

Green metals: Delivering Australia's opportunity

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Overview

Australia's industrial sector faces transformative change to meet global and domestic emission-reduction targets. A 21st Century industry policy to deal with a 21st Century problem could underpin Australia's successful transformation to a world-leading energy superpower. Done well, such policy could underpin the development of an Australian green metals industry focused on steel and aluminium.

Global and domestic demand for Australia's coal and gas will decline over the next few decades as the rest of the world implements its commitments to achieve the goals of the Paris Agreement. Now is the time for Australia to build export-oriented industries based on its extensive renewable energy and mineral resources, to thrive in a net-zero global economy.

Meeting global and domestic emission-reduction targets will impose transformative change on Australia's heavy manufacturing and mining sectors, change for which we are only just beginning to prepare. We have an opportunity, based on our comparative advantage in globally competitive renewable energy, to add value to globally significant mineral resources, and support employment in the regions of Australia where carbon-intensive industries will decline. The challenge is to act to seize this opportunity.

The production of already important commodities such as steel and aluminium will need to be transformed to low-emission alternatives. Extracting and processing minerals critical in a low-emissions world and materially present in Australia holds the prospect of new export growth and job creation. And developing green hydrogen is likely to be a key factor in the supply chain to deliver green metals.

The commercial realisation of green metals and hydrogen faces a 'green premium' challenge - the gap between the cost of zero-emissions production and the cost of conventional production.

Three things can close that gap. First is cheaper electricity. Metals processing is energy-intensive, and the future of energy is electric, whether used directly or to produce hydrogen as a fuel.

Second is higher carbon prices. Heavy industry is covered by the Safeguard Mechanism, which imposes a carbon price to drive down emissions. But under the Safeguard's current settings, this price isn't likely to be high enough to close the cost gap before 2040.

Third is support for 'green' versions of these commodities. The best support at this time would be an industry policy that evolves from the federal government's Hydrogen Headstart program and uses contracts-for-difference – contracts designed to support investment by underwriting part of the additional cost of production – to help industry grow. Later, a broad-based carbon standard could drive demand for green commodities in construction.

This program now fits within the broader framework of the government's Future Made in Australia initiative, although that initiative and associated funds and mechanisms are still at an early stage of implementation. Renewable hydrogen and green metals have been identified as sectors aligned with the national interest framework announced by Federal Treasury at the time of the 2024 Budget.

The federal government has a once-in-a-century opportunity. Despite the very real challenges, the opportunity should be taken – the downside is too ugly to be contemplated and the upside too great to be missed.

1 Recommendations

1. Australia needs an over-arching industry policy framework with consistent, targeted policies linked to clear goals, developed and executed in sustained collaboration with industry. The recently announced Future Made in Australia initiative, alongside specific funding mechanisms and guided by Treasury's National Interest Guidelines, is a good place to begin.
2. Australia should use the next decade to create a foothold in the emerging green metals markets. The best way to support the supply of green metals is through direct government funding to support private investment in higher-cost, but lower-emissions, iron, alumina, and aluminium production – green metals 'flagship' projects. The government should expand the Hydrogen Headstart program to cover green metals and similar green commodities, based on a Contracts-for-Difference structure, with contracts issued annually for 10 years.
3. The government should work with Australian industry to facilitate financial investment from overseas buyers of our current iron ore, alumina and aluminium exports into joint ventures participating in the above Contract-for-Difference program.
4. Electricity demand for producing green metals and hydrogen should be imbedded in electricity system planning, including the Australian Energy Market Operator's Integrated System Plan and the development of Renewable Energy Zones.
5. Domestic demand for green metals can be best supported through the adoption of embedded carbon construction standards for buildings and other infrastructure.
6. The government should consider a carbon border adjustment mechanism for Australia in the medium term to reduce the risk of

Australian manufacturers becoming uncompetitive with overseas suppliers not subject to equivalent carbon emissions constraints.

2 Introduction

This submission is by Tony Wood and Alison Reeve of Grattan Institute, an independent think tank focused on Australian domestic public policy. Grattan aims to improve policy by engaging with decision-makers and the broader community.

In May 2024, the Department of Industry, Science, and Resources published a Consultation Paper on unlocking Australia's green iron, steel, alumina, and aluminium opportunity. This submission emphasises the importance of industry policy to realising these opportunities and responds to the policy matters raised in the Consultation Paper.

