

Disruptive Technologies: The Implications of Decarbonisation in the Indo-Pacific for Australia's Strategic Interests

29 Feb 2024, 1-2.30pm JST; 3-4.30pm AEDT



**Australian
National
University**

Disruptive Technologies: The Implications of Decarbonisation in the Indo-Pacific for Australia's Strategic Interests



Professor Llewelyn Hughes

Professor at the Crawford School of Public Policy, Australian National University, where he works on low carbon energy transition policies in the Asia Pacific. Prof. Hughes also serves on the Energy Transition Subcommittee of the Australia Japan Business Co-operation Committee, and is Australia Focal Point for the Energy Research Institute Network of the Economic Research Institute for ASEAN and East Asia. He received his PhD from the Massachusetts Institute of Technology, and holds a Masters' Degree from the Graduate School of Law and Politics at the University of Tokyo.



Dr Thomas Longden

Senior Research Fellow, Systems Innovation and Demonstration, Urban Transformations Research Centre, Western Sydney University, and a Visiting Fellow at the ANU Institute for Climate, Energy and Disaster Solutions. Thomas holds a PhD in environmental economics from the University of New South Wales (UNSW). His work on energy and technological change has been published in leading international journals (including Nature Energy, Climatic Change, Energy, Technological Forecasting and Social Change, and Energy Policy). Thomas was a Contributing Author on the AR5 WGIII Intergovernmental Panel on Climate Change (IPCC) report titled Mitigation of Climate Change.





How can we defend Australia from disasters?
Join our next Game Change Webinar on Monday 26 June

About Us

We connect people with climate, energy & disaster-risk research from The Australian National University. Our goal is to advance innovative solutions to address climate change, energy system transitions and disasters. We facilitate integrated approaches to research, teaching and policy, industry and community engagement across disciplines. We also lead the [ANU Below Zero Initiative](#) in research, teaching and engagement. The initiative is working to reduce the University's greenhouse gas emissions to below zero.

Our Institute consolidates and builds on the activities of the former ANU Climate Change Institute, Energy Change Institute, and Disaster Risk Science Institute.

Zero Carbon Energy for the Asia-Pacific Initiative (ZCEAP)



Photo: Shutterstock

Australia supporting the energy transition in the Asia-Pacific region.

For more information, contact: zerocarbon@anu.edu.au

About Us »

Find out more about ZCEAP, including how to partner with us.

Programs »

Read more about our research programs.

People »

Find a list of our academic and professional staff.

2024

Journal Articles

- Lee V. White, Bradley Riley, Sally Wilson, Francis Markham, Lily O'Neill, Michael Klerck, Vanessa Napaltjari Davis, [Geographies of regulatory disparity underlying Australia's energy transition](#), *Nature Energy*, (January 2024) [Journal Article]
 66
- Tong Zhang, Paul J Burke, Qi Wang, [Effectiveness of electric vehicle subsidies in China: A three-dimensional panel study](#), *Resource and Energy Economics*, 76, 101424, (January 2024) [Journal Article]
- Falko Ueckerdt, Philipp C Verpoort, Rahul Anantharaman, Christian Bauer, Fiona Beck, Thomas Longden, Simon Roussanaly, [On the cost competitiveness of blue and green hydrogen](#), *Joule*, (January 2024) [Journal Article]

Working Papers




- Lee V. White, Emma Aisbett, Oscar Pearce, Wenting Cheng, [Principles for embedded emissions accounting to support trade-related climate policy](#) (ZCWP 02-24) (PDF, 941 KB) [Working Paper]
- Christopher Jackson, Emma Aisbett, [Multi-Criteria Analysis for Green Industrial Policy: methodology for application to Australia's Guarantee of Origin Scheme?](#) (ZCWP 01-24) (PDF, 2.13 MB) [Working Paper]








Policy Briefs

- Lee V. White, Bradley Riley, Sally Wilson, Francis Markham, Lily O'Neill, Michael Klerck & Vanessa Napaltjari Davis, [Regulatory disparities disadvantage remote Australian communities in energy transition](#), *Nature Energy*, Volume 9, (January 2024) [Policy brief]

2023

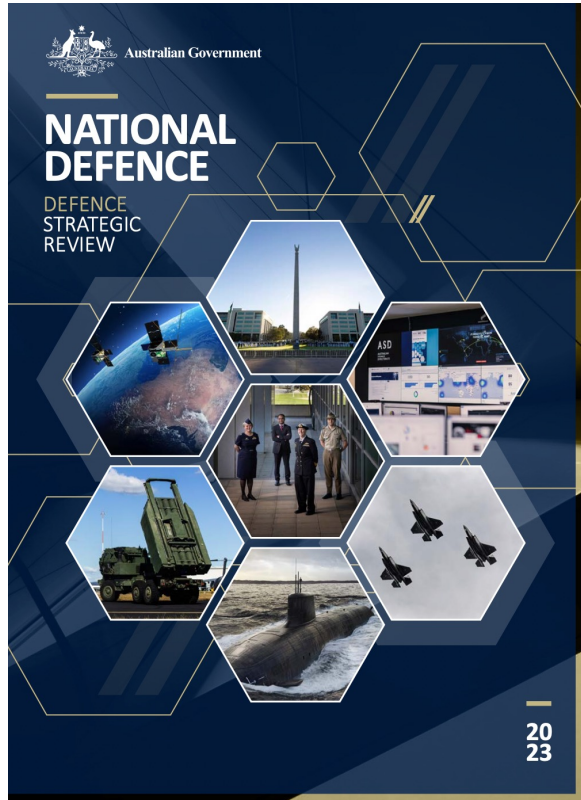
Journal Articles

- Llewelyn Hughes, Thomas Longden, [Offshore wind power in the Asia-Pacific: Expert elicitation on costs and policies](#), *Energy Policy*, Volume 184, (November 2023) [Journal Article]
 14
- Paul J. Burke, [Comment on "Implications of deglobalization on energy and carbon neutrality in Asia and the Pacific region"](#), *Asian Economic Policy Review*, [In press]
- Astha Sharma, Thomas Longden, Kylie Catchpole, Fiona J. Beck, [Comparative techno-economic analysis of different PV-assisted direct solar hydrogen generation systems](#), *Energy and Environmental Science*, (August 2023) [Journal article]
 2
- Emma Aisbett, Wyatt Raynal, Ralf Steinhauser, Bruce Jones, [International Green Economy Collaborations: chasing mutual gains in the energy transition](#), *Energy Research and Social Science*, Volume 104, 103249, (August 2023) [Journal article]
 10

