The Superpower Institute

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Unlocking green metals opportunities for a Future Made in Australia

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About The Superpower Institute

The Superpower Institute's (TSI's) mission is to help Australia seize the extraordinary economic opportunities of the post-carbon world.

A net zero Australian economy will reduce global emissions by just over 1%. But if Australia successfully seizes the economic advantage in exporting zero emissions goods, this can create a sustained economic boom, improving national prosperity and living standards, and reducing global emissions by around an additional 6-9%.

Renowned economist Ross Garnaut and economic public policy expert Rod Sims have joined forces through The Superpower Institute, to focus on practical research and policy to unlock this boom. The Institute specialises in the policy settings and market incentives needed to make Australia an economic superpower and provides practical knowledge to governments and industry to realise this opportunity.

TSI works across the building blocks of the Superpower Economy including: renewable energy, green hydrogen, land carbon and minerals processing; the potential zero carbon export products including green iron and green aluminium; and the enablers of this economy including economic and fiscal policy, trade policy and regional development.

https://www.superpowerinstitute.com.au/.

Australia's enormous green metals opportunity

The Superpower Institute (TSI) welcomes the opportunity to contribute to the Department of Industry's Green Metals consultation process.

This submission sets out TSI's positions on how to unlock Australia's enormous green metals opportunities. With the right policy settings addressing key market failures Australia could be exporting 10 million tonnes of green iron by 2030. Along with other green metals opportunities, development of these industries can underpin prosperity in Australia for decades to come and make a significant contribution to global carbon emissions reduction.

TSI's answers to the questions posed in the consultation paper are also attached to this submission (Attachment A).

The scale of the opportunity

The scale of this opportunity for Australia is immense, with the potential to secure a long period of high investment, rising productivity, full employment and rising incomes in Australia.

We estimate the annual export value of green iron to be $295 billion, or three times the current value of iron ore exports. Green aluminium exports could be worth an additional $60 billion, compared with the current value of bauxite and alumina exports of $10 billion.

Australia's comparative advantage

Australia possesses two key comparative advantages that position it uniquely to take advantage of green metals opportunities:

1. Abundant low cost renewable energy, in the form of high quality wind and solar resources across an expansive geography
2. Abundant bulk mineral resources as the largest (or one of the largest) producers of iron ore, bauxite, copper and many other rare/critical minerals

While other countries around the world have a combination of these endowments to varying extents, none match Australia.

Executives in the two largest investors in European green iron plants—ArcelorMittal and H2 Green Steel—have both remarked that Europe will not be able to produce most of its own green iron. Instead, Europe must:

> *[m]ake the green iron where the electricity is cheaper and then ship the green iron to where you have the steel plants, where you have the know-how and the existing infrastructure.*

This is true of most of Australia's major trade partners: they do not have enough cheap renewable energy resources to meet their future needs. China, India, and the EU have some quality renewable resources, but the scale of future electricity demand means that those resources will be exhausted and marginal prices will rise. Japan and South Korea confront starker shortages, and already have among the highest renewables prices in the world.

Australia's high-quality renewable energy resources vastly exceed its future domestic needs. This leaves a practically unlimited surplus available for exploitation by export industries. The most efficient way to export cheap renewable energy to the world will be by embedding it in value-added products such as green metals.

Obstacles to the green metals opportunity

In a well-functioning market, profitability is aligned with social return. Market actors allocate capital to activities with the highest private returns, and in doing so maximise social returns and so real economic growth.

In Australia, investments in green metals are currently unprofitable. This is a consequence of profound market failures that are well-characterised in standard economic theory. Failure to address these market failures will result in costly resource misallocations, and greatly diminish the Australian standard of living.

These market failures are of three main types:

1. The non-pricing of CO_2. The lack of a global carbon price is an enormous market distortion. Carbon emissions are a negative externality, imposing large costs on society that emitters currently do not bear. Steel and aluminium production using fossil fuels are responsible for more than 10% of world carbon emissions. The costs imposed on society by these emissions are not borne by producers, nor reflected in the prices of these products to customers. This makes it impossible for green manufacturing processes to compete on a level playing field and to deliver economically efficient and zero carbon supply of metals.
2. Innovation spillovers. Innovators and early-movers pay large capital costs, and take on large risks, to generate knowledge and expertise that largely benefits other players. Investments in this area therefore create positive externalities. The size of the innovation market failure is proportional to the future social return from innovation. Because Australia’s potential future income from green metals is so large, the innovation spillover is very large. It compounds with the

non-pricing of CO_2 market failure to further reduce the return to investments in green metals processing.

3. Common infrastructure spillovers. Regions with the greatest potential for efficient, large-scale green metals production will usually lack adequate transmission, and infrastructure for transporting and storing inputs such as green hydrogen. It is not profitable for a single private entity to provide these at efficient scale, and many of the benefits of increased regional economic activity cannot be captured by a single entity. Common user, or consortia, approaches and/or government support are likely to be necessary.

In addition to these market failures, a fourth potential obstacle is in the decarbonisation strategies adopted by our major trade partners. Steel and aluminium are essential materials for major industries and for economic development. Current "brown" metal producers around the world are exploring options for reliable supply. This includes extremely costly approaches for retaining a domestic industry (e.g. importing ammonia for injection into blast furnaces), and the possibility of imports from our competitors (e.g. Brazilian ores processed in the Middle East).

Australia must position itself as a credible partner. Our investments in supply will shape the expectations, and so the investments and decarbonisation strategies, of our trade partners.

Finally, we must ensure that Australian production satisfies the requirements of partners' green trade schemes, such as the EU's Carbon Border Adjustment Mechanism (CBAM).

Our policy recommendations

This leads to TSI's four pillars for an efficient policy response to the green metals opportunity:

1. pricing the negative externality (CO_2 emissions);
2. subsidising the positive externality (innovation);
3. Government provision of natural monopoly infrastructure; and
4. active international diplomacy to secure green premia

Many of TSI's responses to the consultation paper questions relate to these four pillars. Each of our policy recommendations is important, but the first pillar of carbon pricing (or alternatives to deal with the externality of carbon emissions), the second of innovation support, and the third relating to infrastructure are high priorities to deal with very significant market failures. It is worth briefly describing TSI's approach here.

Carbon pricing

Australia should impose a carbon price on emissions or an equivalent mechanism. TSI advocates for the Carbon Solutions Levy (CSL), to be introduced by no later than 2030. The CSL would apply at all fossil fuel extraction sites in Australia (around 105 sites) and on all fossil fuel imports into Australia.

Fossil fuel firms will remain profitable. By way of comparison, the Middle East's average tax rate on oil producers is 85%, and the Middle East retains an oil industry. What these fossil firms have in common is a return on capital vastly in excess of the market rate—i.e large economic rents. Two centuries of economic theory tells us that rent taxation is the most efficient and least distortionary form of taxation.

