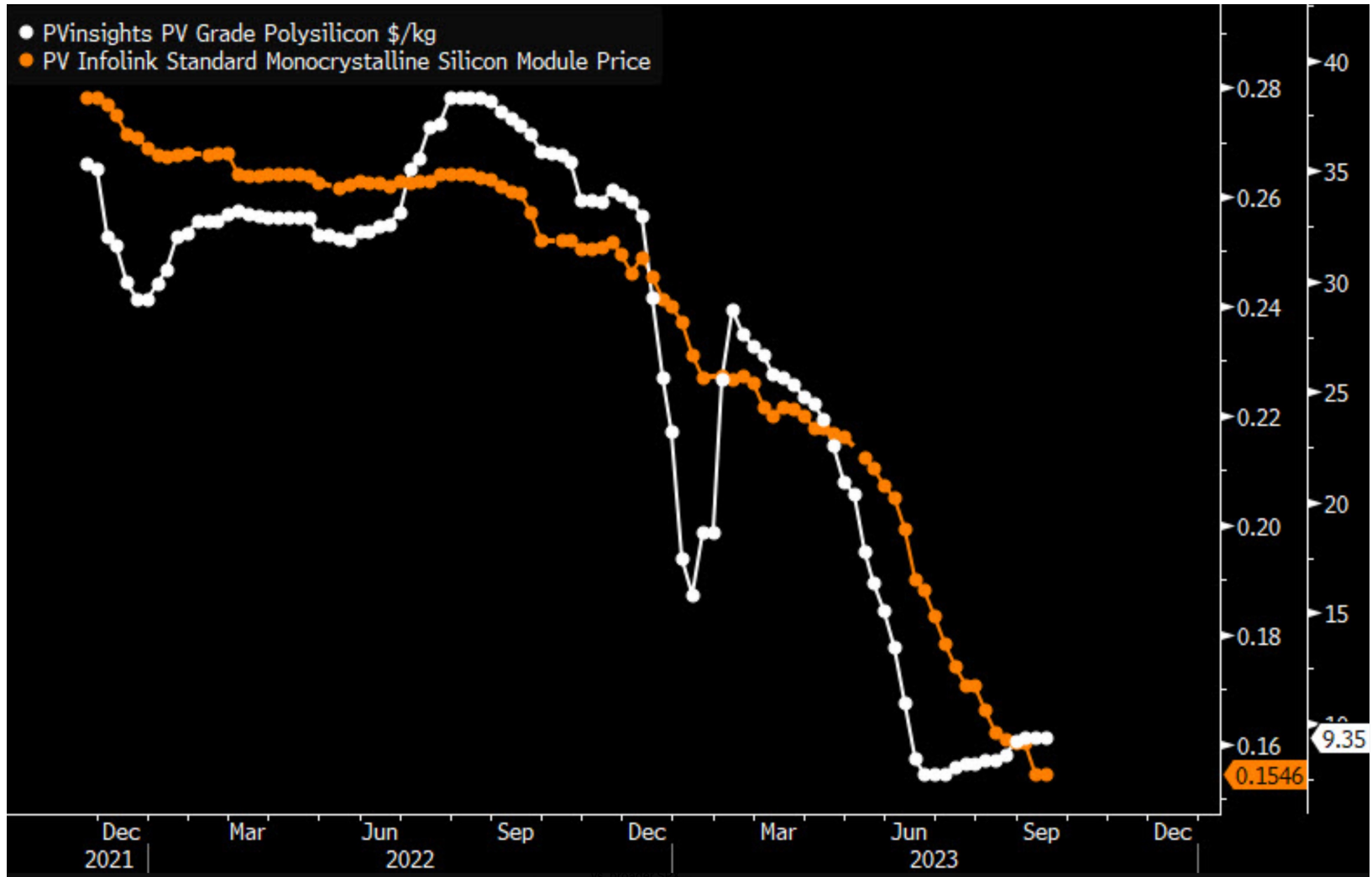
Source: Bloomberg, Multiplying Solar and Battery Factories Put Net Zero in Closer Reach, 25 May 2023

https://www.bloomberg.com/news/articles/2023-05-25/boom-in-solar-panel-ev-battery-factories-brings-net-zero-closer?utm_source=website&utm_medium=share&utm_campaign=twitter&leadSource=uverify%20wall