- Emma Aisbett, Wyatt Raynal, Ralf Steinhauser, Bruce Jones, [International Green Economy Collaborations: chasing mutual gains in the energy transition](#), *Energy Research and Social Science*, Volume 104, 103249, (August 2023) [Journal article]
 10
- Naufal Rospriandana, Paul J. Burke, Amalia Suryani, M. Husni Mubarok, Miranda A. Pangestu, [Over a century of small hydropower projects in Indonesia: A historical review](#), *Energy, Sustainability and Society*, Volume 13, Article 30 (August 2023) [Journal article]
 7
- Wenting Cheng, Kai Zhang, [Setting 'green' boundaries for Chinese green finance: Multi-level governance and regulatory stringency](#), *Environmental Policy and Governance*, (July 2023) [Journal article]
- Bradley Riley, Lee V. White, Simon Quilty, Thomas Longden, Norman Frank Jupurrurra, Serena Morton Nabanunga & Sally Wilson, [Connected: rooftop solar, prepay and reducing energy insecurity in remote Australia](#), *Australian Geographer*, (June 2023) [Journal article]
 57
- Thang Nam Do, Paul J. Burke, Bin Lu, [Harnessing solar and wind for sustainable cross-border electricity trade in the Greater Mekong Subregion](#), *Frontiers in Environmental Science*, Volume 11 (June 2023) [Journal article]
 8
- Bradley Riley, Lee V. White, Sally Wilson, Michael Klerck, Vanessa Napaltjari-Davis, Simon Quilty, Thomas Longden, Norman Frank Jupurrurra, Morgan Harrington, [Disconnected during disruption: Energy insecurity of Indigenous Australian prepay customers during the COVID-19 pandemic](#), *Energy Research & Social Science*, 99, 103049 (March 2023) [Journal article]
 121
- Wenting Cheng, [The green investment principles: from a nodal governance perspectives](#), *International Environmental Agreements: Politics, Law and Economics*, (March 2023) [Journal article]
- Thang Nam Do, Paul J. Burke, [Phasing out coal power in a developing country context: Insights from Vietnam](#), *Energy Policy*, Volume 176 (May 2023) [Journal article]
 30
- Alireza Rahbari, Armando Fontalvo, John Pye, [Solar-thermal beneficiation of iron ore: System-level dynamic simulation and techno-economic optimisation](#), *Applied Thermal Engineering*, Volume 223, (March 2023) [Journal article]
- Paul J. Burke, [On the way out: Government revenues from fossil fuels in Australia](#), *Australian Journal of Agricultural and Resource Economics*, Volume 67, Issue 1 (January 2023) [Journal article]
 14
- Mara Hammerle, Lee V. White, Bjorn Sturmberg, [Solar for renters: Investigating investor perspectives of barriers and policies](#), *Energy Policy*, Volume 174 (January 2023) [Journal article]



Australian Government Defence Strategic Review 2023



“Climate change is now a national security issue.”

“Climate change will increase the challenges for Australia and Defence, including increased humanitarian assistance and disaster relief tasks at home and abroad. If climate change accelerates over the coming decades it has the potential to significantly increase risk in our region. It could lead to mass migration, increased demands for peacekeeping and peace enforcement, and intrastate and interstate conflict.”

“Australia has the potential to benefit substantially from global decarbonisation if we can harness our renewable and mineral resources and drive investment in clean technology supply chains and energy intensive industry. Defence also needs to focus on clean energy transition.”

“Australian statecraft now requires a consistent and coordinated whole-of-government approach to international affairs and the harmonisation of a range of domestic and external national security portfolios, from trade and investment to education, minerals and resources, clean energy, climate, industry, infrastructure and more.”



Disruptive Technologies: The Implications of Decarbonisation in the Indo-Pacific for Australia's Strategic Interests

- ◉ Australia has been, and remains, a key supplier of energy commodities to countries in the Indo-Pacific region, including Japan.
- ◉ Policies implemented in the region in responding to climate change have important implications for energy geopolitics. For example,
 - ◉ Changes in the ratio of different energy sources used to supply the domestic economy.
 - ◉ Changes in volumes of traded energy.
 - ◉ The emergence of potentially disruptive technologies, such as hydrogen, storage options, and Carbon Capture and Sequestration (CCS).
- ◉ There is also uncertainty about future levels of climate ambition and decarbonisation pathways from different countries.



How Can We Study This Issue?

- ◉ The demand for fossil fuels in Australia's key trading partners may change as they implement strengthened climate commitments.
- ◉ To investigate the possible energy futures in the Indo-Pacific we use an Integrated Assessment Model to compare scenarios.
- ◉ We use the Global Change Assessment Model (GCAM) to compare:
 - ◉ level of climate policy ambition;
 - ◉ the available technology options supporting decarbonisation:
 - ◉ carbon capture and storage,
 - ◉ options for firming renewables, such as batteries and pumped hydro.



Why now? – Changing region

- Future of coal and gas in Asia is a contemporary issue in terms of energy security.
- It will become more important for the Australian trade of fuel commodities when climate policies start to take effect.