That part of the tax that does not fall on rents will flow through to consumers. Proceeds from the CSL would be more than sufficient to compensate or indeed over-compensate consumers through energy bill and fuel excise relief, and to fund the complementary green industry policy initiatives outlined in this section.

Global policies to efficiently price carbon emissions to deal with this negative externality are fundamental to unlocking green metals export opportunities. This will ensure different technologies compete on merit, having regard to the differences in the level of costs imposed on society by their respective carbon emissions (or lack thereof).

In Australia, until a policy such as the CSL is implemented, the government should provide for second-best carbon price surrogates, in the form of subsidies for crucial parts of the green value chain. The Hydrogen Production Tax Incentive of a $2/kg for renewable hydrogen (H2) is well targeted and supported by TSI. It will be of particular benefit to green iron production. A renewable energy subsidy, akin to the soon-to-expire RET, is another essential surrogate. It will be of particular benefit to green aluminium production, which mainly depends on low cost electricity.

Innovation grants/credits

An efficient approach to innovation grants or credits will be market-based: firms choose projects and retain a large stake in project outcomes. Grant criteria should be general and transparent, with grants made available to any serious project that meets the criteria.

Up-front capital contributions have the highest impact. This may take the form of a grant or a tax-based mechanism, with these being financially equivalent with the right design. For a taxed-based mechanism, we suggest immediate expensing of capital expenditure, an uplift on CAPEX for tax deductions, and allowing credits to be cashed out if the taxpayer has no taxed income against which it can be deducted.

For the first few commercial projects in a given technology category, we suggest capital grants of 50% or equivalent tax credits. Grants (or tax credits) thereafter should receive diminishing support on a sliding scale towards zero as the number of projects reaches a certain level. It may be appropriate to impose payment floors and ceilings. In terms of grant size, the design has similarities with the US Industrial Demonstrations Program, a US$20+ billion program that contributes up to 50% of the costs of innovative green industrial projects. Payments are capped at US$500 million, and the minimum size is US$35 million. If implemented through the tax system, the design is closely related to the R and D tax credit currently in operation.

Grants should be applied to the component of the project that requires innovation (where innovation includes bringing a technology to scale in Australia for the first time). For example, in a project with hydrogen electrolysers, a hydrogen direct-reduction-iron (DRI) plant, and renewable energy, the electrolysers and DRI are new to Australia and should attract the incentive. The renewable energy component should not be supported by innovation grants/credits, but it may be supported by renewable energy-specific mechanisms.

Government funded natural monopoly infrastructure

The third market failure to address is in supporting the essential infrastructure that will underpin investment and green metals production. We do not want a lack of ready infrastructure, or excessive costs, holding back development. Government should fund new natural-monopoly infrastructure that is essential for green iron, steel, and other green exports, to ensure low prices and to ensure that infrastructure gaps are not a barrier to private investment. In particular, the government needs to build ahead of demand.

The Government can, of course, recover its costs of infrastructure provision at a government discount rate through a government business enterprise which would be off budget. Further, it will be more economically efficient to have this infrastructure funded by government rather than the private sector where regulatory settings often see returns allowed which impose high costs on users.

An achievable target by 2030

We note that responses in this document mainly relate to the green iron/steel opportunity, with some comments on the simpler case of aluminium. However, similar principles apply to other metals processing which may be covered by the 10 percent production credit for critical minerals.

With the policy recommendations we suggest in place, an ambitious but achievable target for green iron would be 10 million tonnes by 2030.

The remainder of this submission addresses the questions posed in the consultation paper.

Attachment A - TSI's responses to the consultation paper questions

Future markets for green metals[1]

Summary

Over the next approximately 5 years green steel demand will exceed supply. The emerging role of green premia, for example the green premium that can be secured by the EU's CBAM, will be critical to encourage supply.

In the longer term, by 2050, global primary steel demand is expected to grow only slightly.

Australia's comparative advantage is specifically in contributing to green primary steel, in the production of green iron metal from renewable electricity (and biomass). By 2050, green steel must make up the large majority of global steel production—well over a billion tonnes—if countries are to meet their Paris commitments.

Australia's primary competitors in iron ore mining are Brazil currently, and Africa in the future. Nordic countries and Canada are other sources.

The primary competitors in green ironmaking are in the Middle East, which may import Brazilian and African ores and transform them with cheap solar and wind power. Brazil has lesser potential for competitive production.

As a share of global iron ore consumption, total investments in green iron production are small so far. These investments are primarily in hydrogen-based direct-reduction iron (H2-DRI), which are most likely to use high-grade magnetite ore based on current technologies. Analysts expect the high-grade ore premium to continue to grow. Without technology development, Australia's exports of lower-grade ore are guaranteed a sharper decline in both volume and price.

Countries in Europe and Asia will import green iron from whichever country, or set of countries, establish themselves as credible suppliers. So far, Brazil and the Middle East are winning the race. Australia must make equal or larger efforts to address market failures, or it will lose out on both iron ore exports and the larger opportunity to process green iron.

Top priorities include: establishing a low-cost green hydrogen industry, investing in hydrogen storage and transport infrastructure, overcoming technical barriers to iron

[1] This section covers questions 1-5 from the consultation paper

ore upgrading for DRI, and contributing to the development of non-DRI technologies that are compatible with lower grade ores.

1. What insights do you have on green metals markets? For example:

a. Expected current and future demand for green metals domestically and in key export destinations.

Short-term demand for green iron/steel (through to 2030)

In the short-term, green steel demand is expected to exceed supply. The World Economic Forum's Net-Zero Industry Tracker observes that customer demand is the only aspect of steel decarbonisation that is currently on-track to meet 2050 targets.

- Demand for low-carbon steel is increasing rapidly from a low base. Bloomberg NEF (2024) notes that "demand is rising faster than production", a view supported by McKinsey (2023), Berkshire Hathaway's Business Wire (2023), and various other analysts. McKinsey (2023) expects low-carbon steel demand to grow 13-fold, from 15 million tonnes in 2021 to over 200 million tonnes in 2030, and for demand to exceed supply to at least 2030.

- Because green iron is more expensive to produce than carbon-intensive steel, suppliers incur a 'green cost gap', or a 'green premium.' In the short term demand will be sufficiently strong that green iron producers will not only secure the cost-based green premium, but may also secure an additional premium due to scarcity. There will be "tight supply/demand balance over the next decade and substantial profit potential" for those firms that innovate successfully. McKinsey (2023), for example, expects premiums for low and zero-carbon steel of "$200 to $350 per metric ton by 2025 and $300 to $500 per metric ton from 2025 to 2030." These are premiums of 50% or more. Changes to the EU emissions trading scheme, and the EU's Carbon Border Adjustment Mechanism (CBAM), will be an important driver of demand for green iron and steel.