China's Taiyangnews, 25 May 2023, <https://taiyangnews.info/business/massive-pv-manufacturing-complex-in-china/>

2. Massive solar Supply Increase => Lower Prices

Polysilicon prices down 75% in 2023 YTD, modules -40%



3. US Inflation Reduction Act 2022

~US\$800bn funding => a resurgence in US manufacturing post the IRA

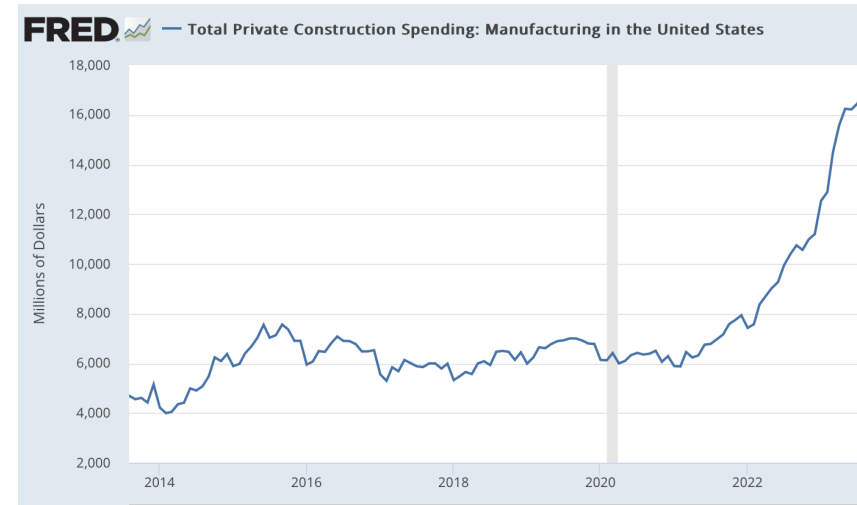


THE WHITE HOUSE

JULY 05, 2023

FACT SHEET: Bidenomics Has Driven \$500 Billion in Private Sector Investments Across the Country, Is Growing South Carolina's Economy From the Middle Out and Bottom Up

President Biden's economic agenda—Bidenomics—is growing the American economy from the middle out and the bottom up, not the top down. Tomorrow, President Biden will announce that companies have committed **over \$500 billion in manufacturing and clean energy investments** in the United States since the beginning of his Administration. The President will visit **South Carolina, where companies have announced \$11 billion** in manufacturing and clean energy investments, and the Biden-Harris Administration has already awarded **\$2.6 billion in funding for infrastructure projects**. The President will highlight that Enphase Energy is joining a growing list of companies beginning clean energy manufacturing operations in the United States—mobilized directly by President Biden's Inflation Reduction Act—**creating 1,800 new jobs nationwide, including up**



Source: The US Census Bureau, monthly to August 2023
<https://fred.stlouisfed.org/series/PRMFGCON>

3. Korea's Refocus on the US IRA

Battery Makers Plow \$31 Billion Into Remaking Korean Steel Hub

The city of Pohang built up a world class steel industry over decades. Now it's turning to EV batteries.



The sun sets over the Posco steel mill in Pohang, South Korea, on July 17, 2018. The city is increasingly seen as the country's new capital for the electric vehicle battery industry.

A South Korean city home to one of the world's biggest steelmakers is betting its manufacturing expertise, billions of dollars in investments and government incentives can help it dominate a 21st century industry: electric vehicle batteries.

Companies in the south-eastern hub of Pohang — famous for **Posco Holdings Inc.** steel mills and one of the country's elite universities — are aggressively building out EV battery campuses as automakers hurry to find reliable suppliers outside China. Three South Korean giants in the global battery market — LG Energy Solution Ltd., Samsung SDI Co. and SK On Co. — have promised 40 trillion won (\$31 billion) in domestic investments with their local suppliers.

President Yoon Suk Yeol said 'the government and companies including Samsung Electronics Co. will pour US\$422bn into areas such as chips and EV in the nation's most aggressive effort yet to win a heated global race for tech supremacy'

Source: Bloomberg's Heejin Kim 16 March 2023
<https://www.bloomberg.com/news/articles/2023-03-15/battery-makers-plow-31-billion-into-remaking-korean-steel-hub>

4. Australia's Critical Minerals Strategy

South Korea-Australia Integrated Mining-Batteries-EV Cooperation

LG Energy Solution to supply EV batteries to Toyota for 10 years

Il-Gue Kim and Yoo-Chung Roh | 5 October 2023 | KED Global



LG Energy Solution's battery plant in Holland, Michigan.