Country	Nationally Determined Contributions	Net Zero pledge
China	Peak CO2 emissions in 2030	2060
India	33-35% reduction in emission intensity by 2030	2070
Indonesia	31.89% emission reduction by 2030	After 2070
Japan	46% reduction in GHG below 2013	2050
South Korea	Reduce emissions by 32% against 2030	2050



Scenario analysis using GCAM

		Climate policy targets	
		Lower ambition	Higher ambition
		<ul style="list-style-type: none"> ○ Countries achieve NDC, then uses that as a cap until 2050 	<ul style="list-style-type: none"> ○ Countries achieve NDC AND emissions reductions continue to Net Zero
Technology assumptions	No change to renewables firming and CCS (baseline GCAM settings)	<ul style="list-style-type: none"> ○ Lower ambition ○ Technology Future 1 (TF1) 	<ul style="list-style-type: none"> ○ Higher ambition ○ Technology Future 1 (TF1)
	More renewables RE firming and limited CCS	<ul style="list-style-type: none"> ○ Lower ambition ○ Technology Future 2 (TF2) 	<ul style="list-style-type: none"> ○ Lower ambition ○ Technology Future 2 (TF2)

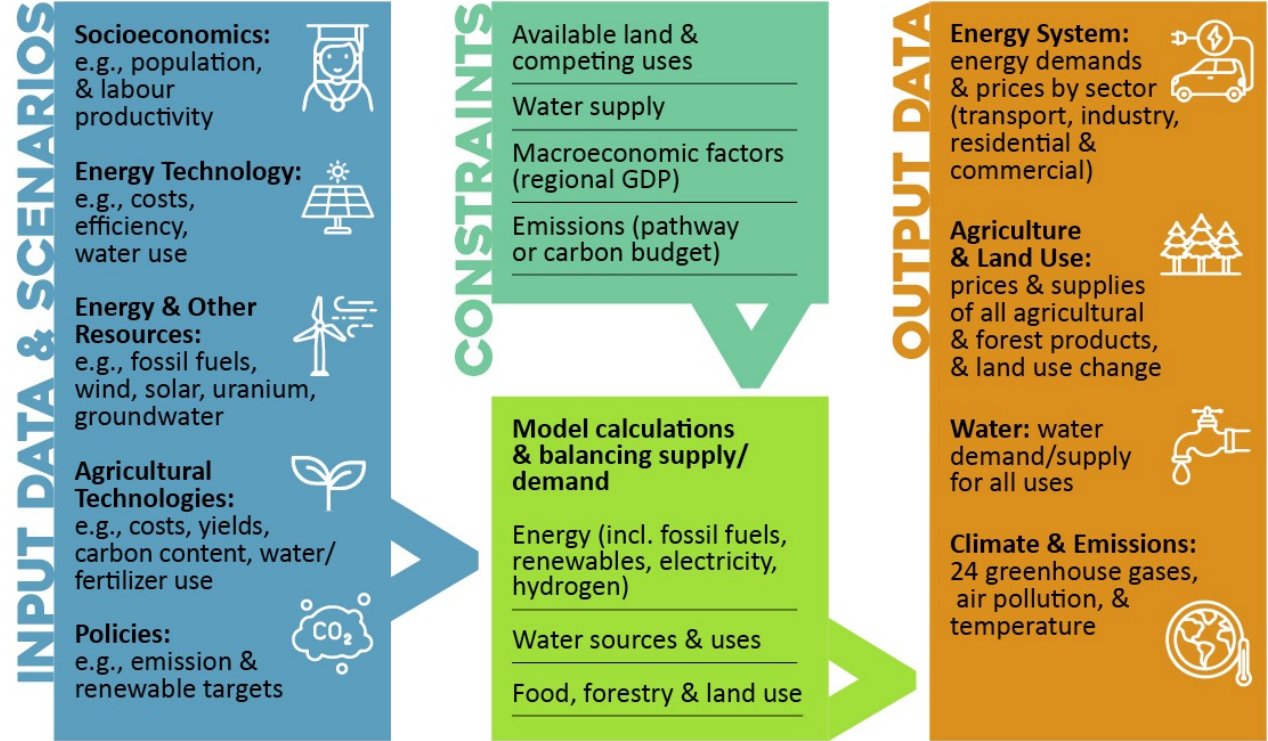


We have adopted **Global Change Analysis Model (GCAM)** to model decarbonisation pathways in the Indo-Pacific.

This has implications for Australian exports of carbon intensive fuels.

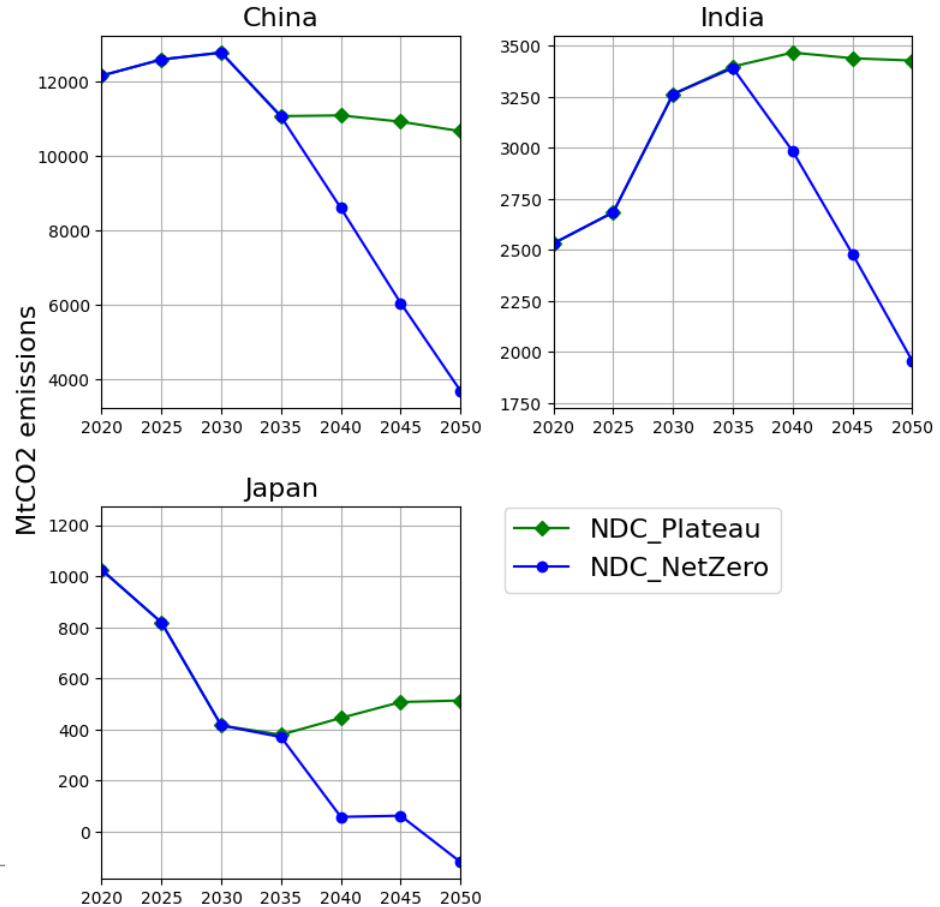
Key revisions were needed, e.g.

