



**CLIMATE ENERGY FINANCE**

Tim Buckley, Director,  
**Climate Energy Finance**  
[tim@climateenergyfinance.org](mailto:tim@climateenergyfinance.org)

**Energy Transition: *Lithium,  
rare earths and other  
minerals - mining and  
value adding in Australia***

Engineers Australia,  
Mittagong

**27 October 2022**

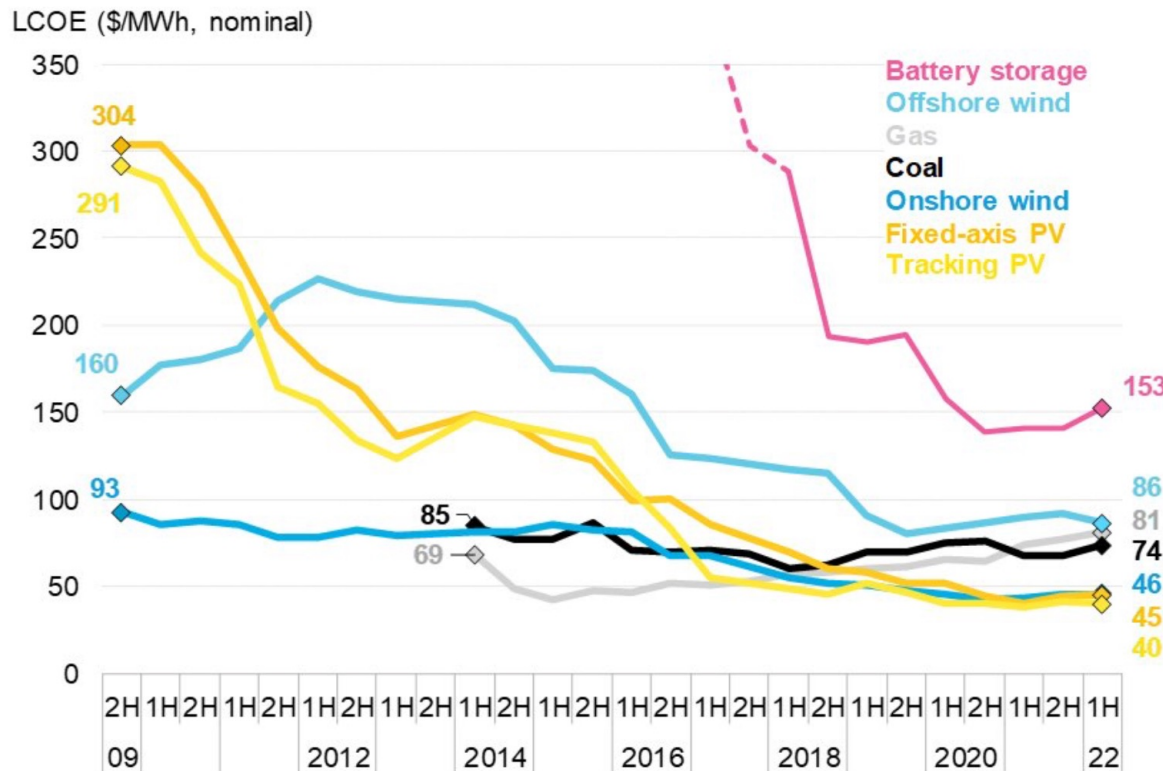
# Agenda: The Global Energy Transition & Accelerating Action in Australia

- The global energy transition is accelerating, driven by the convergence of factors:
  1. Technology-Driven Deflation in Renewables
  2. Global Policy Developments in Decarbonisation
  3. CO<sub>2</sub> Pricing (& CBAM)
  4. Global Finance Zero Emissions (GFANZ) Pledges – US\$130 trillion
  5. The Climate Science
- Global Energy Sector Investment Trends: China leads the world; India and US building momentum
- Australia – 43% Emissions cut by 2030 / 82% RE / Safeguard Mechanism / Tax Reform
- Value-adding Critical Minerals pre-export: Australia as a Renewable Energy & Critical Minerals Superpower

# Technology-Driven Deflation

## Ongoing Renewable Energy and Battery Deflation

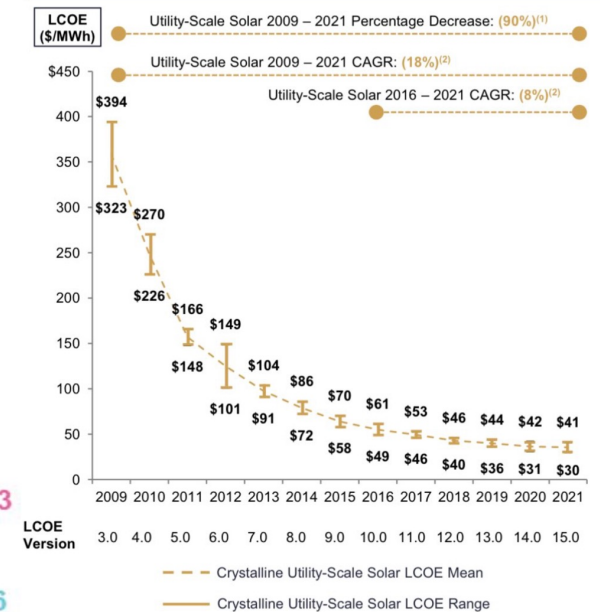
**Figure 1: Global levelized cost of electricity benchmarks, 2009-2022**



Source: BloombergNEF. Note: The global benchmark for PV, wind and storage is a country-weighted average using the latest annual capacity additions. The storage LCOE is reflective of a utility-scale Li-ion battery storage system with four-hour duration running at a daily cycle and includes charging costs.

Source: Bloomberg New Energy Finance, July 2022

**Unsubsidized Solar PV LCOE**

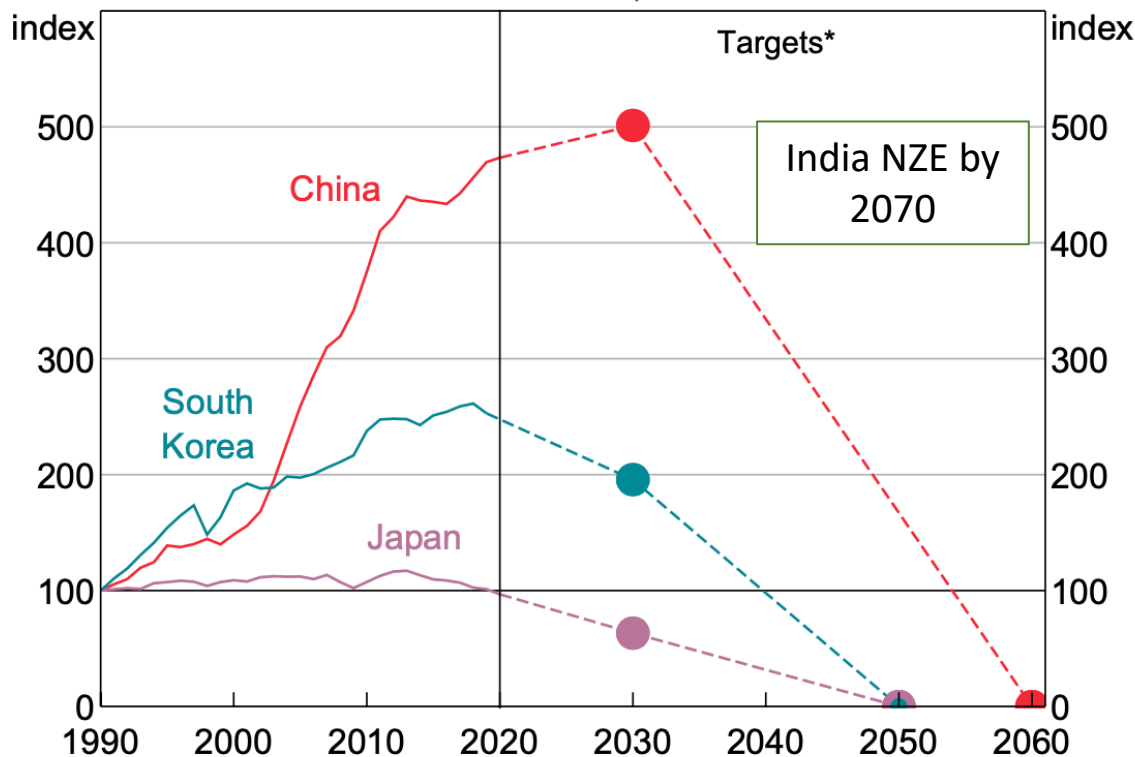


Relative advantage is accelerating vs hyperinflation in fossil fuel prices in 2022.