Australian industries that extract resources and add value through manufacturing currently contribute significantly to GDP, and employ about 1.2 million people.¹ But they also contribute about 30 per cent of our domestic greenhouse gas emissions.² And the emissions from our exported coal and gas add to the climate responsibilities of other nations. A serious global commitment to net-zero emissions has profound economic, social, and environmental implications for Australia.

Activities such as low-emission extraction and processing of critical energy minerals are insignificant today but are an opportunity where Australia could capitalise on globally significant comparative advantages. Current activities such as iron, steel, alumina, and aluminium (green metals) production will continue to be needed and should be able to transform through economic, low-emission technologies.

Timing of government support for the transformation will be important for such capital-intensive industries. As the existing facilities age,

1. ABS (May 2024).

2. DISER (2021).

owners will face difficult choices about whether to switch to new, lower-emission technologies or lock-in emissions for decades to come.

The challenge for Australia is to navigate the phase-out of fossil fuels while identifying and implementing the strategies, policies, and investments to realise the opportunities that lie with green metals, other commodities such as green ammonia, and critical minerals.

Four Grattan Institute reports have included detailed analysis of the challenges and opportunities for Australia as a green energy superpower. They identified Australia's opportunity in green steel and green aluminium production, the broader opportunity that arises with decarbonisation of industry, and the case for a 21st Century industry policy to underpin Australia's transformation to a net-zero economy. These reports can be viewed in full on our website.

- [The next industrial revolution: Transforming Australia to flourish in a net-zero world \(2022\)](#)
- [Towards net zero: Practical policies to reduce industrial emissions \(2021\)](#)
- [Start with steel: A practical plan to support carbon workers and cut emissions \(2020\)](#)
- [Hydrogen: Hype, hope, or hard work? \(2023\)](#)

A key conclusion from these reports is that Australia needs an over-arching policy framework with consistent, targeted policies linked to clear goals, developed and executed in sustained collaboration with industry. Substantial progress is being made towards this framework, including the Future Made in Australia initiative and associated Innovation Fund, the Net Zero Plan that includes focus on the industry

sector, Hydrogen Headstart, the revamped Safeguard Mechanism, and the Net Zero Transition Authority.

The last of these initiatives highlights the fact that some regions, where fossil fuel extraction is currently the backbone of the economy, may face thousands of job losses as mines and other carbon-intensive facilities close. And some areas will have great economic opportunities due to their minerals reserves and proximity to renewable energy and relevant infrastructure.

Developing an Australian green metals industry is only one of the opportunities before us. Establishing and maintaining clarity and coordination of this framework over a decade or more will be essential to success.

3 The background to green metals

To be viable in a net-zero world, some industrial products such as steel and aluminium will need to be produced cleanly.

Australia has two major integrated steel mills, four aluminium smelters, and six alumina refineries³. These facilities and their roles in the steel and aluminium supply chains developed over more than 50 years. They can form the base of a green metals industry with an equally long future.

3.1 Iron and steel

Of Australia's clean energy opportunities, the largest and most economically viable appears to be using renewable hydrogen to produce 'green' (near zero emissions) iron. With globally cost-competitive hydrogen, it will be cheaper to produce green iron here than to ship hydrogen and iron ore to countries such as Japan or Indonesia that have inferior renewable resources.

Grattan Institute's 2020 report, *Start with steel*⁴, showed that for the bulk of iron ore mined in Australia, iron production is probably the right place to stop along the value chain, and that Australia could produce green iron cheaper than many of its neighbours. A compacted form of direct reduced iron (DRI), hot briquetted iron, is easy to ship, and turning it into steel requires more labour and less energy than the direct reduction process, giving low-wage countries an advantage in that step of the process.

To capture this opportunity also requires access to the right type of iron ore. The direct reduction process requires a processed iron ore

product that contains more iron content and fewer impurities than a blast furnace. But currently, the overwhelming majority (96 per cent) of the iron ore mined and exported from Australia is hematite, which is not well-suited for feeding a direct reduction process. Magnetite is the type of iron ore that is better suited for direct reduction. While 38 per cent of Australia's economic-demonstrated resources of iron ore are magnetite (primarily located in WA and SA), it is currently not mined as extensively. The availability of magnetite and high-quality renewable resources also may not be aligned geographically.

It is possible to process hematite to be suitable for direct reduction, but the technologies are immature. Australia will probably have to expand efforts on both fronts if it is to succeed in capturing a larger slice of the green iron market.

A market for green steel is emerging, particularly among car manufacturers, but this market is new and demand is uncertain. Low-emission commodities are generally more expensive than their emissions-intensive equivalent. It would be risky to build a commercial-scale low-emissions plant just to satisfy the green premium market.