- Population and GDP projections,
- Capital costs and firming of renewables.



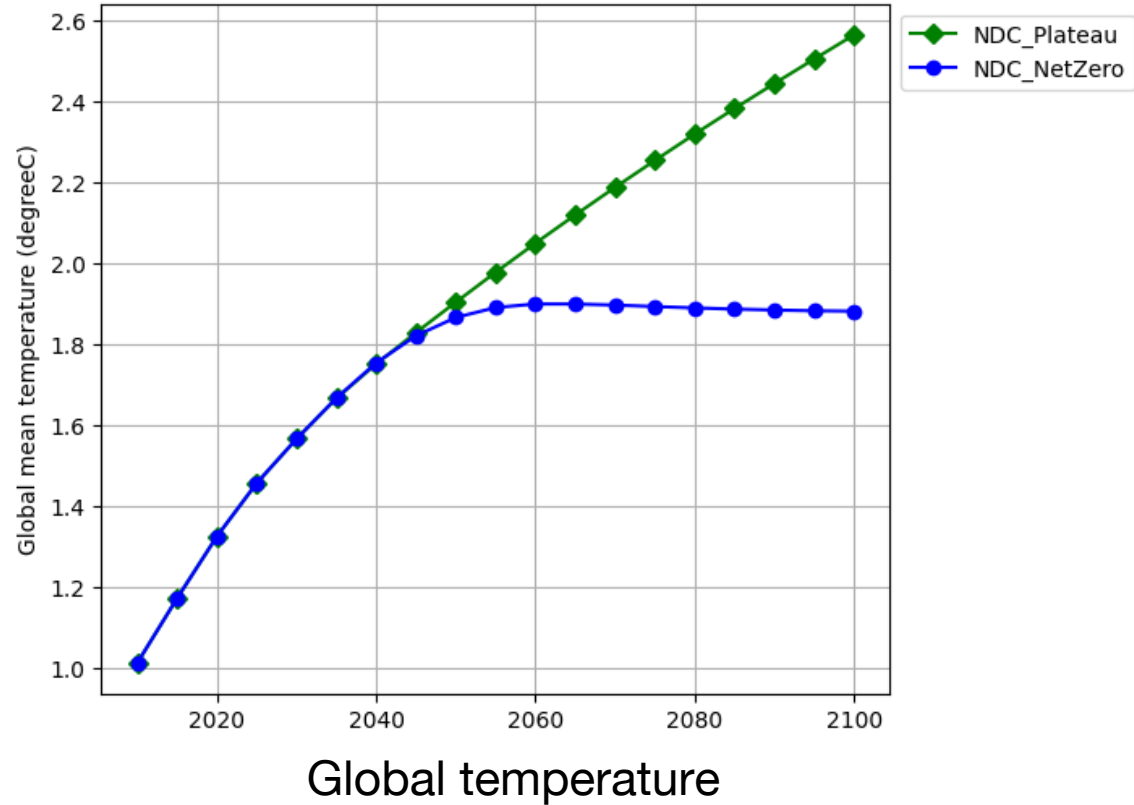
Two emissions pathways

- By combining the NDCs for 2030 with Net Zero targets, we can show the impact of these scenarios on global temperatures.
- Basically, the difference between continued increase and staying below 2°C

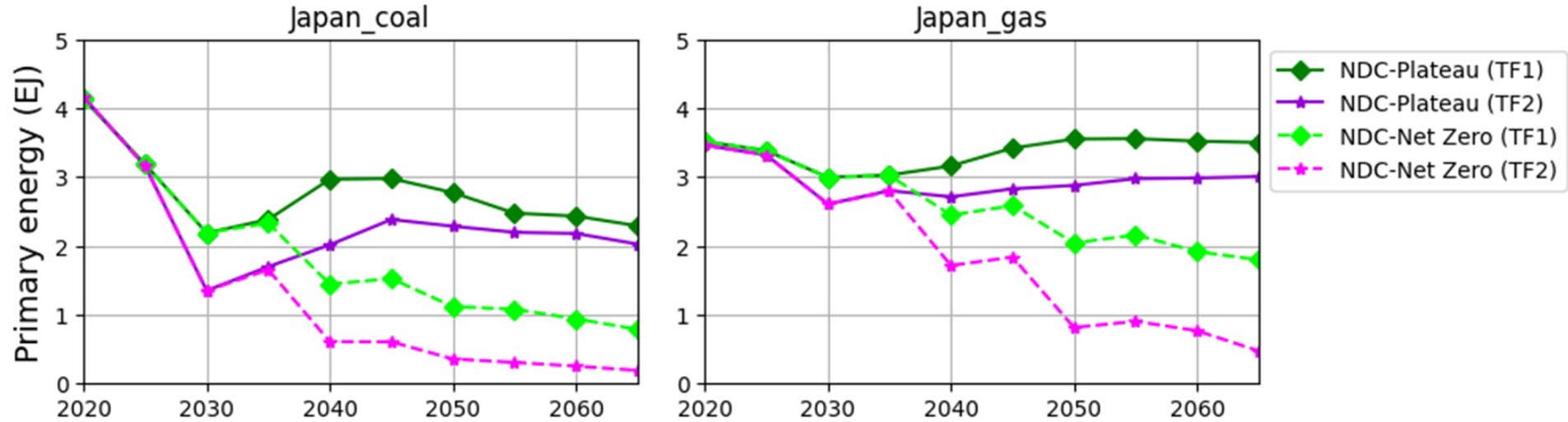


Two emissions pathways

- By combining the NDCs for 2030 with Net Zero targets, we can show the impact of these scenarios on global temperatures.
- Basically, the difference between continued increase and staying below 2°C

