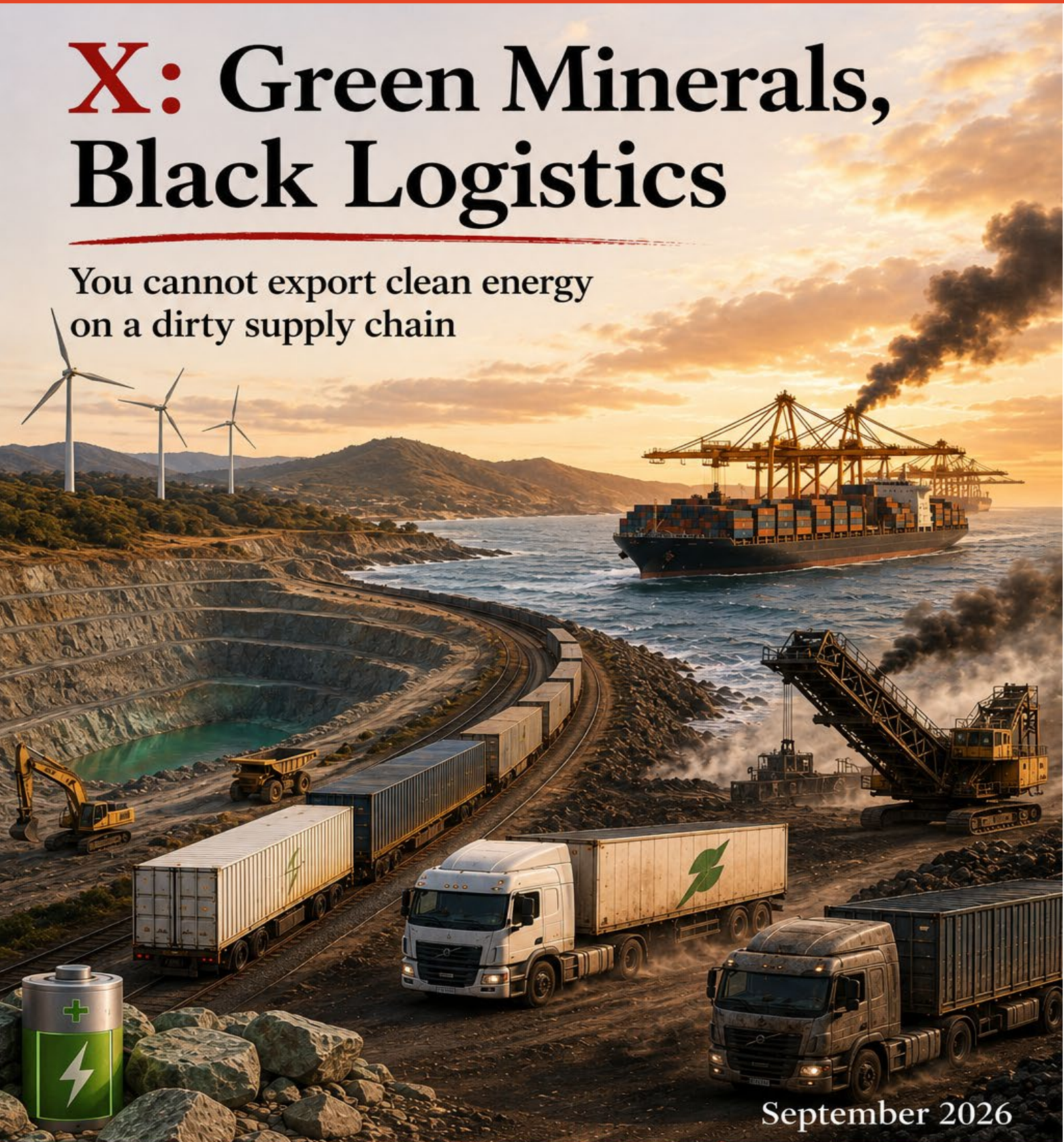




THE UNIVERSITY OF
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X: Green Minerals, Black Logistics

You cannot export clean energy
on a dirty supply chain



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Acknowledgement of Country

We recognise and pay respect to the Elders and communities – past and present – of the lands that the University of Sydney's campuses stand on. For thousands of years, they have shared and exchanged knowledges across innumerable generations for the benefit of all.

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Australia loves the phrase clean energy superpower. It rolls easily off political tongues. We are rich in lithium, nickel, cobalt, rare earths and iron ore. We supply the minerals that underpin batteries, wind turbines and electric vehicles. We are told that this positions us at the heart of the global transition.

There is truth in that ambition. But there is also a blind spot. A mineral does not become green simply because it ends up inside a battery.

The climate impact of critical minerals is not limited to extraction and processing. It includes transport. It includes how those tonnes move from mine to rail, from rail to port, from port to ship.

Transport produced about 90 million tonnes of carbon dioxide equivalent in 2022, representing roughly 21 percent of Australia's total emissions, according to the Climate Change Authority (2024). On road vehicles account for around 85 percent of transport emissions. Freight is a substantial component of that system.