## 2. Global Policy Developments

### Carbon Dioxide Emissions

Selected economies, 1990 = 100



\* Bubbles show targets; dashed lines show indicative paths to achieve them; Japan and South Korea's greenhouse gas targets are shown in terms of carbon dioxide; China's 2030 target is authors' estimate based on carbon intensity target for 2030 and authorities' desire for GDP growth to 2035

Sources: CEIC Data; International Energy Agency; RBA

Australia's 43% by 2030 is far better than 26%, but still far from aligned with the science.

2005 is Australia's all time emissions high, a false starting point vs other countries.

To align with 1.5°C we need the West to target NZE by 2040, to pull forward China and India decade each.

# 3. Emissions – CO<sub>2</sub> Prices are Rocketing Up

## The Five-Year EU ETS Pricing (€/t)





# Global Finance Zero Emissions Pledges

## UN Net Zero Finance Alliance aligning to 1.5°C

New Financial Alliance for Net Zero Emissions Launches



PRESS RELEASE ISSUED ON BEHALF OF THE COP25 and COP26 CLIMATE CHAMPIONS

*Industry-led and UN-convened Net Zero Banking Alliance also announced today, co-launched by the UNEP Finance Initiative and the Financial Services Taskforce of the Sustainable Markets Initiative*

- The Glasgow Financial Alliance for Net Zero (GFANZ), chaired by Mark Carney, UN Special Envoy on Climate Action and Finance, brings together over 160 firms (together responsible for assets in excess of \$70 trillion<sup>1</sup>) from the leading net zero initiatives across the financial system to accelerate the transition to net zero emissions by 2050 at the latest.
- All GFANZ member alliances must be accredited by the UN Race to Zero campaign. They must use science-based guidelines to reach net zero emissions, cover all emission scopes, include 2030 interim target setting, and commit to transparent reporting and accounting in line with the UN Race to Zero criteria.
- 43 banks from 23 countries (with assets of \$28.5 trillion) form the Net-Zero Banking Alliance (NZBA) today – which joins GFANZ – with its members committing to align operational and attributable emissions from their portfolios with pathways to net-zero by 2050 or sooner.

**US\$130 trillion by Nov 2021  
(+90% in 6 months)**

## A Tectonic Shift Accelerates

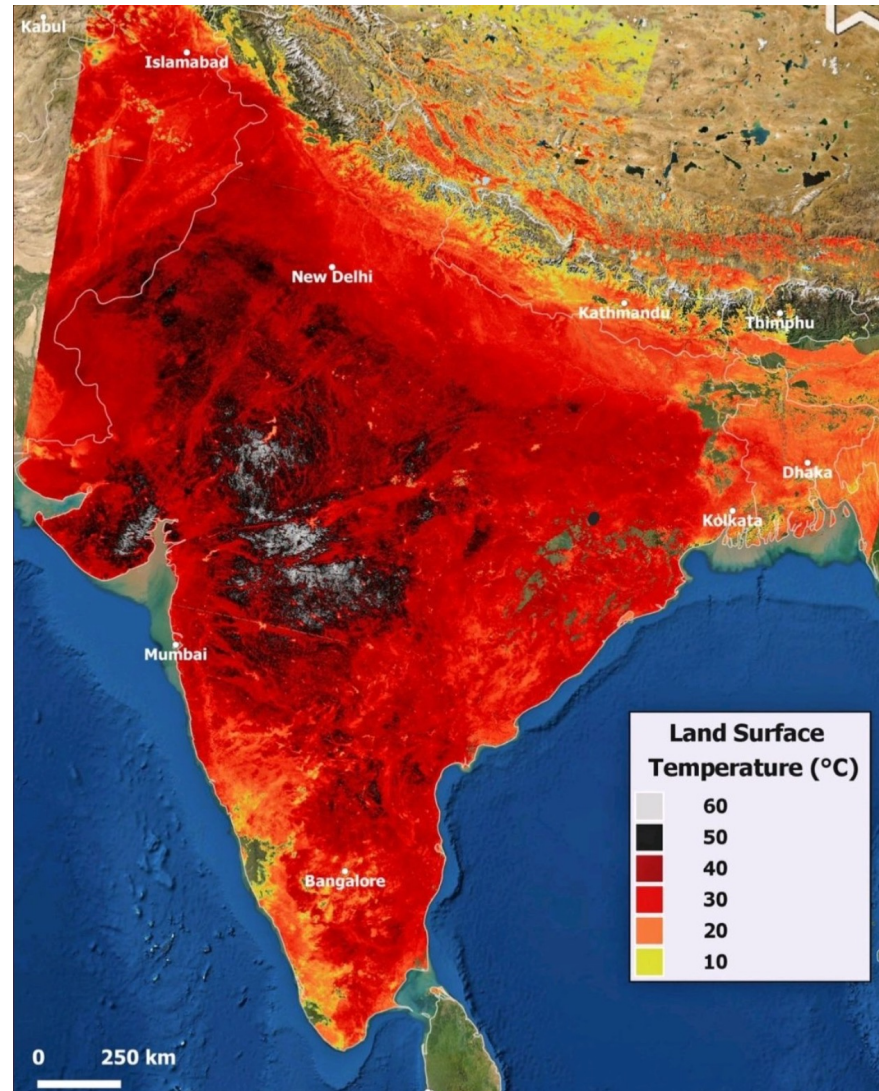
In January of last year, I wrote that climate risk is investment risk. I said then that as markets started to price climate risk into the value of securities, it would spark a fundamental reallocation of capital. Then the pandemic took hold – and in March, the conventional wisdom was the crisis would divert attention from climate. **But just the opposite took place, and the reallocation of capital accelerated even faster than I anticipated.**

From January through November 2020, investors in mutual funds and ETFs invested \$288 billion globally in sustainable assets, a 96% increase over the whole of 2019.<sup>1</sup> I believe that this is the beginning of a **long but rapidly accelerating transition** – one that will unfold over many years and reshape asset prices of every type. **We know that climate risk is investment risk. But we also believe the climate transition presents a historic investment opportunity.**

BlackRock (AuM \$10 trillion)  
[Larry Fink 2021 CEO Letter](#)

## 5. The Climate Science

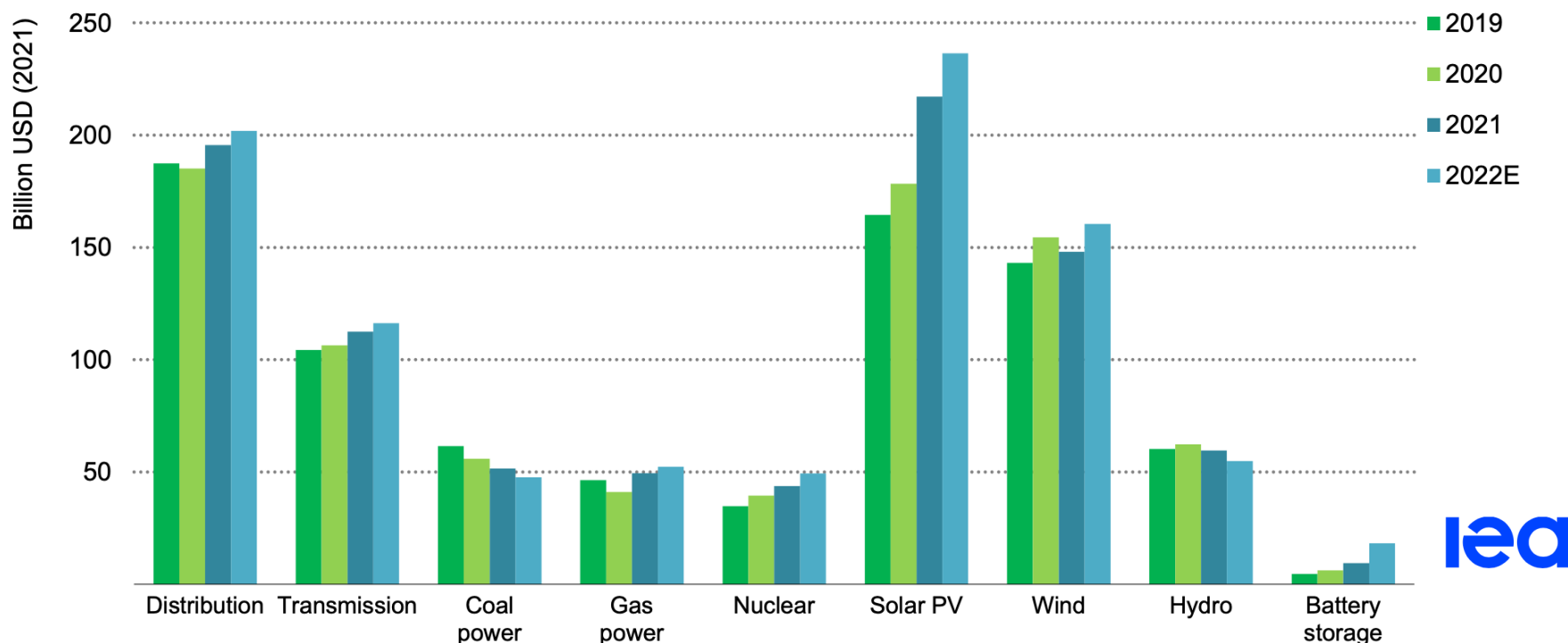
There is no economy on an unliveable planet



# Global Energy Investments

The world will see a cumulative US\$100 trillion 'invested' in energy by 2050

Global annual investment in the power sector by technology, 2019-2022E



IEA. All rights reserved.