- Iron and steel producers in the EU have historically been protected from the full weight of the EU carbon price, and have received free EU allowances. This will change from 2026. Free allowances for EU producers will be progressively reduced, until they reach zero in 2034.
  At the same time, importers of simple iron and steel products will progressively be exposed to the EU carbon price through the CBAM, with the full EU carbon price applied from 2034. Based on an illustrative forecast price of €100/tonne of CO_2, conventional steel production, which emits 2 tonnes of CO_2 per tonne of

steel, will face cost increases of A$320 per tonne. Based on IEA figures—and on figures from major EU investments—the full weight of the forecast EU carbon price should be enough to make hydrogen DRI competitive.

- Producers of green iron will only be able to cover the cost-based component of the green premium in the longer term if there is a global price on carbon, or if there are other policies that mimic the effects of a carbon price. Short-term scarcity reflects early support from first-mover buyers, who are not representative of most commercial buyers and longer-term demand. In the automotive industry, for example, green steel may add as little as $100-200, well under 1%, to final product cost, and is the cheapest way to cut a large share of product emissions. These cars can attract a premium as low-carbon vehicles. The same is true for appliance and equipment manufacturers. .

Long-term demand for green iron/steel (through to 2050)

Global steel demand is expected to grow to 2050, driven by growth in the global population and in per capita steel demand. The IEA projects an increase in steel demand of, at minimum, 33% by 2050, and other sources (e.g. BCG) expect a nearly 50% increase to 2.8 billion tonnes.

Demand for primary steel—of most consequence for Australia—is expected to grow only slightly. While there is some uncertainty about scrap availability, the IEA, IEEFA, CSIRO, and many others expect that the share of scrap recycling in steel production will rise from 32% today to around 45% in 2050. The combination of increased demand with increased recycling implies an increase in primary steel demand on the order of 5-15%.

Our comparative advantage is specifically in green primary steel, in the production of green iron metal from renewable electricity (and biomass). Looking to the long-term, by 2050, green steel must make up the large majority of global steel production—well over a billion tonnes—if countries are to meet their Paris commitments. For Australia, demand in Northeast Asia, and rapidly developing Southeast Asia and India, will be of the greatest significance. The EU will be an important target market in the 2020s, although less significant in the long-run.

It is fundamental to note that none of these markets can get to net zero without importing green metals.

1.b Australia's potential production volumes of green metals.

Long-term potential production volume

Around 37 percent of the world's primary steel, around 500 million tonnes, is made with Australian iron ore.

While there are many barriers that need to be overcome, at the limit all exported ore could be converted into green iron metal (and potentially some into steel) before shipping. The potential is therefore around 500 million tonnes. How close Australia gets to this maximum depends on the competitiveness of its production and, most important, Australian policy settings..

Studies find that green iron and steel producers' competitiveness is overwhelmingly sensitive to electricity costs. The cost of capital is a distant second (and Australia is also well placed in this), and labour costs are insignificant as a fraction of costs per tonne.

The Government's Green Metals paper observes correctly that Australian renewable electricity costs will be the lowest among advanced economies. However, TSI strongly disagrees that Chinese and Indian costs will be lower than Australia's in the future. This is a simple consequence of available supply versus future energy demand. Demand for electricity in China and India will continue to grow with development, and will be greatly increased by electrification. Together, these cause electricity demand to outstrip the low-cost supply of clean electricity. China and India will ride up the clean energy supply cost curve as they exhaust their best resources.

Australia faces no such constraint—solar and wind resources are in great excess to any possible need, and its supply cost curve is effectively flat. By importing Australian green iron and other energy-intensive products, these countries import our abundant cheap energy.

Whether or not Australia grasps this opportunity depends on whether it successfully implements the four pillars of good policy set out in the Introduction, as well as sound macroeconomic conditions to allow for low cost access to equipment and capital.

Short-term potential production volume

Production within the next five years will remain modest. Demand does not appear to be the limiting factor; if McKinsey estimates are correct, then there may be demand for up to 200 million tonnes of low and zero-carbon steel by 2030, close to 10% of total steel demand. On current global investments, this will be undersupplied, hence McKinsey's expected increase in green premiums.

Australian production is limited by the availability of:

- low-cost green hydrogen, and for some potential producers of green iron, infrastructure to transport and store hydrogen.
- high grade ores, or cost-effectively upgraded hematite/magnetite, for DRI processes; and

- non-DRI technologies that can handle lower grade ores, such as high and low temperature forms of electrolysis.

These are key problems to solve, or at least to lead on, by 2030. In the interim, Australia has significant availability of magnetite in the period to 2030. Australia's capacity to process larger quantities later will depend on its ability to lower access technologies to process lower grade ores.

TSI recommends that Australia should aim to process 10 million tonnes of green iron by 2030. This is an ambitious but achievable goal.

1.c Which countries/markets are green metals currently being sourced from and used in?

There is relatively small-scale production and consumption of primary green steel in Europe, Northeast Asia, and the US.

Major billion-dollar investments have been made in Sweden, Germany, the US, and Brazil.

- As of June 2024, H2 Green Steel in Sweden had raised around A$10.5 billion in funding for its first plant. This is the second-largest hydrogen project in the world, and will produce 2.5 million tonnes of DRI each year. Half of this production has already been sold in 5-7 year binding contracts on the steel offtake market. Production is expected to increase to 5 million tonnes by 2030. Typical contracts are reportedly at a 20-30% premium to conventional steel, with premiums rising over the past year.
    - Purchasers reportedly include Adient, BE Group, Bilstein Group, BMW, Electrolux, Ingka/IKEA, Kingspan, Kirchhoff, Klockner & Co, Lindab, Marcegaglia, Mercedes-Benz, Miele, Mubea, Porsche, Purmo Group, Roba Metals, Scania, Schaeffler, Volvo, Zekelman Industries and ZF Group.
    - Investments are supported by a loan guarantee of A$1.9 billion from the Swedish National Debt Office.
- ArcelorMittal is building H2-compatible DRI plants in several European countries, receiving around A$5.6 billion in grants and subsidies. These include:
    - DRI in Hamburg. A$176 million, with 50% funded by the German Government. Capacity of 100,000 tonnes of DRI annually. Fed initially by "grey" hydrogen from steel plant waste gases, and to be fed by green hydrogen as more production comes online.
    - DRI in Bremen. Including one electric arc furnace (EAF) in Bremen, and two more EAFs in Eisenhüttenstadt. Use of green hydrogen will "steadily

increase", though is expected to be low at the start. The project is supported by a A$2.1 billion grant from the German state, and production is expected to be up to 3.8 million tonnes of green steel.