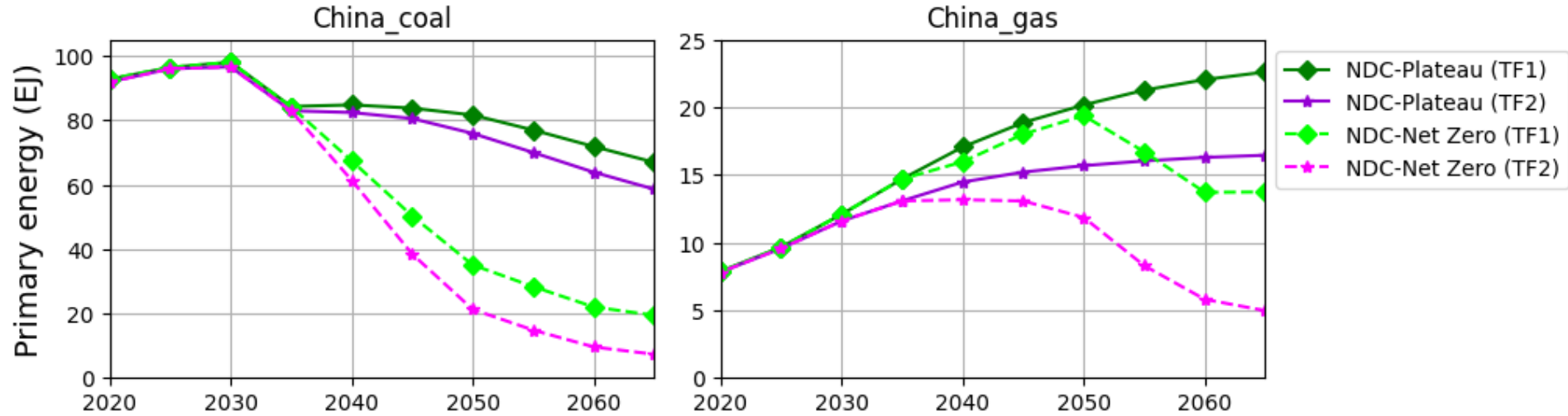


Japan – coal and gas demand



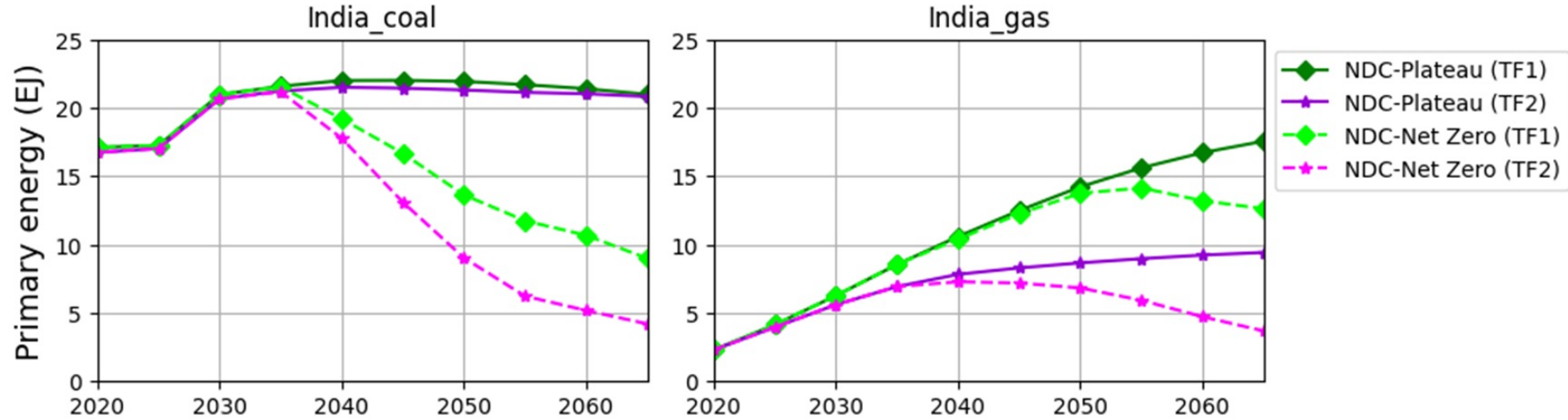
- Coal use would decrease rapidly – due to 2030 NDC.
- Gas would fall if CCS cannot be upscaled.

China – coal and gas demand



- Coal use after 2030 may decrease rapidly – depends on climate policy target after NDC
- Gas use could increase and remain high (if TF 1 occurs).