Notes: Gas-fired generation investment includes both large-scale plants and small-scale generating sets and engines; hydropower includes pumped-hydro storage.

Source: IEA World Energy Investment 2022

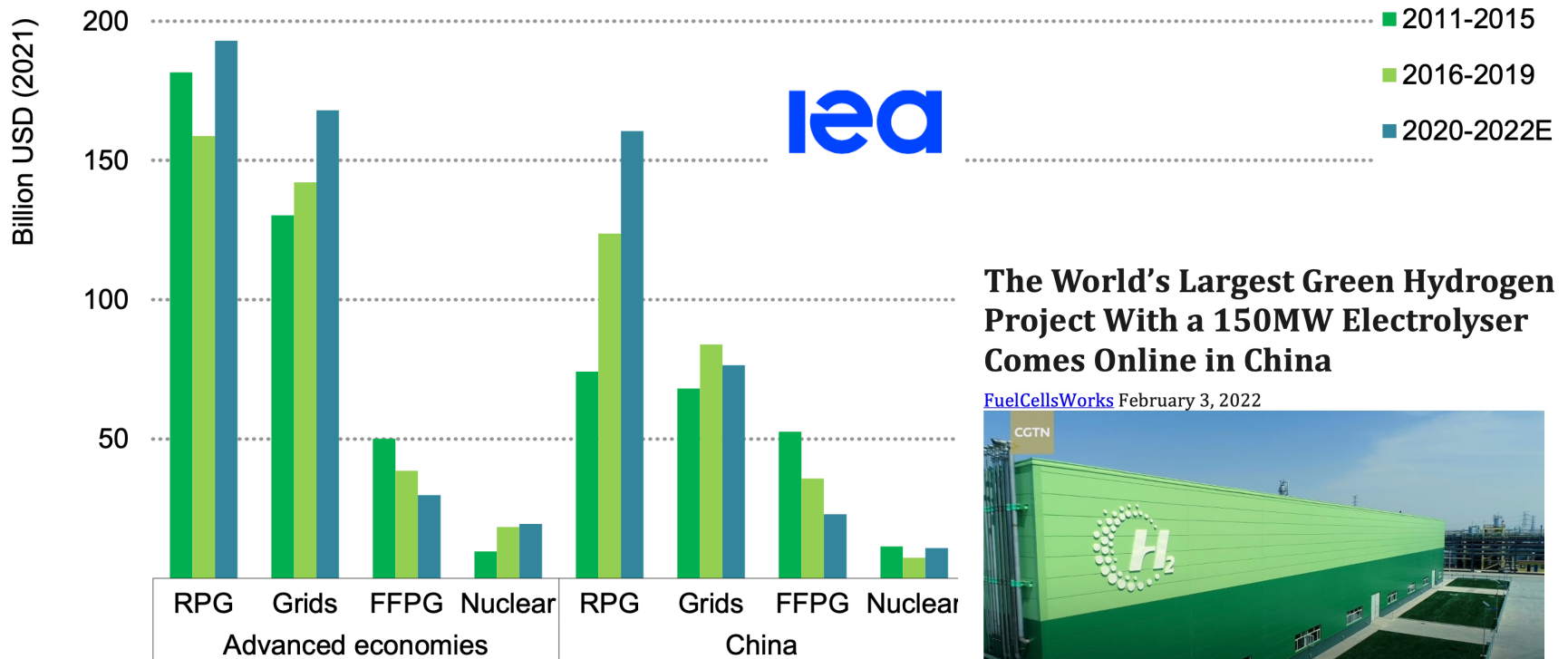
As emerging markets grow, and annual fossil fuel spend is capitalised into upfront RE infrastructure capex, energy investments will rise to ~\$4 trillion pa - US\$100 trillion by 2050



# China Leads the World on RE & EV Investing

China is big in coal, but it aims to be bigger in decarbonisation industries

Average annual investment in the power sector by geography and category, 2011-2022E



Source: IEA World Energy Investment 2022

Notes: RPG = renewable power generation; FFPG = fossil fuel power generation.

China leads the world on wind & solar installs & manufacturing, EV & batteries, hydro, nuclear, ground heat pumps, grid T&D, refining critical minerals (eg lithium, rare earths, nickel) and GH2.

CEF CGTN op-ed: [How China is leading in global energy transition](#)

## The World's Largest Green Hydrogen Project With a 150MW Electrolyser Comes Online in China

[FuelCellsWorks](#) February 3, 2022



Chinese chemical manufacturer **Ningxia Baofeng Energy Group** has commissioned the world's largest green hydrogen project in central China's Ningxia Autonomous Region with a 150MW alkaline electrolyser powered by a 200MW solar array.

Baofeng Energy's unprecedented facility achieves full commissioning as Chinese oil giant Sinopec breaks ground on 260MW plant

# China Leads the World in Electric Vehicles

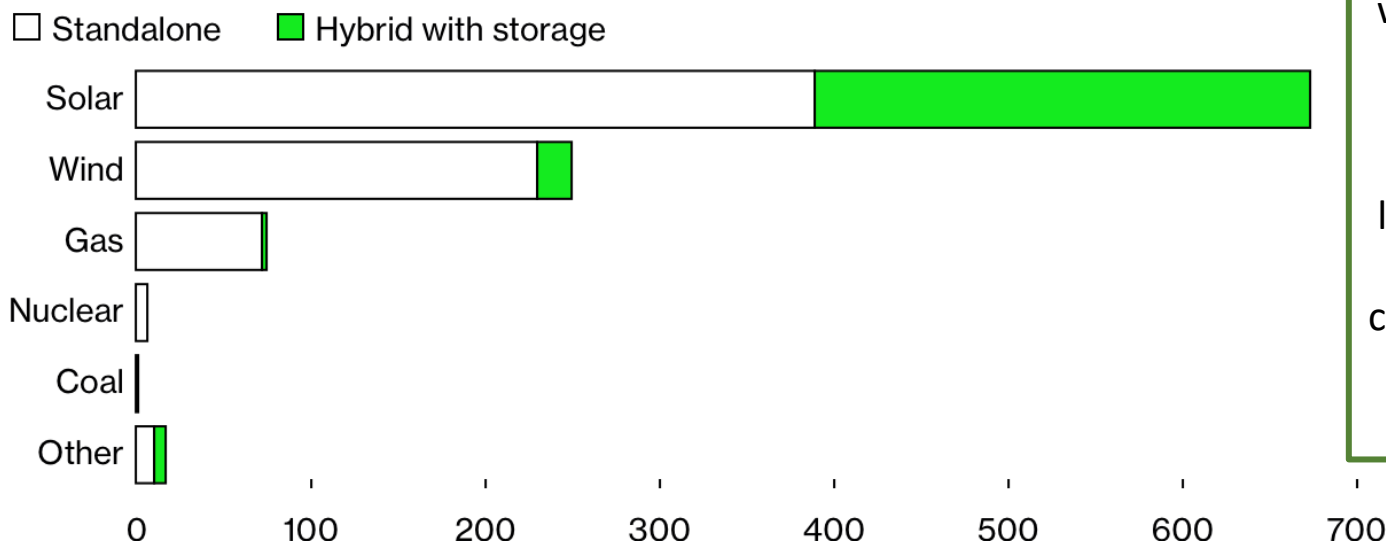
China has produced and sold 4.1 million EV/PHEV YTD'2022; growth of 110% yoy.  
China is on track to sell ~60% of the world's EVs in 2022.  
29% of all China car sales in August 2022 were EVs

<b>China Autos - 2022</b> (1,000 sets)	<b>August Absolute Value</b>	<b>August Increase rate Y/Y (%)</b>	<b>Share Aug</b>	<b>Jan-Aug Absolute Value</b>	<b>Jan-Aug Increase rate Y/Y (%)</b>	<b>Share Jan-Aug 2022</b>
Automobile	2,426	39%		17,358	6%	
Of which: New Energy Autos	714	117%	29.4%	4,074	110%	23.5%
BYD (world's #1 EV firm)	175	155%	24.5%	974	274%	23.9%

# US Inflation Reduction Act 2022

The US under President Biden has talked the talk, the IRA 2022 delivers serious firepower – US\$370bn

US interconnection queue by resource, year-end 2021, gigawatts



The US has 1,000 GW of wind & solar proposals in development (US\$1.5 trillion).