  - DRI in Gijón, Spain. A$720 million in state funding, and production of 2.3 million tonnes of DRI annually. Production will initially use natural gas, and switch to hydrogen as costs decline.
  - DRI in Ghent, Belgium. A$1.75 billion project, 2.5 million tonnes of DRI annually. Production will initially use natural gas, and switch to hydrogen as costs decline.

- In Brazil, CSN Mineração, the second-largest ore producer, is investing A$2.15 billion in a project that will produce DRI-grade ore (67% Fe) to sell to the EU market once the CBAM operates in 2026.
- In the US, the IRA has so far directed at least US$1.5 billion towards six green iron/steel projects. The following firms are at least at the award negotiation stage:
  - Cleveland-Cliffs' proposed H2-DRI plant with a 2.5 million tonne per year capacity (up to US$500 million in support).
  - SSAB Americas' proposed H2-DRI plant with HYBRIT technology (up to US$500 million in support).
  - Vale's iron ore preparation project (up to US$282 million in support).
  - Three smaller induction melting/conversion projects (up to US$75 million each).

1.d Which other countries/regions will supply / demand green iron/steel?

Demand: Europe, Northeast Asia, and South and Southeast Asia

Demand for Australian green iron/steel will be driven by countries with large manufacturing and construction sectors. Many of these countries and regions currently produce carbon-intensive steel as inputs to these industries.

In the nearer term demand will come from the EU, especially as the CBAM takes effect. Taken as a whole, the EU is the second-largest steelmaker in the world, producing 150 million tonnes in 2021.

Japan and South Korea will follow and together produced around 165 million tonnes in 2021. For Australia they will be particularly significant, given their proximity and existing trade relationships with Australia, and especially because of their severely constrained options for cheap renewable electricity.

In the longer-term, Southeast Asia, India and China will become major sources of demand. Chinese demand is, of course, exceptionally large; it produces more than half the world's steel. India is rapidly growing. Both India and China will, with development and electrification, confront clean electricity demand that outstrips available cheap renewable resources. Demand for steel is growing in Southeast Asia, which has poor quality wind resources and solar resources about on par with Melbourne (due to the monsoon climate). They too will have uncompetitive electricity prices for manufacturing green iron.

Supply: High-grade ores

High-grade ores are easier to process, and the leading technology for zero-carbon iron – hydrogen-based direct reduction – uses iron ore with an iron content above 67%.

Competing suppliers of green iron/steel include countries with abundant high-grade ore, and those with abundant renewable energy supplies. Political stability, and risk premia on investments, will also be an important factor.

The current trade in iron ore reflects investments in carbon-intensive processing, which uses lower-grade iron ore. Global iron ore consumption is about 2.1 to 2.2 billion tonnes, and the seaborne trade accounts for the large majority of this at around 1.6 billion tonnes. Only 3% of the seaborne iron ore trade is of direct-reduction (DR) grade, or >67% iron. The following countries have high grade iron ore in production or reserves.

The first is Sweden, which we can largely set aside as a minor, within-Europe competitor. It holds 60% of Europe's iron ore resources, although the total resource is small. Sweden's main mine, Kiruna, produces magnetite at a grade of around 44% (high for magnetite), which is upgraded to over 65%. In total, Sweden produced around 38 million tonnes of iron ore in 2023. Given the low initial ore grade, this is enough to feed into around 15 million tonnes of steel—or only 10% of Europe's steel production in 2021 and a little over 1% of global production.

Brazil is the second largest iron ore exporter in the world and produced around 380 million tonnes in 2023, mainly from the Pará and Minas Gerais regions. It has the second largest reserves, roughly 60% of the size of those in Australia. It mainly exports hematite, with an average grade of over 62%, but this grade is increasing and Brazil's mines have significant capacity to produce ores of over 65% grade. Brazilian firms are investing in delivering DR-grade ore products to DRI steelmakers:

- CSN Mineração is investing more than $1 billion to expand production of DR-grade ore to take advantage of the EU CBAM in 2026;

- Vale is working with the DRI-producing French firm Gravity to produce direct reduction briquettes from its high grade ore; and
- Samarco is extending a deal to supply DRI to Nucor’s EAF plant in Charlotte, North Carolina.

Africa’s ore reserves are relatively poorly explored. Countries with proven or likely reserves, and active or potential investment, include Cameroon, the Republic of the Congo, Gabon, Guinea, Sierra Leone, Liberia, Mauritiana, Morocco, and South Africa. These projects are generally high risk; the corruption that has slowed realisation of the Simandou mine by more than a decade is an obvious example. Guinea is worth the most attention, with the Simandou mine likely to deliver around 60 million tonnes of iron ore annually by 2028, much of it of grade >65%. This will comprise about 3% of global iron ore supply, a small volume, but its impact on the emerging DRI market would be large.

Supply: Electricity for DRI

Brazil will have the capacity to turn some of its iron ore into iron metal, but unlike Australia its capacity for green processing is limited. This is because Brazil has less renewable energy potential than Australia.

Brazil’s population is eight times larger. Its electricity use is two and a half times Australia’s, and it will grow with rising incomes. And while Brazil’s grid is dominated by hydroelectricity, the resource is limited and its consumption of fossil fuels has increased in recent decades. Continued economic development will combine with electrification to increase Brazil’s electricity demand at least threefold, far exceeding its hydroelectric potential. It has generally poor-quality wind, and some limited excellent solar resources to satisfy this demand. These constraints are reflected in Brazilian firms’ early focus on exporting DR-grade ores and ore products.

The Middle East is Australia’s most important competitor in cheap energy availability. China, Japan, and South Korea are exploring plans to process Brazilian ores in the Middle East, with Vale planning to co-invest in iron production facilities in Saudi Arabia, the UAE, and Oman.’ The potential is limited by the scale of Brazilian ore reserves, and the world’s willingness to concentrate steel production in the Middle East. So far the Middle East focus (Saudi and the Emirates) is on brown iron (gas-powered DRI), but there is potential for renewables-based H2 to replace it.

3. Verification of green metal emissions reductions

For Australian green iron and steel to benefit from the EU carbon border adjustment mechanism (CBAM) and future CBAMs in other markets, the carbon content of Australian green iron and steel exports will need to be measured and documented with a system recognised by the EU and other governments.

The Australian government is developing a Guarantee of Origin (GO) scheme for green hydrogen and renewable energy. A goal is to align these GO schemes with international requirements.

The most recent Federal Budget allocated $11.4 million dollars over 4 years to fast-track the first phase of the GO scheme and to expand it to green iron, steel, and aluminium.

The Superpower Institute supports these measures and recommends that the government commits to a GO scheme for iron and steel that is formally recognised by the EU by 2030.

Factors influencing investment decisions in Australia and globally[2]

Summary

The scale of investment required to unlock green metals export opportunities is immense.

