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Australian Academy of Science submission on the
Green Metals Consultation Paper

Decarbonisation and the transition to net-zero emissions demand technological shifts that are underpinned by scientific capability. The Future Made in Australia policy framework needs to draw on a strong science foundation to inform investments in promising applied science and technology to deliver the required capabilities for Australia. Advancing science capability not only enables innovation in green metals to deliver economic growth but also enhances sustainability.

The Academy advises that:

- Australia needs a multi-faceted approach to stimulate investment in enabling renewable energy infrastructure for green metals, including private sector engagement and investment.
- Green metals industry must examine the true sustainability of green metals by:
    - Implementing lifecycle assessments of green metal materials or products to quantify the environmental impacts of green metals production.
    - Developing policies that consider the entire green metals supply chain, from mine to end-use products to recycling, addressing every step as a 'green' process.
- Including copper in policy considerations is crucial due to its essential role in electric vehicles, renewable energy systems, and storage batteries. However, production of copper lags behind demand, making it urgent to focus on green processing methods to ensure a sustainable transition.

Australia needs a multi-faceted approach to stimulate adequate investment in enabling renewable energy infrastructure for green metals

Renewable energy infrastructure and green hydrogen production are essential for a sustainable green metals industry. Implementing this infrastructure presents serious challenges for global materials supply chains.

Developing this industry will require environmental and industrial policies encompassing R&D funding, project financing, financial incentives and low-emissions certification.[1]

The Academy acknowledges the importance of actions that complement industry-led initiatives, such as recent projects funded by ARENA for the steelmaking value chain, including the ferrous minerals industry and hydrogen production. However, it is equally important to consider basic research and development in these fields. While expanding the development and application of industry projects is vital, we must also continue to advance our foundational knowledge in chemistry, physics, and mathematics. This will strengthen the foundation for new methods and scientific capabilities and underpin the breakthroughs and innovations necessary for a greener future.

Overcoming technological challenges in green metals requires science

Scaling up green metal technologies from lab to industrial levels presents significant technological challenges, which will require scientific knowledge to address. These unresolved challenges include:

- Efficiency loss during scale-up from lab to industrial levels.
- Increased system design complexities in large-scale operations.
- Mass and charge transfer resistance affecting process efficiency.
- Lack of commercial incentives for adopting green technologies.
- High costs associated with technologies such as hydrogen production.

Broader, system-level approaches should also be considered, including using waste materials to create positive supply chains within a circular economy,[2] and reducing the need for mining.

This requires businesses to adopt new supply chains that incorporate reformed materials from waste. Developed technologies in this area, such as using waste to produce hydrogen for steelmaking, serve as effective case studies. These green manufacturing technologies reduce reliance on coke and coal, further supporting sustainable practices.[3,4]

Ensuring green metals are really 'green'

Assessing the environmental impact of green metals is crucial, focusing on climate change, acidification, water consumption, and land occupation.

Assessments should look at the green metals supply chain holistically, from mine to end-use products to recycling, addressing every step in the process. This could include, for example, focusing on minimising environmental degradation during extraction, reducing energy consumption, water usage, and greenhouse gas emissions during processing and refining, prioritising the use of electric vehicles, solar panels, and green products, and emphasising recycling to reduce the need for new resource extraction.

Maximising the lifespan of green metals reduces environmental impacts and enhances sustainability. Integrating Life Cycle Assessment (LCA) with advanced technologies such as machine learning and simulation allows for process optimisation and the identification of innovative solutions to close the loop of the circular economy and extend the lifespan of green metals.[5]

The Academy recommends an annual, independent review of trends in green metals investments to assess previous policies, analyse data and guide development of investment strategies. Adopting a flexible regulatory framework is crucial for adapting to changing circumstances, demonstrating strategic resilience, and demonstrate their contribution to the objectives of the Future Made in Australia policy.

Additional opportunities in green metals

The discussion paper references green iron, steel, alumina, and aluminium but omits copper, a crucial component for renewable energy technologies with a demand projected to rise.[6] Currently, the demand for copper surpasses global supply capabilities, resulting in a deficit.[7] Copper is an important component of renewable energy technologies and is recyclable, but resource extraction remains highly inefficient and resource-intensive, especially in terms of energy and water usage. Depending on the future value chain and energy chemistry, Australia should investigate sustainable practices and improve methods for green copper mining.

To discuss or clarify any aspect of this submission, please get in touch with Mr Chris Anderson, Director of Science Policy, at Chris.Anderson@science.org.au.

References

1. Venkataraman, M., Csereklyei, Z., Aisbett, E., Rahbari, A., Jotzo, F., Lord, M., & Pye, J. (2022). Zero-carbon steel production: the opportunities and role for Australia. *Energy Policy*, *163*, 112811. https://www.sciencedirect.com/science/article/pii/S0301421522000362
2. Centre for Policy Development, May 2024, Green Good, Strategies for Decarbonising Government Purchasing in Australia, https://cpd.org.au/work/green-goods-strategies-for-decarbonising-government-purchasing-in-australia/
3. Biswal, S., Pahlevani, F., Bhattacharyya, S. K., & Sahajwalla, V. (2020). A novel reforming approach of utilizing spent coffee grounds to produce iron. *Resources, Conservation and Recycling*, *163*, 105067. https://www.sciencedirect.com/science/article/pii/S0921344920303840
4. InfraBuild, Polymer Injection Technology (PIT), https://www.infrabuild.com/resources/sustainability-resources/polymer-injection-technology-pit/

5. Rachid, S., Yassine, T. A. H. A., & Benzaazoua, M. (2023). Environmental evaluation of metals and minerals production based on a life cycle assessment approach: A systematic review. *Minerals Engineering*, *198*, 108076. https://www.sciencedirect.com/science/article/pii/S0892687523000900
6. Government of South Australia, South Australia Copper Strategy, https://www.energymining.sa.gov.au/__data/assets/pdf_file/0005/843332/Copper-Strategy-May-2017.pdf
7. Barclay Pearce Capital, Casey Portors, August 2022, Copper is Vital for green energy future in Australia, https://www.barclaypearce.com.au/blog/copper-is-vital-for-a-green-energy-future-in-australia