This includes a world leading 300GW of firmed RE proposals are in the connection queue. The US will install 6GW of batteries in 2022.

Source: Berkeley Lab

Note: Not all of these projects will ultimately be built!

October 2022 saw President Biden announce the US\$2.8bn American Battery Materials initiative, to mobilise the US government and its allies to strengthen the global supply chain for critical minerals used for power, electricity, and EVs.

# Rooftop Solar + EV + Storage => Disruption

US: 22GW in total, potentially 5.3GW adds in 2022

## Storms and steep utility bills drive US rooftop solar boom

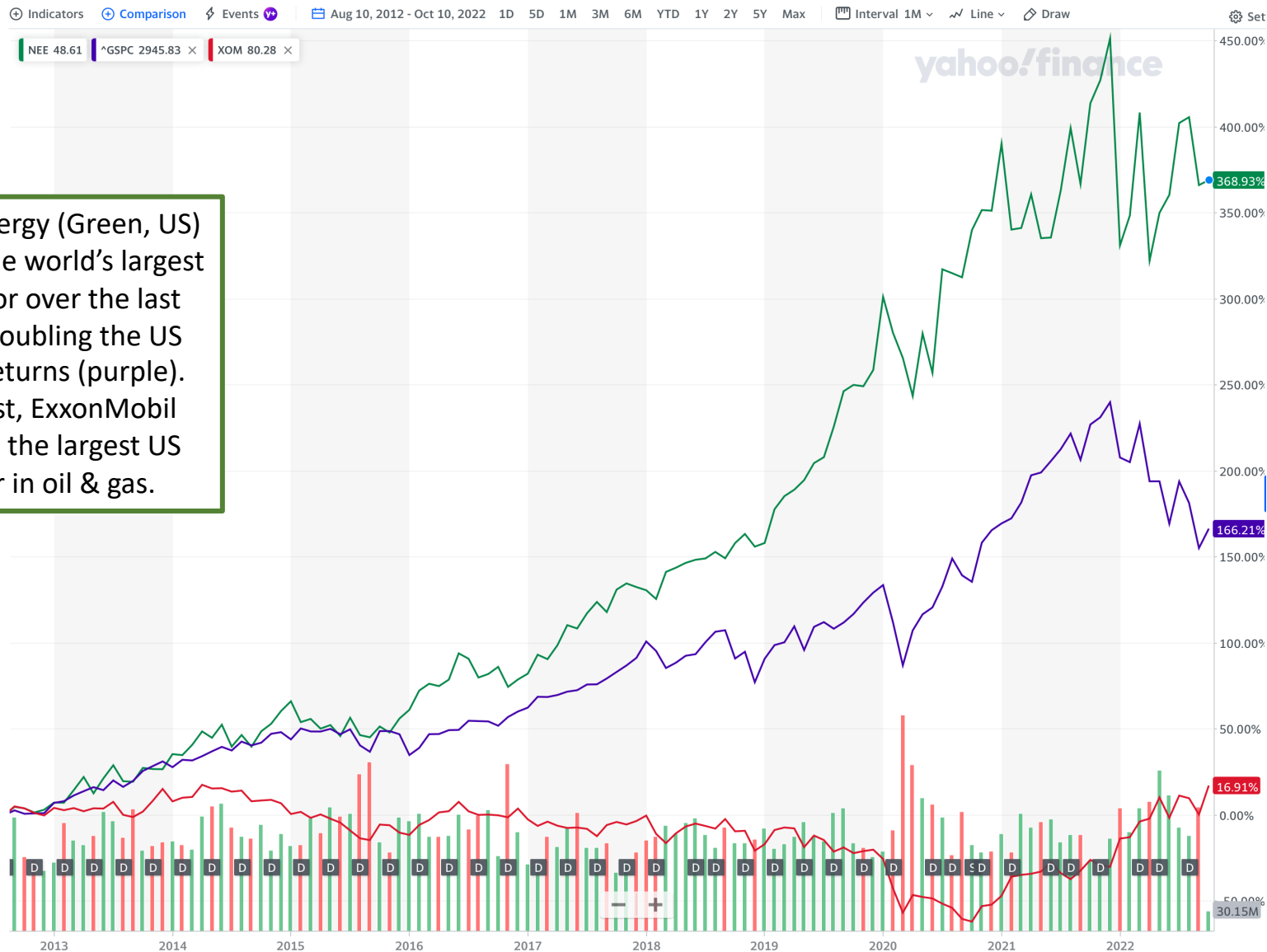
Installations have risen by 40% year on year as households seek alternatives after blackouts

Installed rooftop solar capacity, gigawatts



Source: Energy Information Administration

# Nextera Energy vs ExxonMobil



NextEra Energy (Green, US) has been the world's largest RE investor over the last decade, doubling the US S&P500 returns (purple). In contrast, ExxonMobil (Red) was the largest US investor in oil & gas.



# India's Aspirations: 400GW RE by 2030

Energy Security means reducing reliance on expensive, high emissions imported fossil fuels for India

## India's Electricity Capacity and Generation (FY2021/22)

	---- Capacity ----		-- Generation --		Capacity	Increase
	GW	%	TWh	%	Utilisation	GW yoy
Coal-fired	210.7	52.7%	1,082.9	72.6%	58.9%	1.4
Gas-fired	24.9	6.2%	31.3	2.1%	14.3%	0.0
Diesel-fired	0.5	0.1%	0.5	0.0%	12.0%	0.0
Large Hydro	46.7	11.7%	151.6	10.2%	37.3%	0.5
Nuclear	6.8	1.7%	47.1	3.2%	79.2%	0.0
Renewables	109.9	27.5%	170.9	11.5%	19.1%	15.4
Bhutan (Import)	n.a	n.a	7.5	0.5%	n.a.	
<b>Total</b>	<b>399.5</b>	<b>100.0%</b>	<b>1,491.8</b>	<b>100.0%</b>		<b>17.3</b>

Source: CEA, CEF Calculations

Electricity demand	2021/22	1,491.8	8.0% yoy
	2020/21	1,381.9	

India's June 2022 fossil fuel import bill was >US\$800bn annualised.

## India's Installed Electricity Capacity (GW) end FY2021/22 vs YTD FY2022/23

Generation Source	Mar-22	Sep-22	Change (GW)	% of new capacity
Renewables	109.9	118.1	8.2	98%
Large Hydro	46.7	46.9	0.1	2%
Nuclear	6.8	6.8	0.0	0%
Thermal	236.1	236.1	0.0	0%
<b>Total Ongrid Capacity</b>	<b>399.5</b>	<b>407.8</b>	<b>8.3</b>	<b>100%</b>

Source: CEA, MNRE, Climate Energy Finance calculations

# Australia: 43% Emissions Cut by 2030

A good start, but 82% RE by 2030 is world leading

NEWS, PRESS RELEASES | DECEMBER 3, 2021

## 82% Renewables by 2030 - Smart Energy Council Welcomes Labor's Powering Australia Plan



MEDIA RELEASE – 3rd December 2021

The Smart Energy Council has welcomed Federal Labor's comprehensive Powering Australia Plan which will see a Labor government lift the share of low-cost renewables in the National Electricity Market to 82% by 2030.

Powering Australia is a blueprint for action – a plan for modernising the economy, creating new jobs, industries and business opportunities.

It is the foundation stone for establishing Australia as a renewable energy superpower.

Powering Australia means more jobs and lower power bills for Australians because that is what smart energy delivers. This is the right policy at the right time.