For green iron alone, we estimate around A$4 billion per million tonnes of green output is required. There is likely to be progress in the technologies between now and 2050 which would bring this cost down, perhaps by half.

Nevertheless, the total capital costs for green iron are likely to be in the order of A$1-1.5 trillion. Capital investments made before and during the mining boom show that this is achievable.

We advocate for early mover innovation grants targeting the $1450 per tonne required for electrolysers and DRI plant. Subsidies towards this could be in the order of $2-3 billion depending on how the subsidy declines.

6. Scale of investment

The required scale of investment is immense. The largest investment is in the renewables needed to power green hydrogen and green iron production. For a solar-powered H2-DRI plant, a rough breakdown:

- DRI plants come in at around A$450 per tonne of annual capacity.
- PEM hydrogen electrolysers cost around $1500-2500 per kW, and taking the middle value this is around A$1000 per tonne of capacity.

[2] Questions 6-7 from the consultation paper

- Renewable electricity purchased from the grid would not attract government support, and may be paid for as OPEX. However, if constructing solar with the plant, this would add around A$2500 per tonne of capacity.
- Hydrogen storage costs are relatively low per tonne of capacity.

These investments alone would require around A$4 billion per million tonnes of green iron output.

The price of electrolyser and renewables technologies will fall substantially , likely halving or more from here to 2050. Full conversion of Australia's iron ore to green iron over this period, with expected learning, would require capital investment of A$1-1.5 trillion in today's dollars. The scale of investment that will be required is substantial, but is achievable when considering the magnitude of the private investments in Australia's mining industry between 2002 and 2015.

Scale of subsidies

Early-mover innovation grants would target the A$1450 per tonne required for the electrolysers and DRI plant—or A$1.45 billion for a 1 million tonne plant. Grants of 50%, or equivalent tax credits, would be around A$725 million. Grants are only required to achieve initial learning and scale advantages, and should be limited to the first 2-3 projects in each technology domain. This suggests investment funding of nearly A$7.5 billion, across a small number of early projects, and potentially a further A$2-3 billion of subsidies depending on the rate of subsidy decline.

Like green iron and steel, Australia will have a comparative advantage in processing green alumina and aluminium, and this sector is also held back by the lack of a global carbon price.

Green aluminium projects will mainly face operational costs, so efficient government support for renewable energy projects will be crucial.

Innovation will not be required on the scale of green iron processing, although there may be some innovation in aluminium plant designs – for example, plants with increased power consumption flexibility, allowing them to take advantage of lower prices when renewable energy production exceeds grid demand. Whether such innovations warrant government support will depend on the particular innovations in question, whether they generate knowledge spillovers that proponents are willing to share conditional on government support.

For this reason, there may be a case for the first few green aluminium projects to receive government support beyond the standard R&D tax incentive, despite lower levels of innovation.

Even with an EU CBAM and an Australian policy to properly price carbon, such as the CSL, there are persistent distortions in international aluminium markets where carbon isn't priced. In the longer term, as more countries adopt EU-style carbon prices, and as countries move closer to their net-zero deadlines, Australia will be able to capitalise on its comparative advantage to produce green aluminium at scale.

Renewable sources of energy do not qualify for early-mover innovation funding, but in the absence of a carbon price the Australian government will need to use surrogate policies to create a sufficiently strong incentive to generate renewable electricity.

Principles for community benefit sharing and how this might apply to the green metals industry[3]

Summary

Community benefits from a green metals export industry are extremely large. For green iron alone, annual revenue from exporting green iron is estimated at up to $295 billion which is a little over three times current export revenue from iron ore. Revenue for green bauxite/aluminium could reach $60 billion, an increase of around $50 billion over current exports.

Importantly, direct and indirect employment benefits would be concentrated in provincial and rural Australia, and primarily in declining fossil energy regions.

8. Community benefits

There are two key community benefits from green metals industries.
The first is that export revenues will support a stronger budget, which benefits all Australians.

If Australia processes green iron on the same scale as current iron ore exports, it could produce around 560 million tonnes of DRI each year.
Based on conventional pricing for DRI that uses natural gas – about $530/tonne – annual revenue from exporting iron metal would come to **$295 billion**, or a little over three times typical export revenue from iron ore. While this estimate is based on the

[3] Questions 8-11 from the consultation paper

highest end of estimated exports, revenues per tonne could also be higher if green DRI continues to attract a premium

If Australia processed green alumina and aluminium on a scale that replaces current bauxite/alumina exports, this would result in production of around 17.25 million tonnes. At a typical aluminium price of $3500/tonne, expected revenue could leave $60 billion. This is a revenue increase of around $50 billion over bauxite/alumina exports.

The second key community benefit from green metals industries is employment. Direct employment would be concentrated in provincial and rural Australia, and primarily in regions that will have declining employment in fossil energy industries. These jobs would be the principal benefit to Australian communities.

9. How are you considering these benefits in evaluating projects? Are there ways to increase opportunities for the local community or broader industry?

N/A

10. How can the government support industry to enable communities and workers to share in the benefits of transitioning to green metals?

N/A

How quickly it is feasible to achieve different 'green milestones' as we move towards zero emissions production[4]

12. Key barriers to green iron investments

The key barriers to green iron processing are the three main externalities discussed in the introduction: innovation spillovers, infrastructure spillovers, and the absence of a carbon price. These externalities manifest in a number of ways, including low technology readiness, first-of-a-kind risk, limited skill availability, and limited supply chain development.

Domestic policy uncertainty is an ongoing obstacle to investment, which would be partly resolved by a commitment to upfront capital subsidies. Government support should also be coordinated across green hydrogen and green metal industries,

[4] Questions 12-16 from the consultation paper

because unavailability of green hydrogen will otherwise be a key barrier to the development of green iron.

Uncertainty about the balance of international supply and demand, and about the timing and magnitude of international action on carbon pricing, is also a barrier.

Demand is expected to be robust to at least 2030, delivering a sizable green premium. But, as noted earlier, as supply grows, the segment of the market that will voluntarily pay a green premium will be saturated; thereafter, the premium depends on carbon pricing and equivalent schemes.

This is why, in addition to addressing market failures, the fourth pillar of our proposed policy response is diplomacy. The government should use diplomacy to increase coordination with key trading partners, including the near-term markets of the EU, Japan, and South Korea, and longer-term markets including China, India, and Southeast Asia.

13. To what extent are barriers composed of upfront capital costs or ongoing operational costs?

In the case of green metals, two market failures affect both CAPEX and OPEX: first, the externalities generated by carbon emissions; and second, the knowledge and scale spillovers generated by innovators and early-movers. This is the justification for government intervention.

Capital grants address both CAPEX and OPEX challenges. Reductions in capital cost reduce the required return for investors. This allows better absorption of both capital and operational risks. Capital grants encourage production efficiency, and have clear budgetary implications for governments. Capital grants are the most valuable form of support for investors per dollar spent.

