**Executive Summary**

# *A Green Iron Plan for Australia: Securing prosperity in a decarbonising world*

## *Realising the green iron opportunity for Australia*

Australia is uniquely positioned to become a world leader in green iron production.

Its natural endowments – abundant iron ore and a comparative advantage in low-cost renewable energy – make Australia the natural home for this emerging global industry. With soundly based policy settings and timely action, this opportunity can underpin prosperity for generations.

Research by The Superpower Institute shows that the future energy trade will not be dominated by fossil fuels, but by trade in goods that embody clean energy. Energy-intensive industries will migrate to regions where cheap renewable energy exceeds domestic needs. Australia is one of those rare regions.

There are three compelling reasons to develop a green iron industry in Australia.

**First, green iron is an economic opportunity of historic scale.**
Leveraging its advantages in iron ore and renewables, Australia can move up the value chain from exporting raw commodities to higher-value industrial materials. The potential is enormous: if green iron replaces iron ore as a primary export, it could generate up to $386 billion annually by 2060. By comparison, Australia's iron ore exports are typically around $120 billion per year.

**Second, green iron offers a large opportunity to contribute to global decarbonisation.**
Conventional steelmaking remains one of the largest industrial sources of carbon emissions worldwide. An Australian green iron industry could abate emissions equal to roughly 4 per cent of the global total – more than three times Australia's current domestic emissions.

**Third, green iron exports provide a strategic hedge against the decline of fossil fuel exports.**
Coal and gas are two of Australia's three largest export industries, currently generating around $120 billion in export revenue each year. Yet most major economies have committed to achieving net-zero between 2045 and 2070. The timeline and trajectory of global decarbonisation may be uncertain, but the direction is clear: fossil fuel demand will contract in the coming decades. Investing today in industries where Australia enjoys a comparative advantage – such as green iron – is the most prudent way to safeguard national income and employment.

## *Modelling*

The Superpower Institute, in partnership with Bivios, has modelled green iron production in five locations in Australia:

- the Pilbara (northwest WA)
- Geraldton (midwest WA)
- Kwinana (southwest WA)
- Eyre Peninsula (SA)
- Gladstone (QLD)

The modelling incorporates:

- 'inflexible' green iron-making technology, which operates continuously, and 'flexible' green iron-making technology, which can ramp up and down
- renewable energy output data for each location
- grid-connected electricity availability and historical pricing data for all locations except the Pilbara
- capital and operating costs for renewable energy, hydrogen electrolysis, green iron production, and associated infrastructure.

## *Findings*

Core findings include:

- **Technology flexibility matters.** Flexible green iron technology, with the ability to ramp production up and down, will likely reduce the cost of producing green iron compared to technologies requiring continuous operation. However, flexible technologies are still under development and will require innovation support to be realised at commercial scale.

- **A grid connection can reduce the cost of green iron.** Connected projects can sell electricity into the grid when prices are high, and buy electricity when prices are low.

- **Location is critical.** Despite the geographic advantage of abundant iron ore deposits, the Pilbara is unlikely to be one of Australia's lower-cost locations for producing green iron, at least initially. Other locations in Australia face lower capital costs, have advantages in existing infrastructure, and some regions have superior renewable energy capacity factors. It may make economic sense to ship ore from the Pilbara to other locations in Australia where green iron can be produced more cheaply.