The Smart Energy Council strongly welcomes major policy commitments by Federal Labor:

- Modernising Australia's ageing electricity grid through a **\$20 billion Rewiring the Nation plan**;
- Up to **\$3 billion to invest in renewables metals**, renewable energy component manufacturing and renewable hydrogen electrolyzers;
- **85 solar banks** and **400 community batteries** across Australia;
- **Removing taxes** from low priced EVs;
- **10,000 New Energy Apprentices** and a **New Energy Skills Program**; and
- The new commitment for the **Australian Public Service** to reach new **zero emissions by 2030**.

# Australia: 43% Emissions Cut by 2030

Final Draft due December 2022; will vested interests derail integrity?



Australian Government  
Department of Industry,  
Science and Resources

Find out how our **department has changed** to reflect Administrative Arrangements Orders commencing on 1 July 2022. and **energy** on this website. Find consultations from **energy ministers** on [energy.gov.au](https://energy.gov.au).

[Home](#) [Consultation hub](#) > Safeguard Mechanism reform: consultation paper

## Safeguard Mechanism reform: consultation paper

[Department of Climate Change, Energy, the Environment and Water](#) | [Climate change policy](#) | [Emissions reduction](#)

# Australia: 43% Emissions Cut by 2030

The 2022/23 Budget has \$25-40bn of new spend on decarbonisation



THE HON DR JIM CHALMERS MP  
TREASURER OF THE COMMONWEALTH OF AUSTRALIA

5 August 2022

## Public consultation begins on Multinational Tax Integrity and Transparency

Joint media release with

The Hon Stephen Jones MP  
Assistant Treasurer  
Minister for Financial Services

The Hon Dr Andrew Leigh  
Assistant Minister for Competition, Charities and Treasury

The Albanese Government has released a discussion paper for public consultation on our election commitment to ensure that multinationals pay their fair share.

Multinational corporations making a profit in Australia should pay their fair share of tax in Australia.

Our multinational tax package will close tax loopholes exploited by multinationals and improve tax transparency.

This will benefit Australians by funding vital services like Medicare, aged care and childcare; helping to service the trillion dollars of debt racked up by the former government; and levelling the playing field for Australian businesses.

The discussion paper addresses our commitments to strengthen the interest limitation rules for multinationals; deny deductions for payments relating to intangibles and royalties that lead to insufficient tax being paid; and enhance multinationals' disclosure of tax information, to ensure the public is better informed of multinationals' tax arrangements.

These commitments complement the Government's ongoing engagement in the OECD's Two-Pillar Global Tax Agreement, which includes a global minimum tax.

Unlike our predecessors, we won't let multinationals off the hook when it comes to their tax obligations and ensuring they pay their fair share of tax.

### Climate Energy Finance Windfall Profits Report, August 17, 2022

- Cancel miners diesel fuel subsidy
- Reform the PRRT
- Multinational Corp tax reform
- An East Coast LNG export levy
- NSW progressive coal royalty

<https://www.smh.com.au/national/it-s-time-for-fossil-fuel-profiteers-to-pay-their-way-20220819-p5bbac.html>



### Windfall profits: time to fix loopholes and subsidies to serve Australians better

*Tim Buckley, Director, Climate Energy Finance  
August 2022*

# Australian Electricity Generation

Coal closures are accelerating, private investors are only backing firm VRE

Renewable Share of NEM:

2017: 16%

2022 (YTD): 33%

2030 (f): 82%

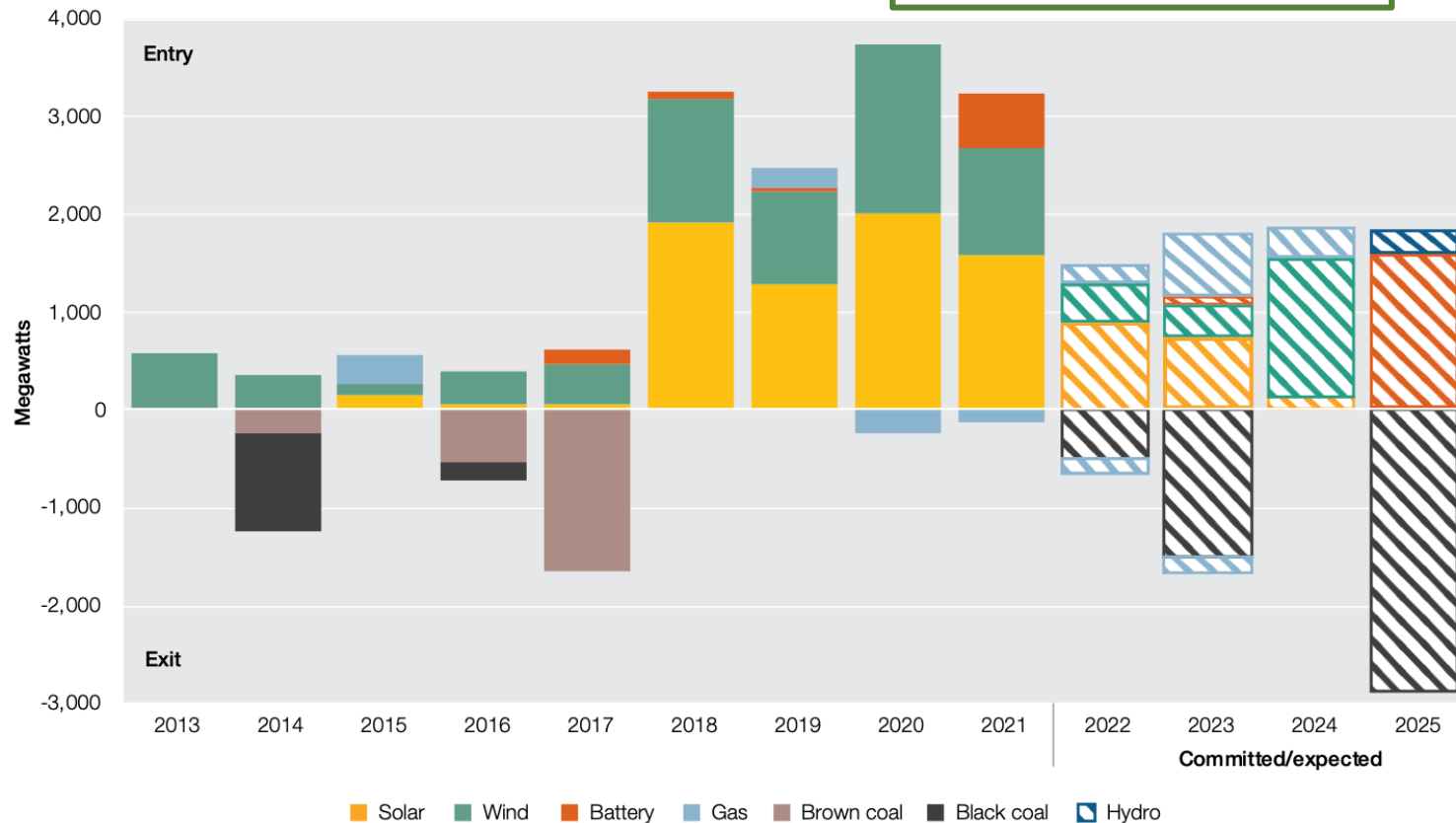
NEM coal closures pending:

2023: Liddell (2.05GW)

2025: Eraring (2.88GW)

2028: Yallourn (1.48GW)

2030-33: Bayswater (2.64GW)





# AGL Energy: From Laggard to Leader?

## Investors demand Paris alignment as AGL dumps split



**Angela Macdonald-Smith**

Senior resources writer

Updated May 30, 2022 – 6.30pm,  
first published at 9.06am



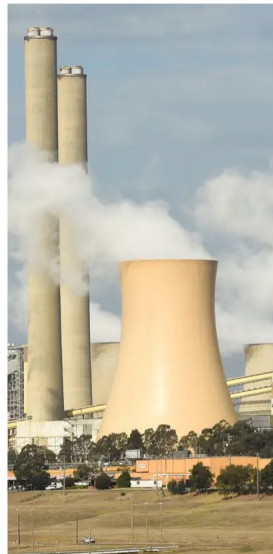
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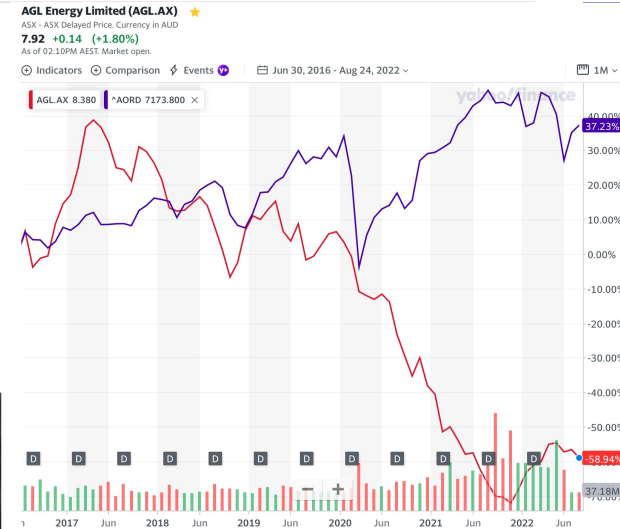
Share

AGL Energy's decimated board is coming under immediate pressure from large shareholders, led by tech billionaire Mike Cannon-Brookes, to bring forward its exit from coal power generation by 10 years or more after it was [forced into a humiliating backdown on a plan to split the business](#).