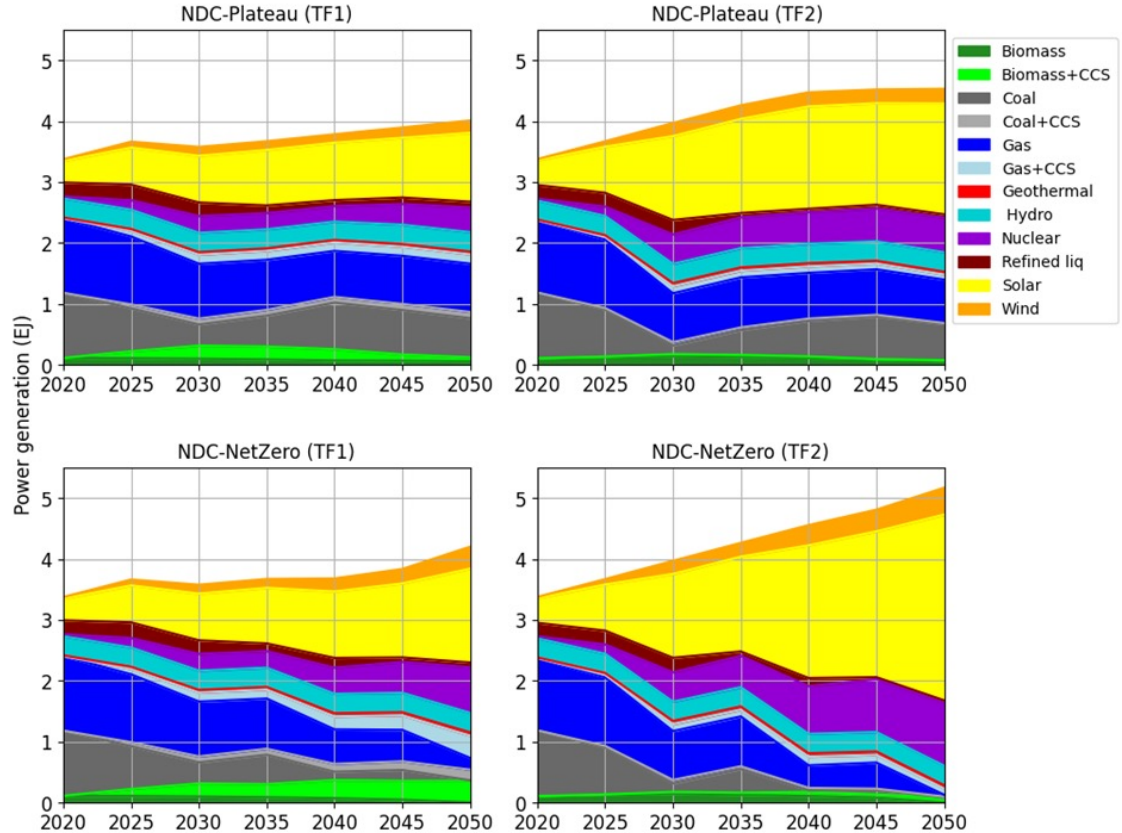
India – coal and gas demand



- Coal use after 2030 to flatten or fall – depends on climate policy target after NDC.
- Gas use could increase and remain high (if TF1 occurs).

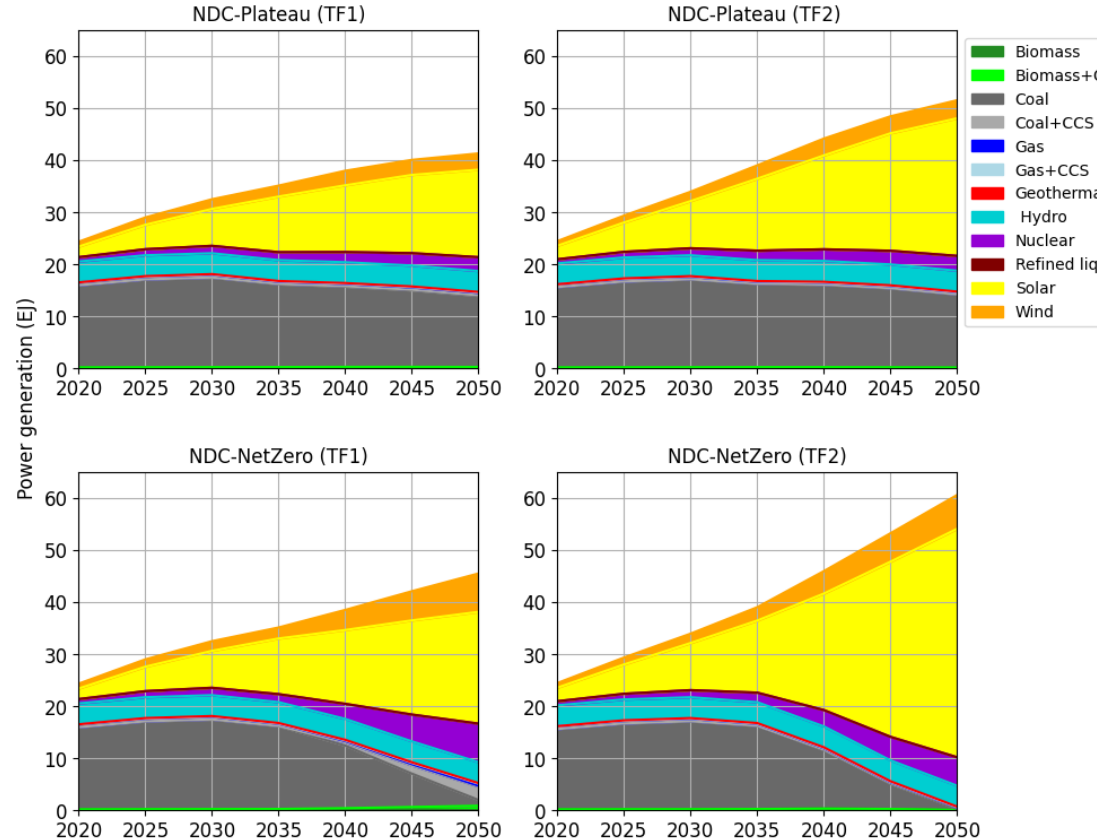
Implications for electricity sector - Japan

- NDC boosts renewables.
- The technological future then determines the electricity mix.