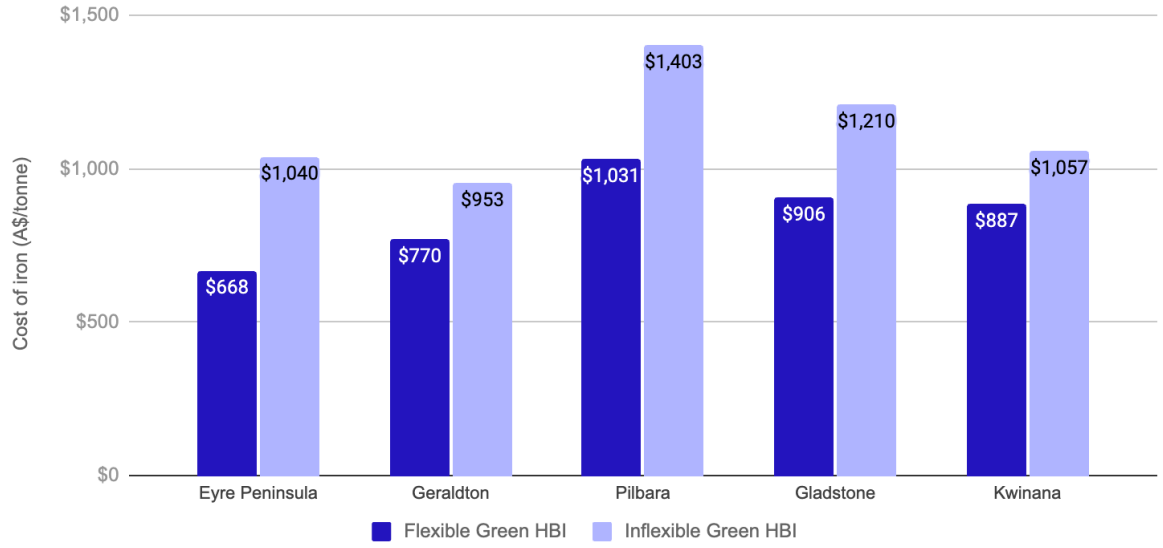


**Figure ES.1: The cost of producing green iron varies across locations and by the type of green iron production technology**

Note: 'Flexible' green iron-making technology can more easily ramp up and down, and does not require a continuous supply of green hydrogen or energy. 'Inflexible' green iron-making technology requires a continuous supply of hydrogen and energy.

Source: BIVIOS and The Superpower Institute

But Australia's potential green iron producers are disadvantaged by the lack of an international carbon price. This distorts the international market for iron products, and creates an inefficient advantage for fossil-fuel based products.

This market failure is a major reason that there is a cost gap between the international price of carbon-intensive iron products and the estimated production costs of Australian green iron. The cost gap for most producers is substantial. Producers in the Eyre Peninsula and Geraldton have lower costs than other producers, and our model suggests they may be able to compete in small segments of the market where there are particularly high prices. Other producers face a cost gap up to $1000 per tonne, depending on the production technology and site location.

Results from the model show that policies addressing market failures will help Australia seize its green iron potential.

If iron producers paid the expected EU carbon price in 2030 – $155 per tonne – the cost of conventional, fossil-fuel-based iron production would rise significantly and the green premium would narrow. We find that producers in more locations would be able to compete in the international market, and producers in the Eyre Peninsula would be able to compete with a much broader share of the international market for iron products.

Bridging this gap requires targeted policy action – not to subsidise inefficient production, but to correct clear and broadly recognised market failures that conceal the true costs of high-carbon products.

## *Fixing market failures*

The Superpower Institute identifies three key market failures that warrant government intervention:

1. **Unpriced emissions from fossil-based production**
   Because there is no system of international carbon prices, iron and steel producers do not pay the social cost of their carbon emissions. The lack of carbon price distorts the market and makes it difficult for green iron to compete with carbon-intensive iron in international markets. To correct for the lack of an international carbon price, the federal government should provide green iron production tax credits.

2. **Under-provision of common-user infrastructure**
   Like other major industries, green iron production requires large-scale, shared infrastructure – roads, transmission lines, pipelines and storage, and upgraded ports. These assets have strong spillover benefits that private investors cannot capture, so the private sector will not invest in them at the efficient scale. Public investment is essential to ensure this infrastructure is delivered at lowest cost.

3. **Innovation spillovers and early-mover risk**
   In establishing new industries, early producers absorb the costs of technical learning, process optimisation, and supply chain development. They confer large benefits on later producers, without reward. Without policy support, this disincentivises early investment. To correct for positive externalities created by early producers, the government should offer capital support worth up to 30 per cent of the investment cost for a green iron project.