The ditching of the demerger proposal confirmed by the country's biggest electricity supplier on Monday claimed the scalps of chairman Peter Botten and chief executive Graeme Hunt, as well as two non-executive directors.



AGL Energy chief executive Graeme Hunt and Atlassian founder Mike Cannon-Brookes. Louie Douvis, Justin McManus, Wolter Peeters



NSW Energy Minister  
Matt Kean's Hunter  
Valley REZ received  
A\$100bn / 40GW of  
firmed VRE proposals in  
March 2022

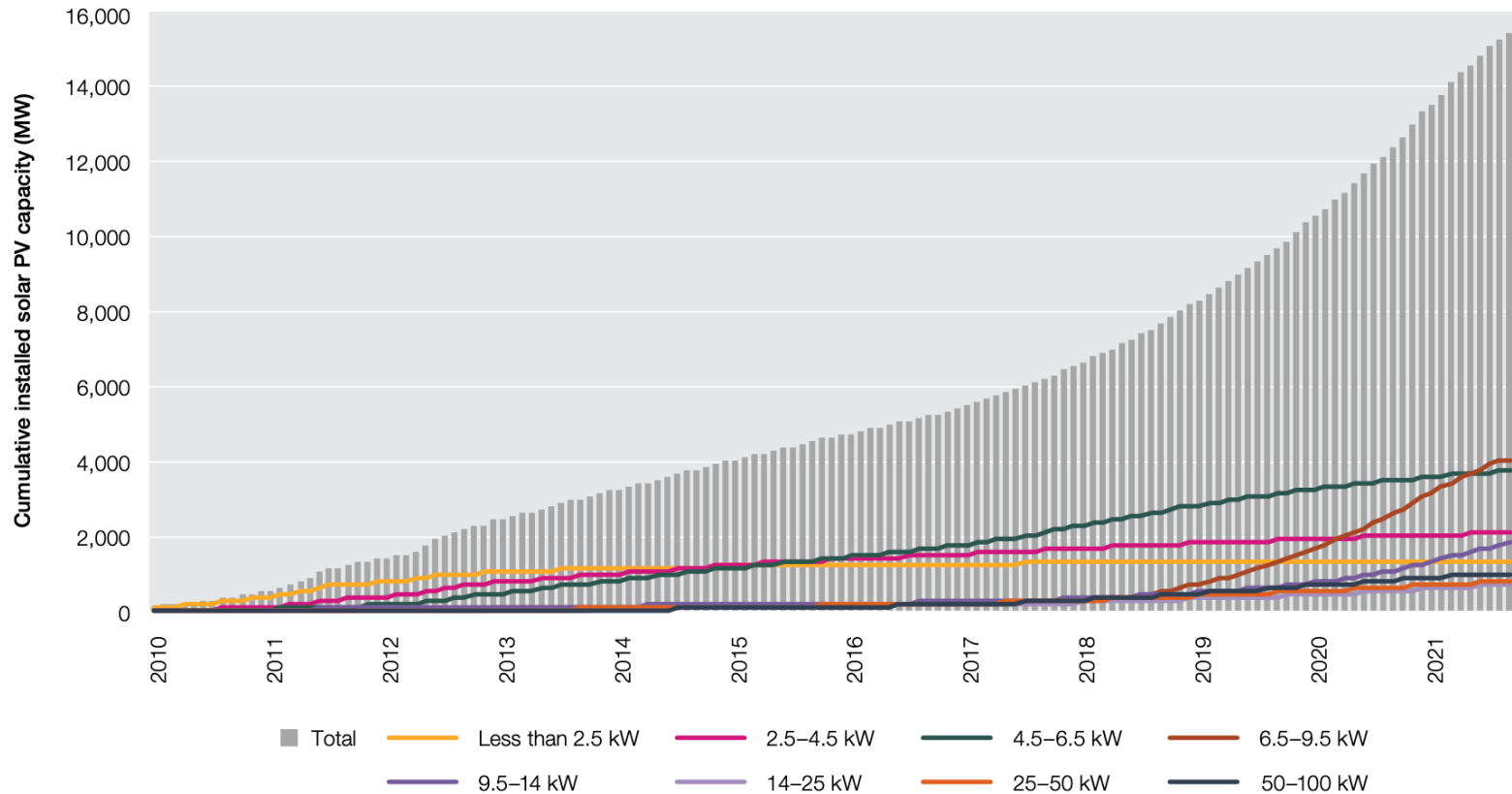
<https://www.nsw.gov.au/media-releases/100-billion-of-investment-potential-for-hunter-central-coast-renewable-energy-zone>

CEF op-ed in AGL (19 Aug 2022):  
[AGL leadership farce: Blind to climate science, and still in the control room](#)

Sentient Impact & CEF report (June 2022): [AGL Investors outline how the company can go from Laggard to Leader](#)

# Rooftop Solar + EV + Storage => Disruption

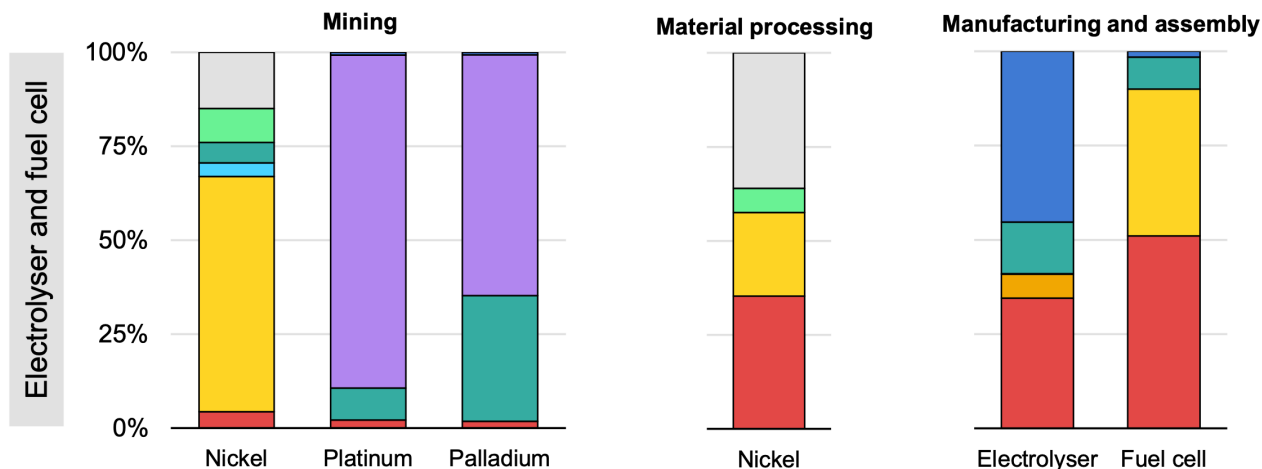
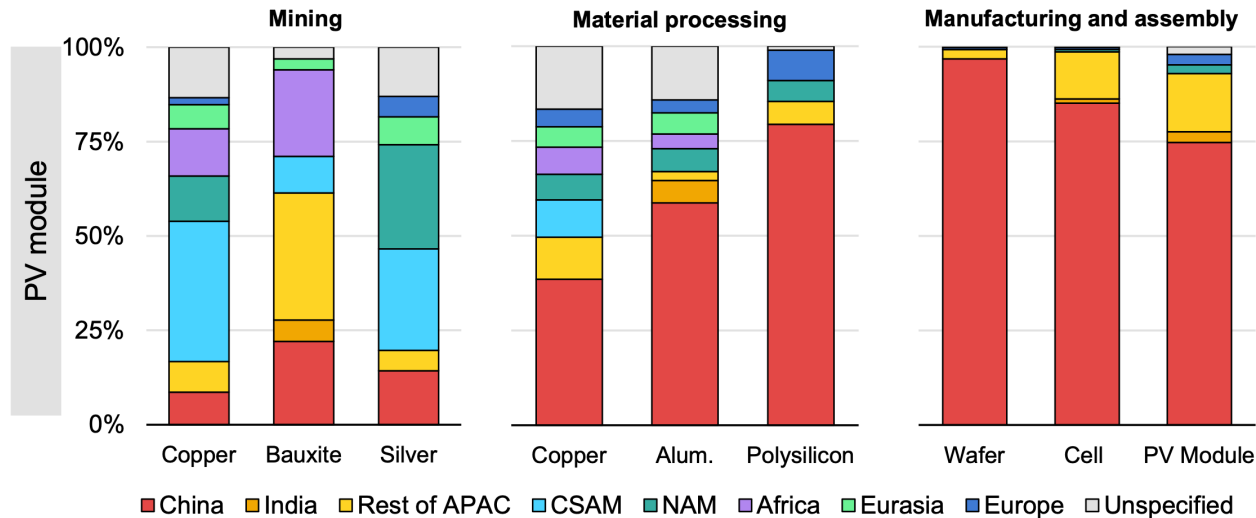
Australia: 15GW of Rooftop Solar, 3GW pa adds