LG Energy Solution Ltd. will supply 20 GWh worth of batteries for EV of the world's No. 1 car seller **Toyota Motor Corp.** every year for 10 years in the top South Korean EV battery maker's largest single EV battery deal.

LG Energy Solution announced on Thursday it has signed a contract with Toyota Motor North America Inc., to supply its EV batteries for the Japanese auto giant's EV from 2025 to 2035. Under the deal, the Korean battery major will supply high-nickel NCMA (nickel, cobalt, manganese, aluminium) pouch-type batteries to Toyota at an annual capacity of 20 GWh.

For the deal, LG Energy Solution will invest 4 trillion won (\$3 billion) in its Michigan battery factory to add new production lines for battery cells and modules exclusively for Toyota EVs. Upon completion of the line expansion slated for 2025, LG Energy Solution's Michigan facility would boast a total production capacity of 40 GWh.

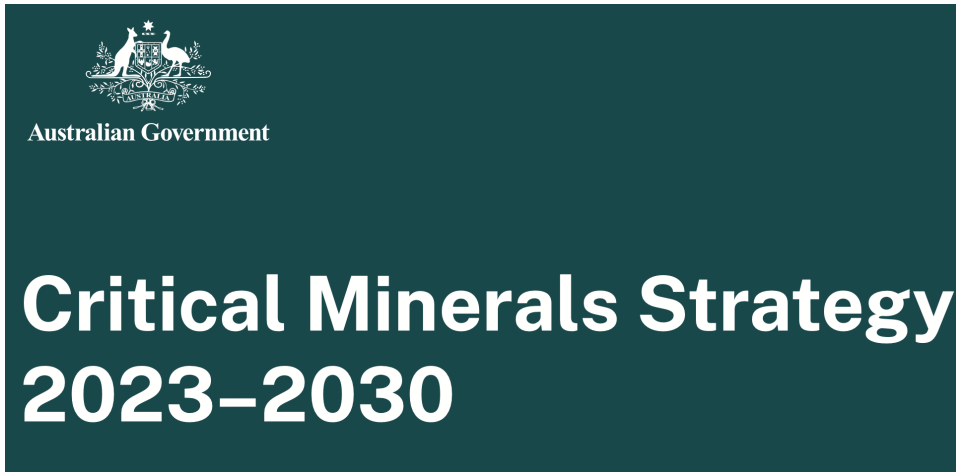
This deal marks the biggest single battery order LG Energy Solution has ever won, apart from its JV deals, the company said. This is also the first supply deal between LG Energy Solution and Toyota.

LG Energy Solution is expected to operate eight battery manufacturing bases in North America by 2025.

Source:

<https://www.kedglobal.com/batteries/newsView/ked202310050006>

4. Australia's Critical Minerals Strategy



Create diverse, resilient and sustainable supply chains through strong and secure international partnerships

We will supply processed critical minerals to diversify global markets and support Australia's access to priority technologies. This includes working with international partners to build secure, resilient and sustainable supply chains that reduce market concentration. We will enhance our high environmental, social, and governance (ESG) credentials and our status as a trusted and reliable trading partner.

Build sovereign capability in critical minerals processing

We will move up the critical minerals value chain and increase Australia's footprint in downstream processing. We will make high-value products that build new industries and strengthen our domestic resilience to supply chain shocks.

Use our critical minerals to help become a renewable energy superpower

We will unlock our vast potential as a major supplier of the critical minerals needed to decarbonise the global economy. Australia's critical minerals sector will help the world decarbonise, including enabling Australia to reach our own legislated targets of 43 per cent below 2005 levels by 2030 and net zero by 2050.