Australia should use the next decade to create a foothold in the emerging green steel market. The best way to do this is through direct government funding to support private investment in higher-cost, but lower-emissions, iron production – an iron 'flagship' project. This would help build the skills and capability needed in a future export-oriented expansion phase.

3. Alcoa's Kwinana refinery is closing in 2024 - <https://www.alcoa.com/australia/en/pdf/refining-kwinana-fact-sheet.pdf>

4. Wood et al (2020).

3.2 Alumina and aluminium

Australia's rich bauxite and fossil fuel resources enable it to manufacture about 15 per cent of the world's alumina today. And Australia's share of world bauxite production (27 per cent) is comparable to, but lower than, its share of iron ore production (36 per cent).⁵

There are two main steps to producing aluminium – both emissions intensive. Firstly, bauxite ore is refined to make alumina. Australia is the world's biggest alumina exporter. Second, alumina is consumed in a smelter to produce aluminium.

Decarbonising alumina refineries is at an early stage. The Australian Renewable Energy Agency (ARENA) has funded three trials by Rio Tinto (\$500,000) and Alcoa (combined \$20 million), to use renewable energy for alumina refining processes.

Most emissions from aluminium production come from the electricity consumed by the smelter (70 per cent). Many Australian smelters have made progress on switching their facilities to renewable energy sources. For example, the Tomago aluminium smelter in NSW, which produces 25 per cent of Australia's aluminium, has committed to switching fully to renewable energy by 2029. But about 15 per cent of emissions are direct emissions, coming from the consumption of carbon anodes in the smelting process. Dealing with these direct emissions is more difficult, and technologies are still being developed.

3.3 The role for green hydrogen

Hydrogen – a zero-emissions fuel – could help transform Australia's metallurgical industries.⁶ But to date, governments have seemed more concerned with hyping Australia's hydrogen prospects and hoping

for the best, rather than doing the hard work to establish integrated industry policy for proportionate, targeted, and timely support.

The best way to seize the hydrogen opportunity is to make strategic choices about its industrial applications that can leverage Australia's comparative advantage in renewable energy resources and minerals, and build on existing export industries.

The most promising uses of hydrogen are in the production of ammonia, the calcination step in making alumina from bauxite, and to replace metallurgical coal in the blast furnace processing of iron ore to iron. These applications could use hydrogen efficiently and cost-effectively at a scale that could support a viable, long-term hydrogen industry that won't require subsidies⁷.

But in each of these cases, hydrogen still faces a 'green premium' – the gap between the cost of using hydrogen for zero-emissions production, and the cost of conventional production.

5. Geoscience Australia (2022).

6. Noting that where electricity is technically viable it will generally be commercially preferable to green hydrogen.

7. Wood et al (2023).

4 Supporting supply of green metals

Even with cheaper electricity (and therefore cheaper hydrogen), the green premium for alumina and iron is likely to persist for some time. The gap between what it costs to produce green commodities, and what buyers are willing to pay for them, can be closed using two complementary tools: raising the carbon price to make non-green production more expensive; and using industry policy to make green production cheaper.

4.1 Closing the cost gap requires carbon pricing to align investment with climate goals

Australia needs carbon price signals that are strong enough to give industry the incentive and the signal to decarbonise. Carbon signals can be explicit prices – such as those in the Safeguard Mechanism – or implicit ones, such as those created by emissions standards.

But carbon signals are not industry policy. Decarbonisation policy should focus on reducing emissions at the least cost. A separate industry policy is the best way to focus on industry development.

4.2 Industry policy should underpin development of green metals

Australia's clean energy opportunities are large, but they are far from certain. Governments cannot single-handedly drive the creation of new global-scale industries, nor invest the hundreds of billions of dollars required. But the federal government can and should implement policies that plan for, and facilitate, this future.

Once the fundamentals of reliable, green, low-cost electricity and stronger carbon pricing are in place, the role of a green industry policy

is to bring down the production costs of low-carbon commodities sooner, by reducing the green premium.⁸

Closing the gap between green and conventional production costs is essential. While some consumers may be willing to pay more for a green product, the size of this premium is highly uncertain, as is the number of consumers willing to pay it, and the length of time that the gap will persist. This makes it harder to use debt to finance facility upgrades or new facilities to produce green commodities, because future uncertainty increases the cost of borrowing. As long as capital prefers the certainty of return from traditional production, low- and zero-carbon transformation will be held back.