AEMO's Integrated System Plan:  
2022: 15GW rooftop solar  
2050: 68GW rooftop solar

# 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



# Australia Will be a Critical Minerals Superpower

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

## Australia's mammoth renewable minerals opportunity – and how to harness it

Tim Buckley & Matt Pollard 25 October 2022 1



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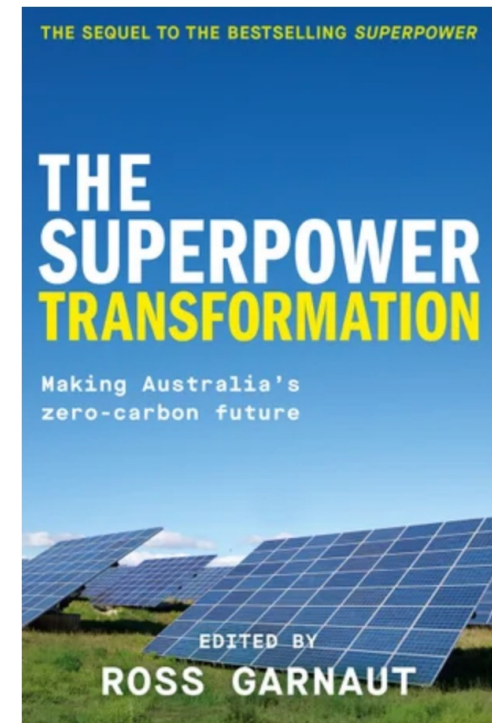
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*This is the fifth article in a series on value-adding critical minerals opportunities in Australia. You can read the first, second, third and fourth installations [here](#), [here](#), [here](#) and [here](#).*

Source: Renew Economy Australia's mammoth renewable minerals opportunity – and how to harness it 25 October 2022  
<https://reneweconomy.com.au/australias-mammoth-renewable-minerals-opportunity-and-how-to-harness-it/>