Extract more value onshore from our resources – creating jobs and economic opportunity, including for regional and First Nations communities

This could add \$134bn to Oz GDP and create 262,600 new jobs by 2040 =>
“Proportionate” response:

- \$500m funding for NAIF
- \$225m to Geoscience Australia
- \$100m critical minerals development program.
- \$2bn EFA critical minerals facility
- NRF: \$3bn Low emissions tech
- NRF: \$1bn Resources value-add
- \$50m Australian Critical Minerals R&D Hub
- \$57m Critical Minerals International Partnerships
- Powering the Regions Fund: \$1.9bn
- \$3.1bn Australian Apprentices Incentive System
- \$500m Jobs & Skills Councils
- \$105m New Energy Apprenticeships

Another critical minerals review 2026

***Another \$100bn of public capital to crowd-in
\$200-300bn of private capital***

4. Australia's Critical Minerals Strategy

'Go hard, be brave', says \$15b green bank boss

[Ben Potter](#) Oct 9, 2023 – AFR



Martijn Wilder, chairman of the new National Reconstruction Fund, in Sydney.

The chairman of the federal government's \$15 billion "green bank" said 27 companies are investigating making batteries in Australia, a challenge to the orthodoxy that taking on the global battery giants would be a stretch for a high-cost nation.

National Reconstruction Fund chairman Martijn Wilder said Australia needed a "Marshall Plan" to decarbonise the economy fast, likening the challenge to the reconstruction of Europe after World War II. Mr Wilder said the fund, Labor's primary vehicle to [restart manufacturing](#), would be in the business of "picking winners", building industries to exploit our abundant wind, sun and land – and make a commercial return of 2 to 3% above the federal bond rate.

It could look at a "whole raft of things" from quantum computing and making drones, hydrogen for green steelmaking, offshore wind turbines to electric vehicle charging and manufacturing to backing software billionaire Mike Cannon-Brookes' plan to have the [4200km of cables required for his Sun Cable project made here](#), and even building ships to lay the cable to Singapore. But Mr Wilder stressed that any investments by the fund had to be economically feasible, make a commercial return and comply with an investment mandate from the government that is yet to be finalised.

4. Australia's Role in Green Iron

Swedish Industrialists Explore \$6Bn Green Steel Project in Canada

- *H2 Green Steel seeks access to Quebec's hydroelectric power*
- *Northvolt just announced \$5 billion battery plant in province*

By [Mathieu Dion](#) and [Rafaela Lindeberg](#) 9 October 2023 Bloomberg

Green iron value-adding powered by RE is a \$100bn pa export opportunity for Australia



An illustration of the future Boden site in Sweden

Sweden's [H2 Green Steel](#) is in talks with governments in Canada to build a factory in northern Quebec, as the young firm tries to deliver on a promise to customers — steel produced with minimal carbon emissions. The company is just starting on construction of its first plant in Boden, Sweden, with an ambitious goal to begin production by late 2025. Supply agreements have been signed with automakers including [Mercedes-Benz Group AG](#).

"We bring with us a portfolio of customers who want to have supply in North America," H2GS CEO Henrik Henriksson said as part of a Swedish delegation led by business mogul Marcus Wallenberg to meet officials including PM Justin Trudeau.

Source: Bloomberg

<https://www.bloomberg.com/news/articles/2023-10-09/swedish-industrialists-explore-6-billion-canada-steel-project>

4. Australia's Role in Global Solar Manufacturing

Sun Cable backer in \$10b tilt at solar panel supply chain

Brad Thompson Oct 31, 2023 – AFR

Mike Cannon-Brookes' investment partner in Sun Cable, **Quinbrook Infrastructure Partners**, plans to build a polysilicon plant in Queensland costing up to \$10bn to supply solar panel manufacturers. Quinbrook is looking for partners with deep pockets as it targets producing some of the world's greenest polysilicon, competing in a field dominated by Chinese producers. Australia has no polysilicon manufacturing capability but a high demand for solar panels as part of decarbonisation targets set by governments, mining companies and private sector interests.

Can the US / EU / Australia allow China to control >90% of the world's polysilicon production, the key to solar modules?



The project would involve a huge solar farm in the outback of the Northern Territory.

The project is earmarked for the Lansdown eco-industrial precinct in **Townsville** and will source silica quartz from the region. Townsville has allocated Quinbrook a 200-hectare site at Lansdown subject to strict development timelines.