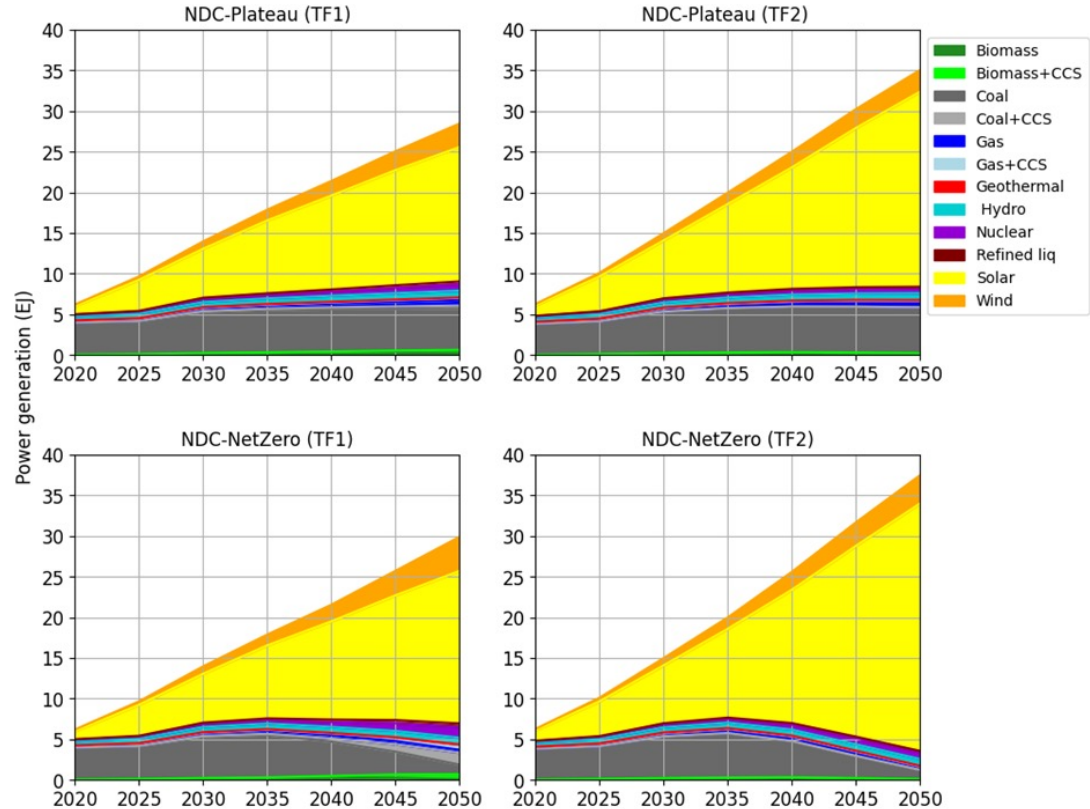
Implications for electricity sector - China

- Key issue is the trajectory of emissions pathway.
- Any increase in gas is in 'other' sectors.



Implications for electricity sector - India

- Demand for electricity is high across all scenarios.
- No matter the scenario, renewables take off – the question is by how much?



IEA estimated storage – Japan – 8 Gt

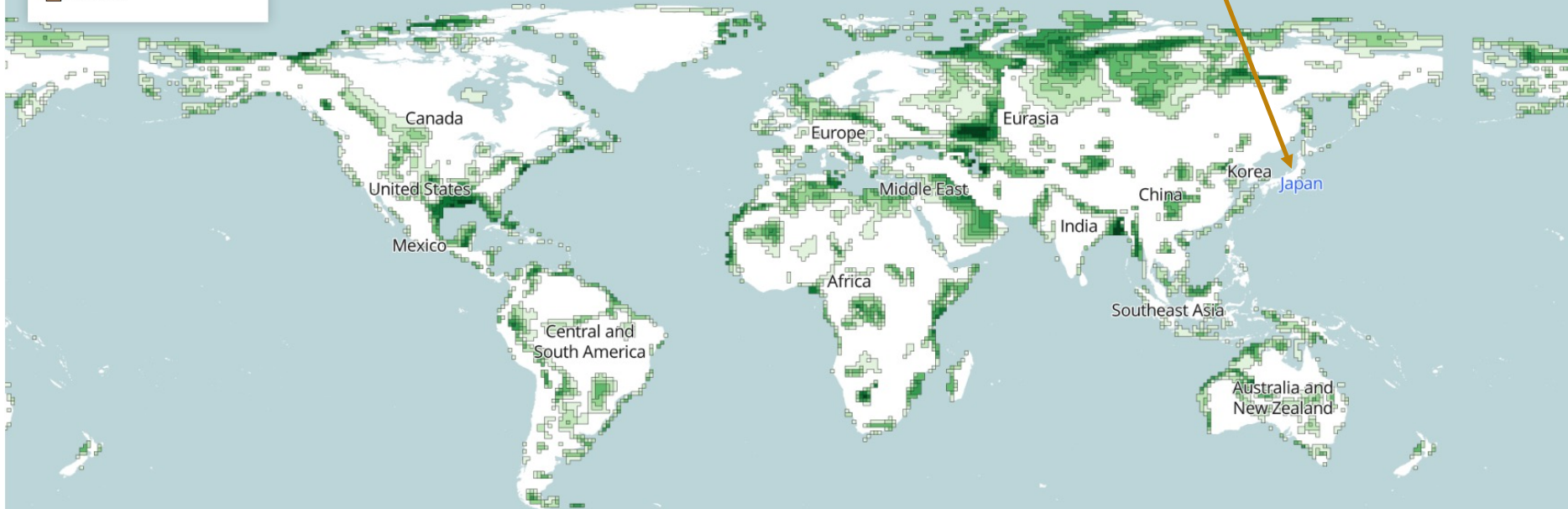
Sedimentary thickness (km)



Estimated storage type

Onshore

Offshore



Japan

Estimated storage: 8 Gt

57%

19

43%

IEA estimated storage – China – 403 Gt

Sedimentary thickness (km)