Production and OPEX subsidies risk reducing the incentive to innovate in operational efficiency, which reduces industry competitiveness. They also present budgetary risks, especially where support is long-running and uncapped. Finally, ongoing support raises politico-economic (and so budgetary) risks: industries that become dependent on OPEX and production subsidies may have incentives to threaten to exit if those subsidies are not extended. This risk is mitigated by one-time, upfront support for several producers.

Given modest green iron/steel price premia (20-30%), we expect grants of 50% to be sufficient to attract investment. Grants will need to be supplemented by investments in electricity transmission, and in hydrogen storage and transport infrastructure, to be used at green metals production hubs.

Other proposed policy mechanisms act as surrogate carbon prices and ease operational costs. The Government's production subsidies for hydrogen, and any extended support for renewables, will lower prices for green iron producers.

Finally, all green metals projects will benefit from a price on carbon. At least for the EU market, that price will come from the CBAM from 2026. It will be crucial to ensure that Australian green metal products are compliant and can benefit from the CBAM. This will require a mechanism to replace the Renewable Energy Target, which currently guarantees clean energy additionality.

Our preferred policy is the Carbon Solution Levy, described in the introduction to our submission.

14. What options are there at each intermediary step to reduce emissions for metal products?

Intermediate steps that produce piecemeal emissions reductions at conventional plants are a poor investment. They will not produce large and lasting economic spillovers, because the technologies involved have little future. Nor are they typically large innovations.

Natural gas DRI, for example, is not an appropriate target for innovation funding.

- It is not a frontier technology, but a well-established technology producing around 10 percent of primary steel globally. Nor will they provide the same scale spillovers to firms who are later entrants to the green-metal market. Australia has no meaningful comparative advantage in natural gas prices—none at all in eastern Australia, where gas prices exceed those internationally, and little if any advantage in Western Australia. WA's gas reservation has kept prices lower, but they have nonetheless doubled in the last few years. WA will in any case be outcompeted by the Middle Eastern states that have much lower gas prices, and already dominate natural gas DRI today.
- Finally, natural gas DRI reduces emissions by only 40%. This is not consistent with the necessary scale and pace of global reductions in carbon emissions. It is also inconsistent with increasing pressure and demand for near-zero emissions steel through the 2030s.

With green metal demand already growing faster than production, and deadlines for net-zero commitments looming, the transition will occur rapidly. In advanced economies, it will occur mainly as a switch from conventional steel to nearly zero-carbon steel. Some developing countries, mainly China and India, have stronger economic reasons to focus on modest efficiency improvements: they have a large fleet of relatively new conventional steel-making assets. They may also adopt approaches that would be uneconomic for new build plants—e.g. CCS—because of the sunk costs of the existing fleet.

In Australia, subsidies should focus on genuinely innovative technologies that (a) exploit Australia's long-term advantage in renewable energy prices, and (b) reduce emissions to near zero, defined as least 80% or 90%.

If a project combines natural gas DRI, or another conventional technology, with an innovative technology that has large benefits for Australia—e.g. a novel method of hematite processing—then only the component of the project that is innovative, producing large long-term spillovers, should receive support.

15. What are the technologies associated with meeting green thresholds?

The following technologies are of potential relevance to Australia:

First, those that require high-grade iron ore, and must be combined with advances in magnetite and hematite upgrading. This mainly includes standard hydrogen-DRI-EAF plants.

Second, technologies that are compatible with lower-grade ores:

- H2-DRI-SMELT-BOF — Hydrogen DRI with the addition of a melting step that allows the use of low-grade ores and makes production compatible with a conventional basic oxygen furnace.
- AEL-EAF / MOE — Alkaline electrolysis and molten oxide electrolysis.
- Low temperature electrowinning (e.g. see Australian firm Element Zero and US firm Electra).
- Fluidised bed reactors — Hydrogen DRI that is suited to lower grade iron fines (e.g. see Cicored, HYFOR, and Posco HyREX)
- Other biomass-plus approaches, including Rio Tinto's BioIron project south of Perth which combines biomass with microwaves, and HIsmelt. We note that biomass-based technology has limited potential at a larger scale, and is therefore less relevant.

The latter technologies are generally at a lower state of readiness, but apart from biomass-based approaches, may dominate if they cost-effectively solve the ore grade problem.

16. Are these technologies being developed or commercialised?

Green metals technologies are being developed, but too slowly given the three very large externalities: innovation spillovers, infrastructure spillovers, and unpriced carbon emissions. Addressing these market failures is the most efficient way to accelerate research and encourage commercialisation at scale.

Existing grant processes are often perceived as onerous. Simpler funding mechanisms, for appropriate technologies, would help speed technology development, but must not compromise vital consultation with First Nations communities, or other environmental protections.

What external constraints may be limiting the production of green metals[5]

17. What factors would enable the acceleration of metals decarbonisation? For producers, what levels of production would be feasible over time?

Addressing major externalities is the best way to improve the market for green metals. As discussed in the response to Q.13, capital investment will follow where there is an attractive return. The return to capital is reduced, inefficiently, in the presence of externalities.

Capital grants for early-mover projects substantially reduce the required total returns, allowing projects to go ahead. Alternatively, production may be subsidised, but such subsidies are of lower value per dollar, risk encouraging inefficiency, and present greater budgetary risks.

The feasible level of production is also constrained by demand. This constraint depends on the timeframe.

- A variety of market analysts expect green iron to be scarce and command a premium up to at least 2030, as discussed in the response to Q.1.
- Looking to the 2030s, the key question is whether Australia's trade partners have been persuaded
  (a) that their own domestic green metals production will be uncompetitive and

[5] Questions 17-21 from the consultation paper

will stretch their limited cheap energy resources, and
(b) that Australia is ready to be a reliable partner in the supply of essential green materials.

This is Australia's diplomatic challenge today. Large Australian investments in green metal industries will signal Australia's commitment and will be the most important tool of persuasion for its trade partners. This is most important for Japan and South Korea, which today express concern about how to decarbonise steelmaking given their high energy costs and high dependence on imported energy. Australian leadership, and the realisation of early contracts for competitively priced green iron, will strongly favour the Australia solution.

While short term political developments in the US and elsewhere may provide temporary setbacks, we regard the medium- and long-term risk that international decarbonisation efforts stall, blocking growth in the green metals market, to be small. Much more likely is mounting pressure for decarbonisation as countries approach the deadline for their Paris commitments, as policies such as the CBAM begin to reshape trade, and as the world continues to see increases in climate change-induced damage.

18. What are the best examples of a 'green premium' being established for low emissions products? What actions could improve demand for these products?

The EU ETS and CBAM is the most obvious and best example of green premia being built into international trade.