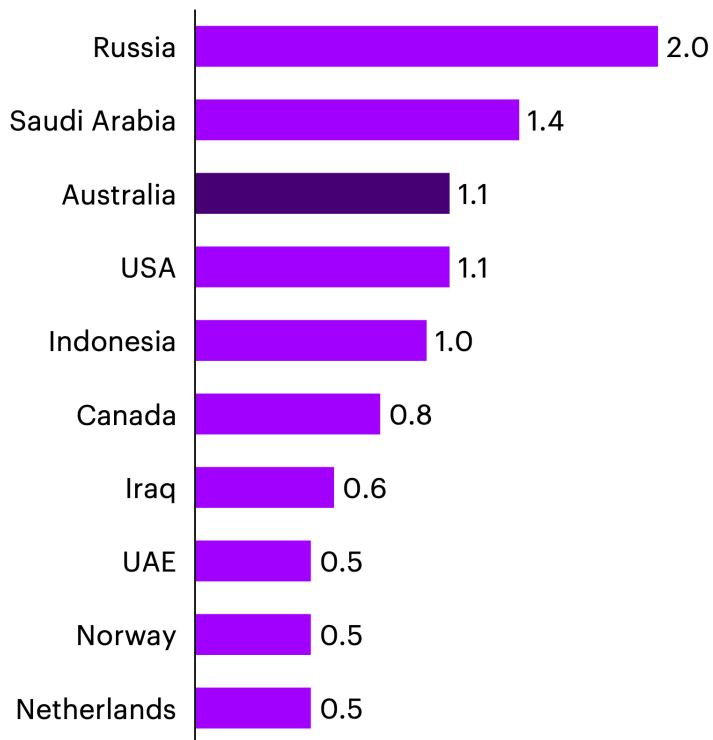


# Australia Will be a Critical Minerals Superpower

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

**Figure 4: Global ranking of CO<sub>2</sub> emissions due to fossil fuel exports<sup>4</sup>**

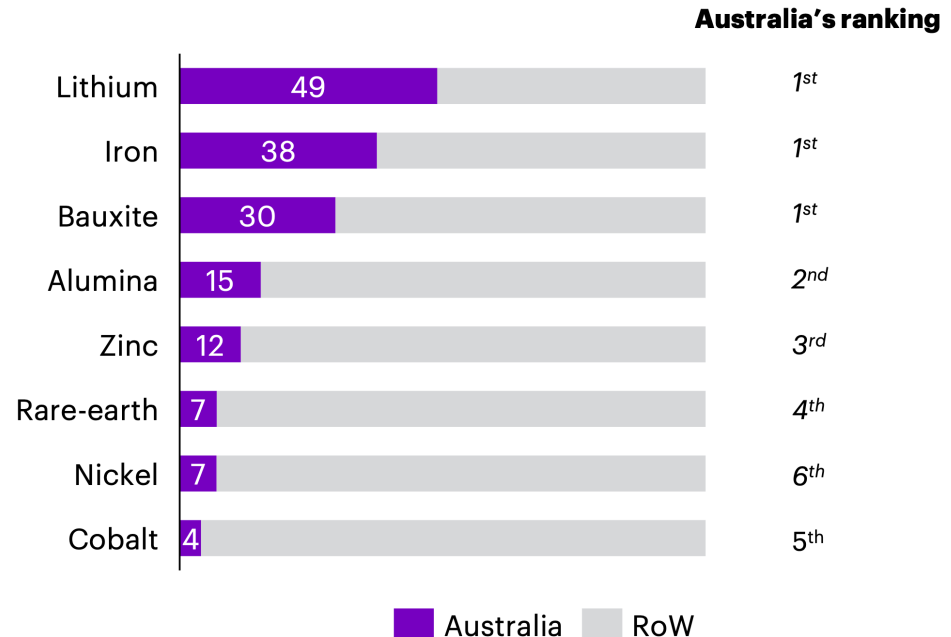
billion tonnes



**Figure 8: Australia's production of select metals and minerals essential for the energy transition<sup>3</sup>**

% of global production

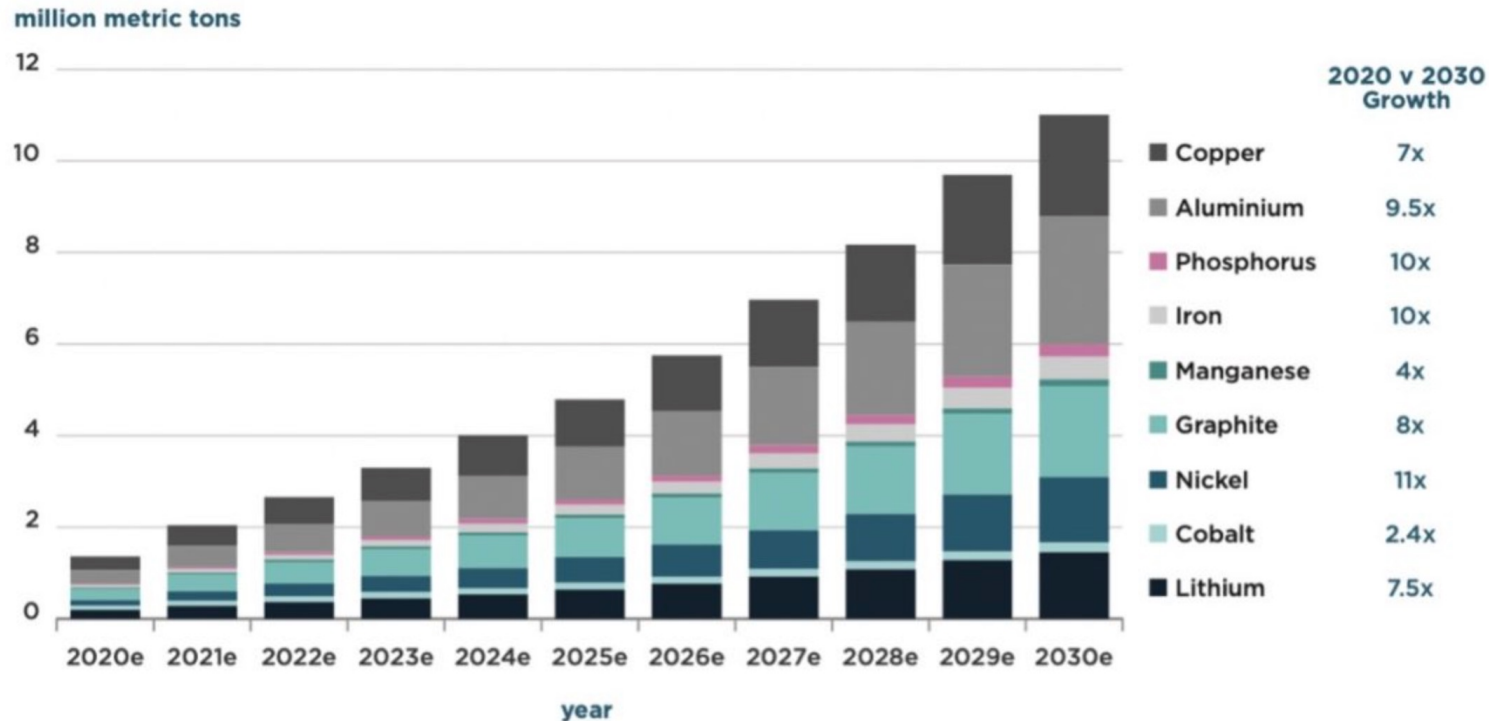
2021





# Australia Will be a Critical Minerals Superpower

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



Source: BloombergNEF

Note: Metals demand is assumed to occur approximately one year before battery demand, i.e. metals demand in 2030 is metal content of batteries deployed in 2031 (with allowances for material waste fabrication). Lithium includes material used in cathodes and electrolytes. It is expressed as Lithium Carbonate Equivalent (LCE). To convert to contained metal, multiply by 19%. Copper includes copper current collectors and pack wiring. Aluminium includes aluminium current collectors, cell and pack materials and aluminium in cathode active materials.

# Australia Will be a Critical Minerals Superpower

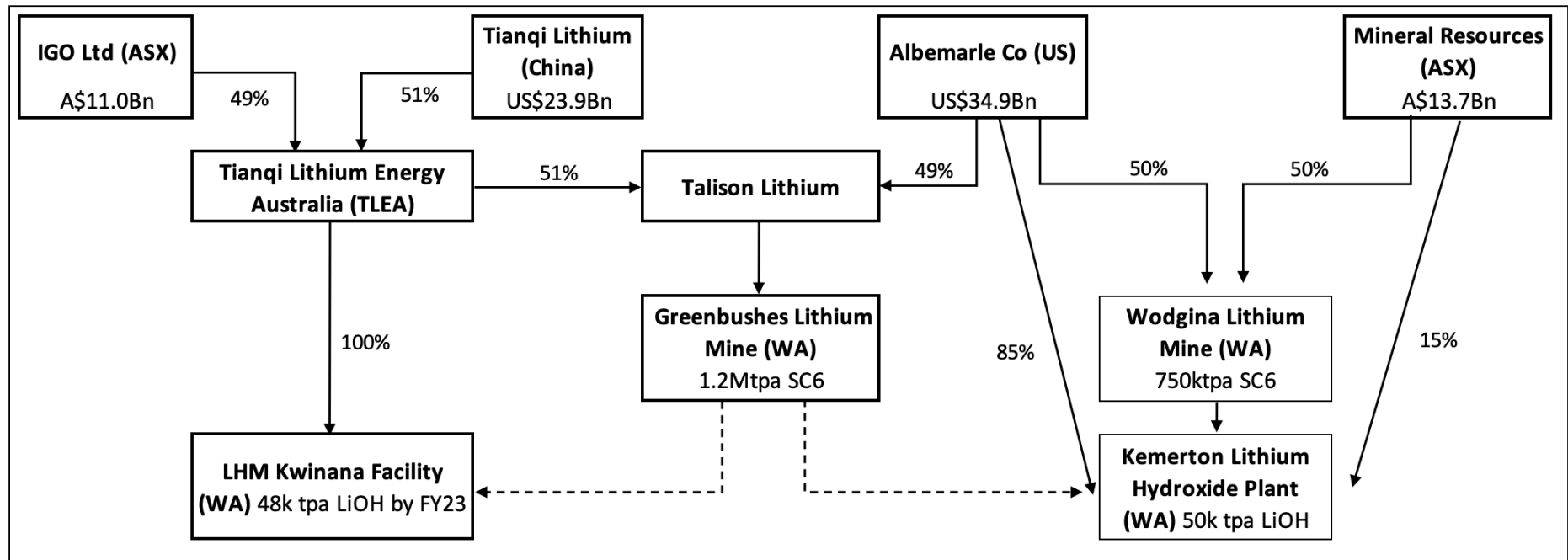
Supply chain security, cheap RE and resource ownership means Australia should be leveraging our new competitive advantages to lead the global energy transition



# Australia Will be a Critical Minerals Superpower

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

**Lithium Mining and Refining in West Australia (IGO, Mineral Resources, Tianqi & Albemarle)**



Source: Company Accounts, Climate Energy Finance calculations

October 2022

# Australia Will be a Critical Minerals Superpower

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

## Western Australia's key midstream investments

- Operating/committed
- Planned – with government funding in place

**Lithium**  
**Tianqi Lithium Australia**  
Production capacity:  
48,000 tpa of lithium hydroxide  
Capex: \$700 million

**Lithium**  
**Covalent Lithium**  
Production capacity:  
45,000 tpa of lithium hydroxide  
Capex: \$1.9 billion\*

**Nickel**  
**BHP Nickel West**  
Production capacity:  
100,000 tpa of nickel sulphate  
Capex: \$60 million

**Graphite**  
**Ecograf**  
Production capacity:  
20,000 tpa of spherical graphite  
Capex: \$100 million

**Rare earths**  
**Hastings Technology Metals**  
Production capacity:  
3,400 tpa NdPr<sup>^</sup>  
Capex: \$650 million

**Vanadium**  
**Australian Vanadium**  
Production capacity:  
11,200 tpa of vanadium  
Capex: \$600 million

**Rare earths**  
**Iluka Resources**  
Production capacity:  
17,500 tpa of rare earth oxides  
Capex: \$1.2 billion

**Lithium**  
**Albemarle Lithium**  
Production capacity:  
50,000 tpa of lithium hydroxide\*\*  
Capex: \$1 billion

**Rare earths**  
**Lynas Rare Earths**  
Production capacity:  
10,500 tpa NdPr<sup>^</sup>  
Capex: \$500 million^^

**P-CAM**  
**Pure Battery Technologies**  
Production capacity:  
50,000 tpa precursor cathode active material (P-CAM)  
Capex: \$460 million

FMG's A\$5bn Iron Bridge  
67% Fe 22Mtpa magnetite  
mine-and-processing  
project 145km south of Port  
Hedland in the Pilbara  
commissioning March 2023.

<https://reneweconomy.com.au/eight-key-critical-minerals-projects-in-australias-10bn-pipeline/>

tpa = tonnes per annum

\*inclusive of mine and concentrator

\*\* 100,000 tpa once fully operational

<sup>^</sup> Neodymium and Praseodymium, produced as a rare earth carbonate

<sup>^^</sup> Figure inclusive of Malaysian plant upgrades

Production capacity and capex figures are provided as estimates only. Actual production and costs may vary

Source: Western  
Australian Government,  
August 2022  
<https://www.wa.gov.au/government/documents/collections/battery-and-critical-minerals-prospectus>