These market failures constrain what Australia could otherwise achieve. The Superpower Institute has developed a detailed set of policy recommendations (Table 1).

With efficient support, Australian green iron can be cost-competitive. A green iron production tax credit worth $170, including the value of the existing Hydrogen Production Tax Incentive (HTPI), would have a very similar effect to a carbon price.

Our proposed production tax credit would address the market distortion created by the missing carbon price. It would narrow or eliminate cost gaps, and expand the number of locations where green iron producers can compete in the international market. It would also mean low-cost producers are better able to compete in the international market.

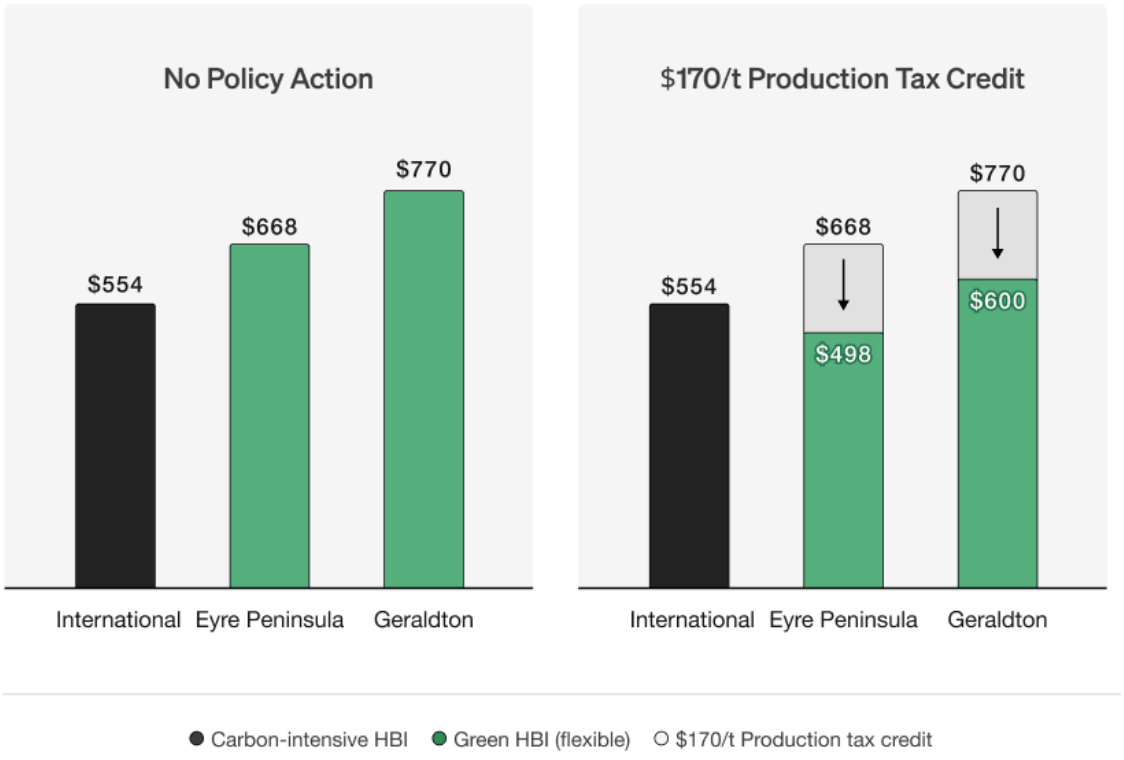


**Figure ES.2: A production tax incentive of $170 would eliminate or narrow the cost gap with carbon-intensive iron**

Notes: Production costs for Australian HBI are based on a dynamic model of green iron production. Prices for carbon-based iron products are based on World Bank data for international fossil-fuel based HBI.
Source: BIVIOS and The Superpower Institute