Green premia paid by automotive, appliance, and equipment manufacturers are also important, and reflect firm sensitivity to consumer preferences as well as explicit regulations that require minimum green content. However, premia based on consumer preferences and voluntary schemes are not a substitute for premia based on the social cost of carbon. Their effects are marginal and uncertain, and cannot drive the scale of metal decarbonisation that is required.

19. What are the key production volumes, cost profiles and price assumptions that would support minimum commercial viability for green metals production?

The Superpower Institute believes that the minimum production scale for commercially viable green iron or steel is about 0.5 million tonnes per annum, but there are economies of scale advantages for production up to 2.5 million tonnes per annum if electricity, hydrogen and other infrastructure is available to support current DRI technologies.

This proposed scale is consistent with international first-mover projects, which provide an indication of the production volumes that are expected to achieve commercial viability in the emerging green iron and steel sector.

As noted in Q1c, major billion-dollar investments have been made in Sweden, Germany, the US, and Brazil, with government support and expected annual production of:

- H2 Green steel in Sweden: funding of A$10.5 billion; expected production of 2.5 million tonnes per annum.
- ArcelorMittal H2-compatible DRI plants:
    - Hamburg: A$88 million grant; expected production of 100,000 tonnes per annum.
    - Bremen: A$2.1 billion grant; expected production up to 3.8 million tonnes per annum.
    - Spain: A$720 million grant; expected production of 2.3 million tonnes per annum.
    - Belgium: A$1.75 billion project, 2.5 million tonnes of DRI annually.
- In the US, Cleveland-Cliffs: up to US$500 million; 2.5 million tonne per year capacity.

20. How would adopting renewable energy and green hydrogen impact on your current costs and the commercial viability of your operations, if you were able to implement them right now? How does this compare to interim or transition fuels?

Production via “transition fuels”, notably natural gas, is more affordable than green technologies today because it is an established technology and because gas does not incur the cost of carbon. It has been adopted at scale in the Middle East because very low natural gas prices make it competitive there.

Crucially, the non-adoption of natural gas DRI in Australia is not sufficient to indicate the presence of an innovation market failure. As discussed in the introduction to this document, innovation market failures assume grand proportions where a technology is non-commercial but, once developed, can make a large and lasting contribution to national prosperity. Both criteria are met for green iron projects. Neither are met for natural gas DRI.

Some Australian firms will naturally prefer to receive large grants to pursue technologies that are already commercial, and that do not carry the same positive externalities. Limited funds should not be directed to projects that will add to national emissions, that have very limited future potential, and that do not help Australia to realise its comparative advantages in the emerging green metals trade.

21. What are your estimates of the cost-gap differences between producing green metals and traditional metals, across your planned decarbonisation pathway (per tonne)?

For steel, estimated green premia for H2-DRI-EAF range from US$100-300, or around 10 percent to 50 percent. These estimates depend on the steel price (typically US$600-900 per tonne), plant configuration, and energy costs. The IEA estimates the green steel premium to be in the middle of this range, at around 25%. The lower end of this range is relevant for Australia, for projects where electricity is sourced from the cheapest renewables.

A carbon price at the expected CBAM level of €100 or A$160 from 2026 is sufficient to provide a premium in the European market of around 25%, based on middle-range prices of US$750/tonne or A$1125/tonne for conventional steel.

a. How do you expect this to change over the next 20 years? Please include what data or assumptions you have factored into your calculations.

The cost-gap will close and green technologies will approach parity as costs come down for green producers, and as costs increase for producers of carbon-intensive metals. Standard economic analysis tells us that the social cost of carbon in an efficient system will rise at the real cost of capital (i.e. it will rise over time).

Costs for green metal producers will fall due to:

- Increased scale of all associated technologies—hydrogen electrolysis, green iron manufacturing methods, and management of different ore grades—taking them down the learning curve. Reductions in cost are mainly a function of scale, rather than time; costs will not come down if countries and firms do not make a start.
- Continued reductions in renewable energy costs, the most significant contributor to costs for all green iron production methods.

Cost for carbon-intensive producers will increase due to:

- Higher carbon prices – or stronger surrogate policies to reduce the carbon intensity of production – in countries with these policies already in place.
- Broader international application of carbon prices, via increasing scope of the EU CBAM and the expected introduction of other CBAMs.
- Increasing maintenance costs for existing plants, and large capital investments in new plants.

b. How do the cost gaps differ if you are able to use recycled metals as inputs?

Australia should recycle metals where it makes economic sense. For example, there is potentially scope to increase the use of recycled steel in electric arc furnaces powered by renewable energy. But the potential benefits of recycling metals with Australian green processing is expected to be small compared to the total value of exporting green metals.

How existing policies are shaping decarbonisation strategies and investment decisions[6]

22. To what extent has government support influenced investment thinking in Australia in respect to projects targeting decarbonisation?

The largest barrier to decarbonisation in Australia is extreme uncertainty about policy – both the nature of support for renewable electricity and green exports, and concerns that policies will change with political cycles. Policy uncertainty makes it particularly risky to invest in decarbonisation when there are interdependencies between green industries. For example, the green iron industry will depend on a green hydrogen industry – which in turn requires the green iron industry as a buyer. Both industries require substantial investments in green electricity.

For this reason, early developments are concentrated in Europe, where carbon pricing and innovation supports are clearer and have stronger bipartisan support—despite Europe's comparative disadvantage.

[6] Question 22 from the consultation paper

a. What impact will the government's industry investment measures, such as the National Reconstruction Fund and Future Made in Australia Innovation Fund, have on your transition?

This depends on how these policies operate. Australia needs general rules that compensate systematically for externalities for anyone who wants to invest, separate from discretionary official decisions of unknown outcomes and uncertain timing. The Government's measures, and the Treasury's National Interest Framework, are promising.

b. What impact will the government's recently announced renewable hydrogen measures have on your transition?

Support for green hydrogen is essential to the development of a green iron/steel industry, and we view government support for green hydrogen as helpful and necessary for green metal industries. The Superpower Institute strongly supports the subsidy for green hydrogen as a surrogate for a price on carbon, and the fact that support for hydrogen is available for any firms that meet the government's criteria.

c. What impact do the government's policies to incentivise renewable electricity generation, storage and transmission have on your transition?

Extreme uncertainty in the electricity sector is a major problem. The Capacity Investment Scheme will not be enough to decarbonise existing industry, especially as further support will disappear with the end of the RET. A carbon price is needed from the time the RET ends in 2030, to provide confidence in market direction and policy certainty.

The types and design of supply side options that should be considered[7]

23. What approach and features do you consider to be most effective? For example:

a. Which incentive would lead to the biggest increase in private investment in green metals production across production, investment, and innovation-linked incentives?