Quinbrook director Brian Restall said Lansdown was close to some of the best silica quartz resources in the world. "We have strong relationships with, and are a major customer of, leading solar and battery manufacturers across the globe – meaning components manufactured here in Townsville will be exported to these leading manufacturers and made into finished solar modules and batteries," he said. Quinbrook plans to build a plant powered by a large-scale solar and battery storage project that it hopes to develop on land next to Lansdown. The aim is to produce polysilicon wafers for use in solar panels as well as battery technology. Silica is more efficient than other minerals at converting light into electricity.

Source: AFR

<https://www.afr.com/companies/energy/sun-cable-backer-in-10b-tilt-at-solar-panel-supply-chain-20231031-p5egic>

4. Exporting Embodied Decarbonisation

Australia needs to move on from the 'dig-and-ship' view



ASX / MEDIA ANNOUNCEMENT

Wednesday, 2 August 2023

FINAL INVESTMENT DECISION FOR MID-STREAM DEMONSTRATION PLANT

BOARD APPROVAL GRANTED FOR CONSTRUCTION OF DEMONSTRATION PLANT TO PRODUCE VALUE ADDED LITHIUM PRODUCT AT PILGANGOORA.

PROJECT SEEKS TO DEMONSTRATE POTENTIAL TO IMPROVE THE BATTERY MATERIALS SUPPLY CHAIN THROUGH DECARBONISATION OF SPODUMENE PROCESSING, REDUCTION IN TRANSPORT VOLUMES AND INCREASED VALUE-ADD PROCESSING AT THE MINE SITE.

- Independent Life Cycle Assessment studies estimate that converting spodumene using electric calcination when using 100% renewable energy has the potential to reduce calcination carbon emissions intensity by >80%², which would materially reduce carbon emissions in one of the most energy intensive steps of the lithium battery materials production process.
- Delivering a more lithium-enriched mid-stream product has the potential for industry wide benefits including reduced transport of waste, greater value creation and utilisation of the mineral resource and unlocking future assets with limited transport infrastructure.
- Estimated construction costs of \$104.9M will be partially funded with a \$20M Australian Government grant³ with Pilbara Minerals now funding \$67.4M of the remaining budgeted construction expenditure.

Liontown snares Western alliance solution to funding shortfall

Kalgoorlie | [Brad Thompson](#) Aug 7, 2023 – AFR

[Liontown Resources](#) has won backing from a coalition of government finance agencies in Australia, South Korea and the US to bridge a \$300m funding shortfall for its flagship lithium project in Western Australia.

The breakthrough secures the funds needed to complete the \$895m Kathleen Valley project. The finance package could be increased and used for working capital against a background of rising costs in the WA mining sector and [lithium market jitters](#).

Liontown also announced on Monday that it had joined forces with Japan's [Sumitomo Corporation](#) to study the feasibility of building a lithium sulphate plant in WA that would supply a finishing plant in Japan producing lithium hydroxide.

The funding option, although not finalised, gets Liontown closer to its 2024 production target for Kathleen Valley after it last week unveiled plans to start shipping unprocessed lithium to realise some cash.

[Export Finance Australia](#), the [Korea Trade Insurance Corporation \(K-Sure\)](#) and the [Export-Import Bank of the United States \(EXIM\)](#) have issued individual letters of support, underlining the strategic importance Western nations have placed on reducing their reliance on China for battery materials.

Liontown is continuing talks with customers, commercial banks and other government funding agencies about additional finance.

5. Hydrogen – Post the 2020/21 hype

Plug Power US (Green) vs NEL Hydrogen (Blue) vs ITM Power UK (Red) vs S&P500 (Purple): The 2021 hype has largely evaporated

