

An aerial photograph of a coastal industrial facility, likely a steel mill or port. The facility features large, dark, conical storage piles of material, possibly iron ore or scrap, situated on a flat, cleared area. To the right, a long pier extends into the turquoise ocean, where a large cargo ship is docked. The surrounding landscape is a mix of green vegetation and cleared industrial land. The sky is clear and blue.

# Green Metals for Sustainable Steel from Australia and Germany

Roadmapping Exercise – Preliminary Report for Consultation  
Findings Draft



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# Executive Summary

Government, industry and academic consultation illuminates the significant opportunity within Australia for developing new green iron and steel supply chains, with progress already being made by major industry players. However, barriers persist which must be overcome by both State and Federal Governments and industry for these new industries to develop and thrive.

Global demand for green iron and steel is seeing increased pressure for iron ore, iron and steel producers to decarbonise their operations. As the current largest exporter of iron ore, with strong ambitions to become a major exporter of green hydrogen and green iron, Australia has a significant opportunity to diversify its economy and develop a thriving green iron and steel industry. However, achieving this requires extensive collaboration between State and Federal Governments and industry. Consultation with Australian and international organisations, iron ore, iron and steel producers, emerging technology suppliers, potential offtakers, industry bodies and academic institutions operating within the space has illuminated the green metals for sustainable steel state-of-play within Australia.

## Key Consultations Outcomes

- 1. Supply-Side Push and Demand-Side Pull Measures.** Having appropriate off-takers is considered one of the biggest risks facing the development of this industry. On the demand-side, where margins are sufficient to absorb green premiums (such as in the production of wind turbines or luxury vehicles), there is demand for green steel products even at current price premiums. However, for lower-margin products, such as white goods or kitchen appliances, there isn't demand for green steel at these price premiums. On the supply side, risks include ensuring adequate renewable electricity and green hydrogen for large-scale production, necessitating the co-development of renewable energy and storage with green iron and steel production. Additionally, there is risk in trading intermediate products like green iron, as steelmakers are hesitant to limit their supply to a few green ironmakers as the industry develops.
- 2. Delivering Cohesive and Targeted Government Assistance.** Improvements to the methods through which government assistance is provided would accelerate project delivery and assist investors and developers looking to enter Australian markets. Companies are currently under pressure to reduce Scope 1 and 2 emissions, which could disincentivise value-adding activities, such as iron and steelmaking. Furthermore, the development of green hydrogen, used for certain green steelmaking pathways, should include incentives to be integrated into value-added products like iron and steel, rather than incentivising the production of hydrogen alone. Additionally, the Transmission Use of System (TUOS) charges are very high in Australia, which needs to be addressed to enhance the competitiveness of hydrogen production, process electrification and decarbonisation.
- 3. Overcoming Project Development and Market Challenges.** The iron and steel industry is dominated by large-scale, global companies whose actions significantly influence change within the industry. Global green iron and steel supply chain development is hampered by uncertainty surrounding green iron and green steel standards, as well as the development of new markets, particularly for the instances where green iron may be traded as an intermediate product. Large-scale trials for the development of renewable energy, hydrogen and green iron and steel projects are necessary, but these are high-cost, high-risk endeavours. Additionally, access to appropriate labor markets is a challenge for remote locations like the Pilbara, as much of the iron and steelmaking expertise is concentrated on the east coast of Australia.
- 4. Supporting Early-Stage and Emerging Technology Development.** Within the iron and steel sector each site location has its own unique mix of variables (such as iron ore quality, access to water and ability to store renewable energy) hence there is no "one-size-fits-all" approach to the development of green iron and steel technologies. Emerging technology players identified targeted support for early-stage technologies as necessary to promote domestic R&D and advanced manufacturing in the green iron and steel sector, with emphasis on the need for government support for the development of green iron and steel demonstration plants.

# Executive Summary - Continued

Government, industry and academic consultation illuminates the significant opportunity within Australia for developing new green iron and steel supply chains, with progress already being made by major industry players. However, barriers persist which must be overcome by both State and Federal Governments and industry for these new industries to develop and thrive.

Global demand for green iron and steel is seeing increased pressure for iron ore, iron and steel producers to decarbonise their operations. As the current largest exporter of iron ore, with strong ambitions to become a major exporter of green hydrogen and green iron, Australia has a significant opportunity to diversify its economy and develop a thriving green iron and steel industry. However, achieving this requires extensive collaboration between State and Federal Governments and industry. Consultation with Australian and international organisations, iron ore, iron and steel producers, emerging technology suppliers, potential offtakers, industry bodies and academic institutions operating within the space has illuminated the green metals for sustainable steel state-of-play within Australia.

## Key Consultations Outcomes - Continued

5. **Australia within the Global Policy Landscape.** Australia can leverage its competitive advantages, such as the co-location of world-class iron ore and renewable energy resources, for green iron and steel production. International mechanisms, like the Carbon Border Adjustment Mechanism (CBAM) in Europe, are seen as opportunities for Australian industry growth. However, there is significant international competition from Brazil, Canada, and the Middle East, which are also looking to develop their own green iron and steel value chains. Brazil and the Middle East benefit from lower wages, while Brazil and Canada have access to hydroelectricity, offering high capacity-factor renewable energy generation.
6. **Achieving and Maintaining Social License.** Gaining community support to maintain social license to develop and operate green iron and steel projects is crucial to the development of this industry. Access to ample renewable energy and water resources, and the environmental and safety impact of harvesting and storing these resources for green iron and steel production must be taken into account. For example, the storage of large amounts of hydrogen for green steel production at locations such as Port Kembla is seen as a safety risk by many local residents.