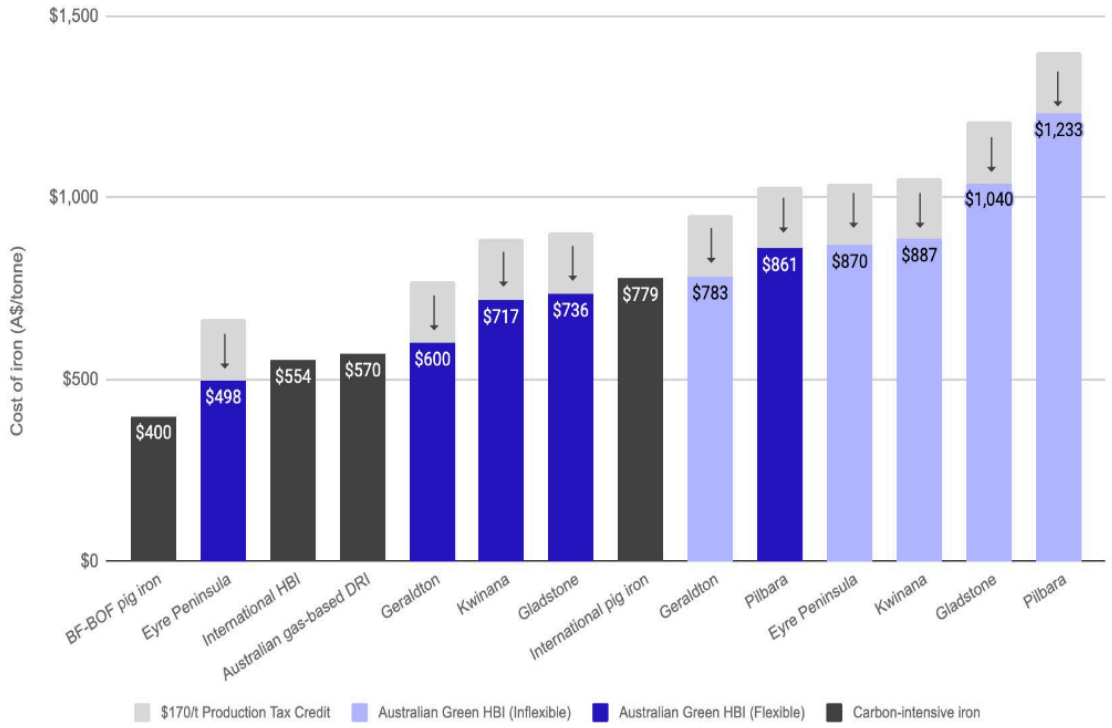


**Figure ES.3: A production tax incentive would level the playing field for Australian green iron producers competing with carbon-intensive iron products international benchmarks**

Notes: Production costs for Australian HBI are based on a dynamic model of green iron production. Prices for carbon-based iron products are based on an illustrative price of $400 for BF-BOF pig iron, and World Bank data for international fossil-fuel based HBI and pig iron.

Source: BIVIOS and The Superpower Institute

A fourth role for the federal government is diplomatic engagement: working with trade partners to help grow international demand for green iron. Japan and South Korea are currently major destinations for Australian iron ore, and are promising destinations for green iron. There is also potential early demand from Europe, where the EU carbon price will drive early demand for green iron. Over the longer term, the opportunity is greatest in China, South Asia, and Southeast Asia.

Our recommendations have substantial cost implications for Australia's budget, but are consistent with the Australian Government's emphasis on productivity growth, and its existing support for green hydrogen and other green exports.

Only a small share of these costs will be borne before 2030, likely in the form of capital support for a small number of early green iron producers, with this support recognising the public benefits of innovation. This will be crucial for building early momentum.

As green iron is produced, likely from the early 2030s, the government will incur additional costs in the form of our recommended production tax credit for green iron. This support will help correct the market failure of the missing international carbon price, and will help ensure green iron is available for our trade partners as they decarbonise their iron and steel sectors. This support for future projects can be reviewed and adjusted in, say, 2030 to reflect the level of take up, international progress towards carbon pricing, and the policies of our trading partners.