We refer to the proposed policies and incentives described in the introduction to our submission, which are designed to address the major market failures affecting green metals investment:

- taxing the negative externality (CO_2 emissions) [or subsidies in the meantime]
- subsidising the positive externality (innovation);

[7] Questions 23-30 from the consultation paper

- Government provision of natural monopoly infrastructure (electricity transmission and hydrogen transport and storage); and
- active international diplomacy to secure green premia.

b. What are the merits of receiving incentives through the tax system relative to grant based funding?

Tax-based and grant-based mechanisms can be financially equivalent depending on design, so long as tax incentives are made available for firms that do not have other income against which to deduct credits. R&D-type incentives are a good model, with the scale increased to reflect the magnitude and urgency of the innovation market failures in the case of green metals.

There is great advantage in certainty and timeliness—the availability of the incentive to anyone who meets known conditions.

c. Would a 'contracts for difference' scheme or other program designs be preferred?

This would not be preferred if allocated through an auction process, as firms must invest heavily before they know whether the support will be available.

d. What length and timing of support is required for long-term viability?

The impact on investment is greatest if tax credits are paid upfront, and the scheme wrapped up at a known date. .

e. Are there any additional features or design principles that would enhance the efficacy of support to produce green metals?

We describe our recommended policy-design principles in the introductory submission. We emphasise the special importance of:

- taxing the negative externality (CO_2 emissions) [or subsidies in the meantime]
- subsidising the positive externality (innovation);
- Government provision of natural monopoly infrastructure (electricity transmission and hydrogen transport and storage); and
- active international diplomacy to secure green premia.

24. Are there parts of the value-chain that require particular support (for example, energy inputs, green alumina or iron inputs, or green aluminium or steel production)?

Yes. Renewable electricity and green hydrogen inputs require investments in natural monopoly transmission infrastructure. Green iron depends on the four pillars of good policy we discuss in our attachment to this submission. Green aluminium will depend mainly on carbon pricing, given it mainly requires green electricity. However, innovations in plant design, e.g. flexibility of operation to better take advantage of fluctuations in electricity supply, may also be significant.

a. Should support be prioritised towards certain parts of the value chain in the first instance?

Innovations and early-mover projects across all aspects of the green iron value chain, from hematite/magnetite upgrading, to hydrogen production, and the various modes of green iron production, require support.

25. Where support is provided across a value chain, such as intermediate metal outputs, what design features are necessary to ensure support is effective for producers with different levels of vertical integration?

N/A

26. What eligibility thresholds would be appropriate to access production incentives?

Emissions reduction thresholds are most relevant. Otherwise, so long as projects are developed by serious firms, they will all add to forms of learning that are valued by other firms.

a. A minimum amount of green production output (for example, tonne of metal).

So long as firms retain a significant stake in project returns, we can expect firms to favour projects that are appropriately sized for the level of technology development. Major international H2-DRI projects are around 2.5 million tonnes capacity. Innovative, large-scale pilots will produce much less—e.g. Rio Tinto's BioIron will reportedly produce closer to 10,000 tonnes per year. Each of these project types are valuable: smaller grants will produce more learning per dollar; larger grants will contribute more to spillovers that arise from scale.

We advocate a market led approach: To a large degree, grants should be made available under simple rules, and firms should be allowed to make the choice about project size and production.

- For world-first-of-a-kind plants and technologies, firms will choose small-scale production. Grants will be smaller in absolute terms but larger in per unit output, and knowledge production will be higher per grant dollar.
- For plants and technologies that are used overseas, but first-of-a-kind in Australia, firms will choose larger scale production. Grants may be larger in absolute terms but smaller per unit output. The benefits will come from new knowledge, but also from the spillovers that arise from scale.

It is nonetheless appropriate to impose a high cap on support per project, e.g. $500 million, to balance project scale and project diversity.

b. Emissions intensity reductions per unit of production (for example, tonne CO2 emitted per tonne of metal).

Projects with near-zero emissions, no less than an 80-90% emissions reduction, should be considered for grant funding.

For Australia, innovation spillovers are largest where technologies:

- are not yet widely commercialised; and
- can exploit Australia's long-term comparative advantage.

That includes the near-zero emissions technologies that require cheap electricity and, to a lesser degree, biomass.

Reduced-emissions ironmaking technologies are not associated with such spillovers. Most notably, natural gas DRI is a well-established technology with numerous commercial-scale plants worldwide. It has relatively little lasting potential in Australia, and will provide little or no scaling spillovers. The Western Australian gas reservation offers a small pool of lower-cost gas, and that gas is significantly more expensive than that used in natural gas DRI projects in the Middle East. Expected growth in carbon prices, cost reductions in alternatives, and the short timespan to 2050 all create the risk of stranding assets for technologies that are not zero-carbon.

c. Eligible business size (for example, minimum facility production capacity).

As discussed, smaller projects will tend to add more knowledge per unit of output, and per grant dollar, than larger projects. TSI sees little reason to be concerned about project size, so long as the company is reputable and retains a sizable stake in the project outcome.

27. Should incentive levels be varied for different thresholds? For example, different incentive levels for different emissions intensity reductions per unit of production.

Innovation grants should be limited to near-zero emissions projects, with reductions of 90% or more.

28. Should there be time limits for accessing production support? If so, what should the duration be and when should it commence, cease, or phase down?

Government support should be made available for a reasonable period, e.g. five years, enough to allow firms to carefully plan and begin construction. Projects would qualify for grants so long as construction begins within that period.

29. What would be an appropriate level of incentive to support the development of competitive production for green alumina, aluminium, steel and iron?

As noted earlier, we suggest capital grants of up to 50% or equivalent tax credits.

The capital grant support would be applied at a declining rate after a specified number of early followers.

30. How could eligibility criteria be most appropriately linked to the delivery of strong community benefits?

Projects should meet specified minimum standards—indigenous, environmental, community, and other standards required by law, regulation, policy and practice. Standards should not be different, neither lower nor higher, than those that apply to other investment projects.

Demand side options that could be considered[8]

31. What demand side options would best drive confidence for green metals producers? Should the government consider regulation, procurement rules for government purchasing, voluntary targets or other demand options?

The Superpower Institute recommends policies that would support Australia's green metal export industry by correcting market failures in an economically responsible manner; we otherwise support surrogate policies that mimic market corrections as cleanly as possible. Our recommended policies are summarised in our introductory attachment. We do not advocate procurement rules for government purchasing.

32. How could the introduction of new demand measures affect competition?

Other ideas

Are there any other issues or opportunities that can be addressed to unlock an Australia green metals industry?

For example, any workforce and supply-chain constraints, better investment facilitation, sequencing issues, scrap recycling or circular economy opportunities.

N/A

Further Information

Contact info@superpowerinstitute.com.au

[8] Questions 31-32 from the consultation paper