Estimated storage type

Onshore

Offshore



China

Estimated storage: 403 Gt



IEA estimated storage – India – 99 Gt

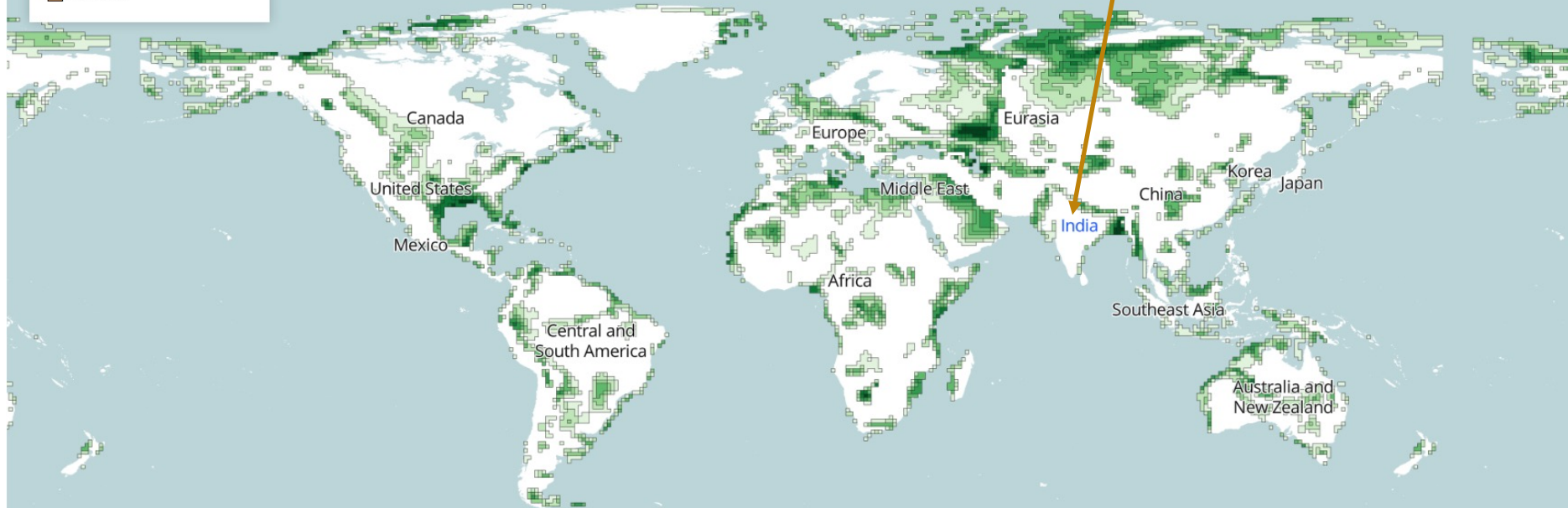
Sedimentary thickness (km)



Estimated storage type

Onshore

Offshore



India

Estimated storage: 99 Gt



Summary

- Across most scenarios, coal is phased out as soon as climate policies start to take effect.
- The future of gas depends on the availability of CCS (TF1)
 - This also differs greatly by country (i.e. the availability of storage sites).
- So, things to watch are:
 - Renewables and storage options, versus CCS; and
 - Climate policies that boost or support the NDC and Net Zero pledges.

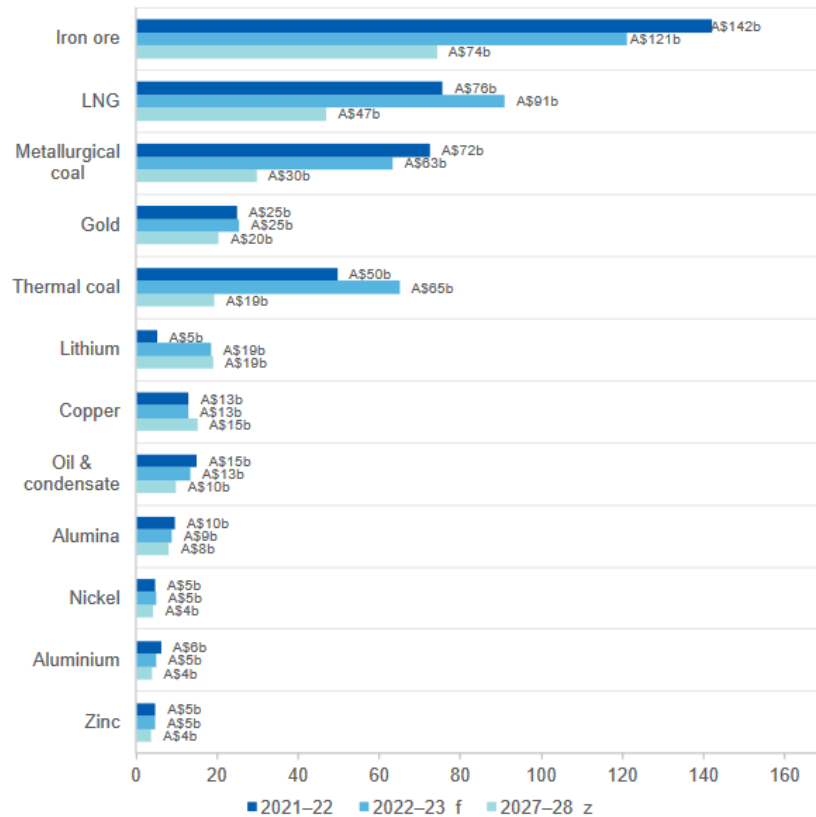


Implications for Australia

- ◉ Japan may remain a strong trading partner – but gas would depend on CCS and they have less storage sites than others in the region.
- ◉ Future exports of coal are already at risk – restrictions on imports have occurred and new supply routes have improved supply in China.
- ◉ India has high potential to develop their own renewables supply, so the future of coal will depend on the affordability of CCS (TF1).
- ◉ Geopolitics of energy is expanding to incorporate supply chains for new technologies. This trend will continue and deepen.
- ◉ Trading patterns could change rapidly...



Figure 1.13: Australia's major resources and energy commodity exports, 2022–23 dollars



Value of Australian lithium exports tipped to match thermal coal in five years

Revenue from mining key metal used in EV batteries to triple by 2027-28 while thermal coal exports set to fall by more than 70%

- Get our **morning and afternoon news emails**, **free app** or **daily news podcast**



Exports of Australian lithium are expected to reach about \$19bn in five years – the same amount as Australia's thermal coal exports. Photograph: Bloomberg/Getty Images

Exports of Australian lithium – a key metal used in batteries – are expected to earn as much as sales of thermal coal within five years, as the world increasingly embraces clean energy and the market value of fossil fuels falls.

New data **released by the Australian government** forecasts local lithium production will double and the industry's revenue will triple by 2027-28 compared with last financial year.