The Bureau of Infrastructure and Transport Research Economics estimates Australia's domestic freight task reached about 786 billion tonne kilometres in 2024 to 2025. A large share of that task involves bulk commodities (BITRE, 2025). Mining regions are often remote. Distances to ports are vast. Logistics chains are long.



Much of this freight is moved efficiently relative to road passenger transport, particularly where heavy haul rail is used. Rail is generally more energy efficient per tonne kilometre than road freight. But outside electrified urban passenger networks, much of Australia's freight rail system remains diesel powered. Road haulage remains common in the first and last legs of mineral supply chains.

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In other words, the journey of a green mineral often begins with black fuel.

This matters for more than symbolism. Global markets are increasingly scrutinising supply chain emissions. The European Union's Carbon Border Adjustment Mechanism and broader corporate climate disclosure rules signal a shift toward embedded carbon accounting. Buyers will not only ask what a product is used for. They will ask how it was made and moved (European Commission, 2026).

Australia risks complacency. We assume that because our minerals enable decarbonisation elsewhere, our own emissions intensity is less relevant. That assumption may not hold.

There is an opportunity here as well as a risk. Australia could position itself not merely as a supplier of critical minerals, but as a supplier of low emissions critical minerals. That would require confronting transport emissions directly.



Electrifying key freight rail corridors that serve mining regions would be a start. Where traffic volumes justify investment, electrification can reduce operational emissions and insulate operators from volatile diesel prices. Strategic use of renewable energy along corridors could further cut lifecycle intensity.

For routes where electrification is not yet feasible, accelerating trials of low emissions locomotives and heavy vehicles would send a market signal. Hydrogen and battery electric heavy haul solutions remain in development, but

without early adoption pathways, they will remain prototypes.

Ports and intermodal facilities are another leverage point. Shore power for ships at berth, electrified yard equipment, and efficient scheduling can reduce emissions in critical nodes.

There is also a policy instrument that Australia has barely explored. A low emissions logistics certification for critical mineral supply chains.

Such a framework could track and verify transport emissions from mine to port. It could create a premium product category for buyers seeking lower embedded carbon. Over time, it could become a competitive differentiator.

Critics will argue that global commodity markets are price driven and indifferent to such distinctions. That may have been true historically. It is less certain in a world of escalating climate commitments, investor scrutiny and border carbon adjustments.

The broader point is conceptual. Sustainability is not an end use property. It is a system property.

When Australia exports lithium destined for electric vehicles, we celebrate the downstream benefit. But if that lithium is hauled hundreds of kilometres by diesel trucks and trains, the climate ledger includes that journey.

This is not an argument against mining. The energy transition requires minerals. It is an argument against partial accounting.

Australia has invested political capital in the clean energy narrative. To make that narrative credible, we must ensure that the supply chains behind it are progressively decarbonised.

That will not be simple. Mining regions often lack robust grid infrastructure. Electrification requires capital and coordination. Freight operators need regulatory certainty and financial support to shift technologies.

But the alternative is a missed opportunity.

Imagine a future where international buyers can choose between critical minerals with high or

low transport emissions intensity. Australia could lead that market or scramble to catch up.

There is also a domestic dimension. Decarbonising freight corridors serving mining regions can deliver spillover benefits to other industries along those routes. Shared infrastructure can support agricultural exports and regional development.

Leadership in clean logistics would reinforce Australia's claim to be serious about net zero, not just in rhetoric but in operational detail.

We should be wary of congratulating ourselves too quickly. Being a supplier to the green transition does not automatically make us green.

A mineral's colour is not determined by its destination. It is determined by its entire lifecycle. If we want to export clean energy credibility, we must decarbonise the roads and rails that carry it. Otherwise, we risk building a reputation as a country that sells the world the tools of transition while running our own supply chains on yesterday's fuel.

References

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Editors of series

John rejoined the Institute of Transport and Logistics Studies as the Neil Smith Research Chair in Sustainable Transport Futures in October 2022, after an 8-year absence. Over the course of his academic career, John has published over 300 scientific articles in peer-reviewed journals, books, and conference proceedings. He has also been an Associate Editor of Transportation, and Co-Editor and Chief of the Journal of Choice Modelling and Transportation Research Part A. He has also held various roles on multiple conference committees both in Australia and overseas.

Since graduating with a PhD, John has been obtained numerous grants worth over \$3.4 million. These include a number of ARC discovery grants in the areas of Public Health, Transportation crowding, general economic theory related to utility separability as well as one on improving the external validity of Discrete Choice Experiments. In addition to academic grants, John has been involved in \$9 million in industry-based contract research since the year 2005. Find out more about John: <https://profiles.sydney.edu.au/john.rose>



Andrea joined the Institute of Transport and Logistics Studies as the Neil Smith Lecturer in Sustainable Mobility and Accessibility in March 2023. Before becoming a lecturer, Andrea spent three years as visiting research scholar thanks to two scholarships, the Early.Postdoc mobility and the Postdoc mobility, awarded by the Swiss National Science Foundation. Andrea holds a Master of Science in Statistics with Honors from the University of Bologna and a PhD in Economics from the University of Lugano. Over the years, Andrea has taken part in different consulting projects with several public and private institutions such as NSW Government, University of Florence, and University of Catania. Find out more about Andrea:

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