Plug Power Inc. (PLUG) ☆

NasdaqCM - NasdaqCM Real-time price. Currency in USD

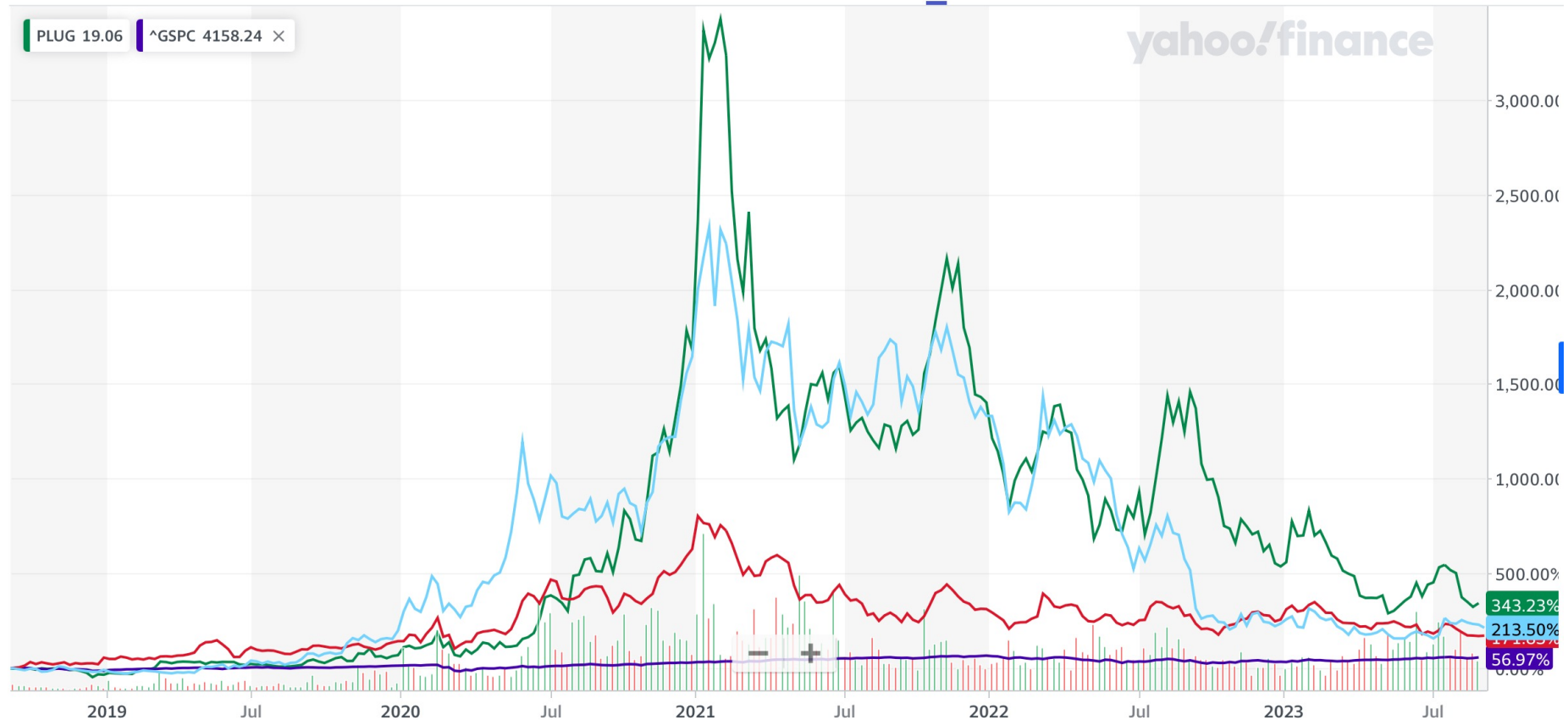
8.51 +0.05 (+0.59%)

8.53 +0.02 (+0.24%)

At close: 1 September 04:00PM EDT

After hours: 1 Sep, 07:58PM EDT

Indicators Comparison Events Date range 1D 5D 1M 3M 6M YTD 1Y 2Y 5Y Max Interval 1W Line Draw Settings