Industry policy shifts the green premium risk from industry towards government or consumers. The key to effective industry policy is to minimise and manage this risk in the choice of the policy instrument and the surrounding governance arrangements.

In Grattan's 2023 report *Hydrogen: Hype, hope, or hard work?* we set out the case for an industry policy, primarily based on competitively allocated contracts. We also assessed alternative mechanisms raised in the Consultation Paper.⁹

Production credits are expensive

Production credits help bridge the gap between the market premium and the green premium, by providing a per-unit subsidy to green commodity producers. The US Inflation Reduction Act makes production credits available for US hydrogen producers, providing a subsidy of up to US\$3 per kilogram of hydrogen.

8. The 'green premium' is the extra cost of green production.

9. Wood et al (2023).

Production credits are a risk to governments because they lock-in a fixed subsidy. If green premiums fall faster than expected, governments end up paying more than they need to. In the case of the US, some forecasters predict that the maximum hydrogen production credit will be greater than the total cost of production by 2030. Where production credits are made generally available to all producers, as in the US tax credit example, governments can also be exposed to an uncapped draw on the budget.

Capital grants are expensive, and don't solve the right problem

Making capital grants available may nudge plant replacement decisions towards low- or zero-carbon technology. But an upfront capital grant does nothing to help with the ongoing cost of the hydrogen, which is a large part of the additional cost for making green iron/steel or green alumina/aluminium.

Cash grants, either to reduce the upfront capital investment or as a fixed payment spread over several years, are more suited to early-stage technology development support through ARENA and mechanisms such as the Future Made in Australia Innovation Fund.

Contracts-for-Difference are a better risk-sharing mechanism

Where capital replacement is funded by debt, a higher cost of production post-replacement is risky, unless the future selling price of the commodity is also going to be consistently higher. For alumina and iron, market premiums for green commodities are well below Australian green premiums, and future market premiums are highly uncertain.

Contracts-for-Difference would be an ideal way to share some of this risk. These contracts are based on the difference between the market price for a commodity, and an agreed price, known as the 'strike price'. If, during the term of the contract, the market price is lower than the strike price, a third party (in this case the government) pays the

producer the difference. If the market price is higher than the strike price, the producer must pay the difference to the third party.

Because the strike price is known in advance, this arrangement gives the producer certainty about future revenue. But unlike with a production credit, the producer has an incentive to seek out buyers that are willing to pay higher prices for a green product. Contracts-for-Difference shift some, but not all, market price risk onto government.

In addition to supporting Contracts-for-Difference, our *Hydrogen* report provides some detail on how such a policy could be designed and the risks managed.

Heavy industry is capital intensive and the best technology solutions to deliver green metals are still being developed. A one-off approach is poorly suited to such a situation. An evolved CfD program should be available for 20 years. Every year for the first 10 years, the government should hold a reverse auction to allocate contracts. For each reverse auction, it would indicate ahead of time an indicative upper limit for the total value of contracts it is prepared to enter into. The contracts would last 10 years, giving the program an overall lifespan of 20 years. Providing clarity on the availability of yearly auctions would give industry the predictability it needs.

4.3 Renewable energy expansion

Renewable electricity will be in demand from all sectors of the economy in the transition to net-zero emissions by 2050. And Australia's renewable energy superpower ambitions rely on an abundance of low-cost renewable electricity.

Australia's latent renewable energy competitive advantage comes from having a lot of renewable resources, and lower opportunity costs in making use of them than is the case in many other countries. These

lower opportunity costs largely arise because of our low population density: the likelihood of there being a more economically valuable use of a particular piece of land is lower in Australia than in other, more crowded, countries. But Australia will maintain a competitive advantage only if the marginal cost of another megawatt of renewable generation is lower than in other countries.

Meeting even a modest level of Australia's green manufacturing opportunities will require considerable electricity. Most planned large hydrogen projects are looking to connect their electrolyzers to dedicated renewable generation, rather than to the grid. This will enable these projects to get cheaper electricity, although they will need to balance this against the need to manage the intermittency of renewable generation. Going with dedicated renewable generation for green metals production, directly or via hydrogen, also unlocks locations not well-served by the grid, but it is not possible everywhere – especially where there is a high opportunity cost in using land for generation.

In other cases, green metals producers may prefer to connect to the electricity grid – if the electricity is clean, if the wholesale price, including transmission, is cheap enough, and if intermittency is otherwise a problem.

These considerations reinforce the need for close coordination between industrial transformation and broader energy system planning. Governments should embed green electricity demand into electricity system planning through the Australian Energy Market Operator's Integrated System and in the design and development of Renewable Energy Zones.