These policies should be a national priority. There is no case for delay. Although green iron projects are being explored around the world, no country or company has yet achieved commercial scale. The global race is underway, but the field remains open. With the right policy supports, Australia's first projects could be operational by 2030. These will serve as proof-of-concept, showing what is possible in Australia and attracting investment from our trade partners.

# *Recommendations*

**Table 1 - TSI's policy recommendations to realise the green exports opportunity**

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| ***Correcting for the missing international carbon price*** | |
| **Recommendation 1** | In addition to its $2 per kilogram support for green hydrogen, the government should provide support for green iron production to simulate the effects of a carbon price. We estimate total support, including the Hydrogen Production Tax Incentive (HPTI), should be worth at least $170 per tonne of green iron in 2030. This could be achieved with a 'stackable' production tax credit for green iron. The production credit should rise to maintain equivalence to the EU carbon price. |
| **Recommendation 2** | Some nascent green iron production technologies do not use hydrogen, but may use significant amounts of renewable energy dedicated to iron-making. Here, the HPTI does not help close the cost gap between green iron and carbon-intensive iron. The government should provide support that simulates the effect of a carbon price for non-hydrogen-based green iron technologies. This could take the form of an expanded production credit for green iron, worth at least $170 per tonne of green iron in 2030. |
| ***Supporting positive spillovers from common-user technology*** | |
| **Recommendation 3** | In locations that are most promising for multiple green iron projects, federal and state governments should support new natural-monopoly infrastructure that is essential for green iron, steel, and other green exports: electricity transmission, hydrogen pipelines and storage, ports, and desalination and water supply in areas with no local water supply. This can be direct government investment or support to private investors. Government's role in supporting infrastructure will solve the coordination problem that will otherwise delay or prevent investments in green iron production.<br><br>Infrastructure use should be priced efficiently, so the cost of using infrastructure is not a barrier to early private investment in green iron. |

## *Supporting green production in low-cost locations*

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| **Recommendation 4** | We propose an Australian green hydrogen certificate scheme, with green hydrogen producers earning tradeable certificates. Certificates could be purchased and surrendered by green iron producers anywhere in Australia. Iron produced with natural gas could be recognised as 'green' iron production when equivalent green hydrogen certificates are purchased and surrendered.<br><br>Producers of other green hydrogen-based products would also be included in the scheme. |

## *Supporting positive spillovers from early producers*

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| **Recommendation 5** | The federal government should provide capital support for early commercial producers of green iron, with a planned output of at least 0.5 million tonnes per annum. This could build on or draw from the already announced $1bn green iron investment fund. Two levels of support should be available:<br><br>1. Early investors in green iron projects, using any kind of green iron technology, should receive capital grants, or equivalent tax benefits, representing 15 per cent of capital costs. We propose that this support should be available for up to three green iron projects.<br>2. Grants worth an additional 15 per cent of capital costs should be made available for the first few uses of a particular kind of green iron technology deployed in Australia.<br><br>Support should be capped at $500m per project. |

## *Policies to support international trade dynamics*

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| **Recommendation 6** | The government should shape its Guarantee of Origin (GO) certificates to be compatible with the EU Carbon Border Adjustment Mechanism (CBAM). This should be done at the earliest possible date after the EU legislates its requirements. |

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| **Recommendation 7** | The Australian government should strengthen support for research on countries' economic challenges and trade opportunities as the world decarbonises. |
| **Recommendation 8** | The Australian government should work with trade partners to secure financial support for Australian green iron production. This may come in the form of contributions by trade partner governments toward the supports described in Recommendations 1 and 2. Such contributions would recognise the shared benefits of successful Australian green iron production, to both Australia and our trade partners. |
| **Recommendation 9** | The federal government should use international platforms to advocate for a system of international carbon prices. It should demonstrate Australia's commitment to the Paris Agreement with policies that impose or simulate the effects of a carbon price consistent with net-zero carbon emissions by 2050. |