5. BESS – Complementary to Solar

BESS Capital Cost Deflation – undermining GH₂ gas peakers

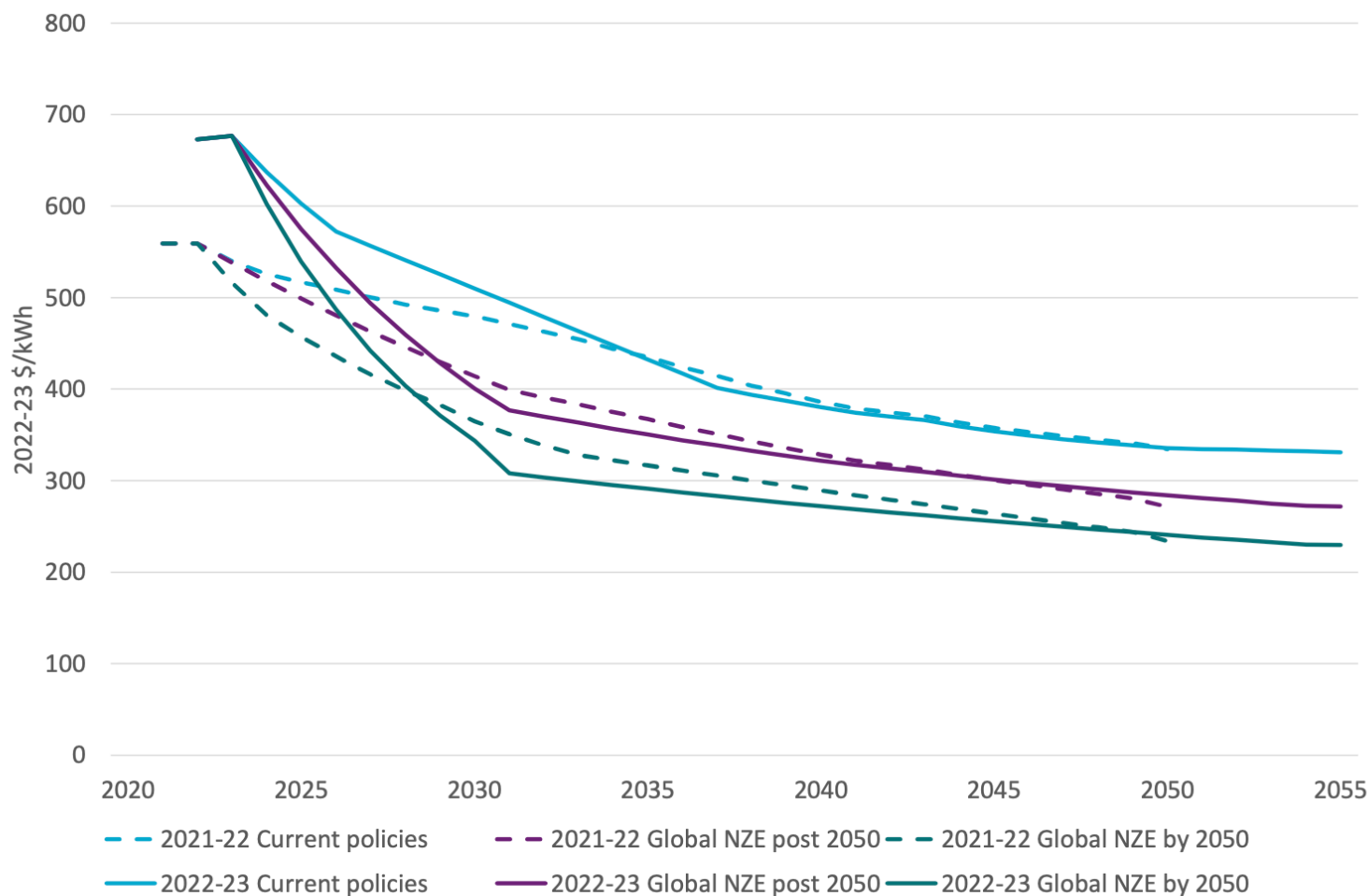


Figure 4-14 Projected total capital costs for 2-hour duration batteries by scenario (battery and balance of plant)

5. Australia - Insurance Implications

The Implications of Climate Change are Rapidly Emerging

// There are now
12% of households
experiencing home
insurance affordability
stress //

Report - August 2023

Home Insurance Affordability Update

Actuaries
Institute.



Sharanjit Paddam,
FIA FIAA

Almost one year on from the publication of the Actuaries Institute's Green Paper *Home Insurance Affordability and Socioeconomic Equity in a Changing Climate*, home insurance affordability remains an ongoing and significant issue in Australia.

Affordability pressures have risen for almost all Australian households since the 2022 Green Paper, with increases in home insurance premiums (driven by both higher sum insureds and rate increases) not matched by household income growth. In particular, while the median increase in home insurance premiums over the last 12 months was 28%, the impacts were far greater for the highest risk properties, increasing by more than 50% for the 5% of households paying the highest premiums.

There are now 12% of households experiencing home insurance affordability stress (up from 10% in March 2022) where affordability stress is defined as paying more than four weeks of household gross income towards home insurance premiums. Overall, we estimate that 1.24 million Australian households face home insurance affordability stress compared to 1 million a year ago. The average