4.4 Levelling the playing field for Australian industry

As Australian industry 'greens', it may face higher costs compared to other producer countries that are not moving as quickly to reduce

emissions. This could cause 'carbon leakage' if Australian consumers choosing cheaper imports over greener local production.

Current policies such as the Renewable Energy Target and the Safeguard Mechanism include assistance to Australian industries to prevent carbon leakage. Other countries have similar assistance for domestic industries.

But permanent assistance is not a sustainable long-term option. The European Union is moving to phase out such assistance, replacing it with a carbon border adjustment mechanism which prices carbon into imports at a level equivalent to domestic production.

The federal government should consider a similar mechanism for Australia in the medium term.

5 Supporting demand for green metals

It is essential that demand for green commodities is underpinned. There is a persistent gap between the number of consumers who say they are willing to pay more for a green product, and those who actually do.¹⁰ Just as relying on consumer preferences for green electricity never raised the percentage of renewables beyond 2 per cent, relying on enlightened consumers to prefer green commodities is unlikely to be a good strategy to bring about the swift and transformative change the sector needs if Australia is to reach net zero and benefit from others doing so too.

Policy to underpin demand, however, is more complicated than for electricity. Industrial commodities are exported (meaning demand is a function of global markets) and imported (meaning import substitution needs to be considered in policy design). And Australia doesn't directly use every commodity it produces – some go elsewhere to be transformed into other products that may then find their way back to Australia via trade.

Australia's green metals industry will be export oriented. Australia's current export-focused commodity businesses such as LNG have benefited from backwards integration - investment in Australian production by the overseas buying firms. This could be the most effective pathway to realising the green metals opportunities. Government-to-government relationships should focus on facilitating such commercial outcomes.

10. Mortimer (2020).

Government purchasing is not the most effective way for the federal government to support green commodity demand

Some national and sub-national governments have created demand for green commodities through government purchasing mandates. For example, the Biden Administration's Buy Clean Task Force uses the US Government's purchasing power to drive demand for lower-carbon materials such as concrete, steel, and aluminium.

In 2022-23 the Australian Government purchased \$27.3 billion in goods. The largest single category of goods purchased was aircraft (\$3 billion), followed by aerospace components (\$2.8 billion). The federal government spent \$4.6 billion on building construction and support, maintenance, and repair services, but it is unclear how much of this was spent on goods and how much on services.¹¹

Direct purchasing by the federal government is unlikely to be sufficient to underpin development of a market for green commodities produced by heavy manufacturing, because the sorts of things it buys do not contain large amounts of these commodities.¹²

However, the federal government does fund a lot of infrastructure, which uses commodities such as cement and steel. The major infrastructure pipeline currently stands at \$230 billion over the period 2022-23 to 2026-27.¹³ The Commonwealth's share of this spending is paid to state governments, which are responsible for procurement and contract management.

11. Department of Finance (2023).

12. While aircraft and aerospace components often include aluminium, this is usually high-grade aluminium, and the overall amount is small in the context of total demand for aluminium in Australia. In addition, Australia does not produce significant quantities of high-grade aluminium.

13. Infrastructure Australia (2023, p. 6).

These infrastructure projects will be a significant source of demand for commodities over coming years. About 30 per cent of infrastructure spending goes on materials, most of it on steel and concrete. The projects in the infrastructure pipeline are estimated to increase annual demand for steel by 20 per cent or more over the next decade, compared to previous decades.¹⁴ Australia imports roughly one-third of the steel it consumes, with the rest being locally produced.

An embodied carbon construction standard could support local demand for green metals

In Grattan Institute's 2022 report, *The Next Industrial Revolution*, we recommended state governments implement embodied carbon standards for construction, to support demand for cement, steel, and aluminium with a green premium.¹⁵ State and federal governments have taken the first step in this direction, agreeing to develop consistent national standards for measuring embodied carbon in infrastructure projects and to consider further policy to reduce these emissions.

If embodied carbon standards are to drive increased demand for green commodities produced in Australia, there will need to be enough production of these commodities to meet the standard; and the commodities will need to be cheaper than imported ones. The standards should therefore be implemented after Contracts-for-Difference have been used to kick-start production.

Otherwise, the effect of an embodied carbon standard would simply be to increase imports of green commodities. That would contribute to global decarbonisation, but it wouldn't bring about industrial transformation here.

14. Ibid (p. 42).

15. Wood et al (2022, pp. 34–38).

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