# Executive Summary – Next Steps for Government and Industry (1 of 3)

There are clear next steps that both State and Federal Government, and Industry can take under 22 themes which have emerged from stakeholder consultation.

Theme	Next Steps
1. Supply-Side Push and Demand-Side Pull Measures	
Revenue Support Mechanisms	<ul style="list-style-type: none"><li>Design and implement a revenue support scheme at the national level to support Australian small-scale green iron and green steel projects in reaching FID and achieve scale-up.</li></ul>
Supply-side Push Mechanisms	<ul style="list-style-type: none"><li>The implementation of the \$2/kgH2 tax incentive and Hydrogen Headstart program should include incentives for integration into value-added products such as green iron and steel, which can include processing obligations for ore producers.</li><li>Industry to develop offtake agreements for first-movers to manage the limited supply of green iron products during the industry's early stages.</li></ul>
Demand-side Pull Mechanisms	<ul style="list-style-type: none"><li>Government to assess the feasibility of an Australian Carbon Border Adjustment Mechanism (CBAM) or encourage off-take for specific product types.</li><li>Industry to evaluate the implications of demand-side pull mechanisms such as domestic and international CBAMs.</li></ul>
Coordination of Infrastructure	<ul style="list-style-type: none"><li>Coordination of infrastructure is necessary for supporting the development of green iron and steel projects. State and Federal Government to ensure the development of new Renewable Energy Zones (REZ) and/or green shipping corridors are in strategic locations to promote the development of these industries.</li><li>The Pilbara is noted for its effective coordination of renewable energy, iron ore reserves, and rail and port infrastructure, which is not necessarily the case for other potential locations in Australia.</li></ul>

Theme	Next Steps
Accessing Renewable Electricity and Renewable Hydrogen	<ul style="list-style-type: none"><li>Competition for renewable electricity and renewable hydrogen will require prioritisation of planned renewable objectives with a cohesive strategy to ensure the appropriate co-development of these projects and infrastructure to minimise supply-side pressures for providing the necessary resources to these projects.</li></ul>
2. Delivering Cohesive and Targeted Government Assistance	
Political Certainty	<ul style="list-style-type: none"><li>Policy to include long-term incentives to provide more certainty to iron and steelmakers and off-takers.</li></ul>
Clearly Communicate Implication of New Regulation with Industry	<ul style="list-style-type: none"><li>Collaborate with organizations like the Australian Steel Institute to ensure any implications of new regulations are properly communicated to relevant industry stakeholders.</li></ul>
Streamlining Project Approval Pathways	<ul style="list-style-type: none"><li>State and Federal Governments can assign single contact points for developers and learn from international cases on addressing cumulative risk which arises from multiple co-located large-scale hazardous processes.</li><li>Governments could introduce measures such as “Fast 41” used in the USA, which allows project approvals to be streamlined for projects that have significant national interest.</li></ul>
Stackable Policies	<ul style="list-style-type: none"><li>Government policy at both State and Federal levels should be designed to be stackable, allowing Federal policies to operate independently while also complementing any existing state-level policies.</li></ul>



# Executive Summary – Next Steps for Government and Industry (2 of 3)

There are clear next steps that both State and Federal Government, and Industry can take under 22 themes which have emerged from stakeholder consultation.

Theme	Next Steps
<b>3. Overcoming Project Development and Market Challenges</b>	
<b>Industry Dominated by Large-Scale, Global Companies</b>	<ul style="list-style-type: none"> <li>Government to provide ample funding support for the development of demonstration plants and technologies, support SMEs developing new technologies for green iron and steel production and apply incentives for large-scale iron and steelmakers to decarbonise.</li> <li>Need to work quickly to ensure first mover advantage in the development of Australian made green iron and steel products before capital investments are made elsewhere.</li> </ul>
<b>Development of New Markets</b>	<ul style="list-style-type: none"> <li>There is international appetite for green iron and steel, but only certain industries can absorb the associated green premiums, which Australia lacks (e.g., car industry).</li> <li>Australian industry can target international markets willing and able to pay premiums for green steel products through the supply of intermediate products such as green iron.</li> </ul>
<b>Immature Supply Chains and Capacity Building</b>	<ul style="list-style-type: none"> <li>Australia could lose competitive edge if renewable energy and green hydrogen prices are not met.</li> <li>Industry players can explore the development of buyer's coalitions, working together to purchase key equipment from international organisations to support procurement and overcome a lack of vendor interest in the Australian market.</li> <li>Another strategy to mitigate supply chain risk is to invest in domestic manufacturing capacity for supply chain equipment (e.g. electrolyzers) to assist in meeting demand in Australian bottlenecks.</li> </ul>
<b>Attracting Investment</b>	<ul style="list-style-type: none"> <li>Private investment community is very risk-averse, this is problematic for getting capital onto those markets. Government backed "special finance providers" such as the Clean Energy Finance Corporation (CEFC) can help to bridge this gap.</li> <li>The Australian Renewable Energy Agency (ARENA) stage-gated funding pathway can also support early-stage and emerging technologies, yet process trial funding requirements are substantial.</li> </ul>

Theme	Next Steps
<b>Labour Markets</b>	<ul style="list-style-type: none"> <li>Where possible, existing iron ore producers and iron and steelmakers are retraining as many of their own personnel as possible for these transitions.</li> <li>In addition, State and Federal Government should investigate establishing regional training programs and facilities designed to reskill existing workers and drive new employees to these regions across all levels of education.</li> </ul>
<b>4. Supporting Early-Stage and Emerging Technology Development</b>	
<b>No "One-Size-Fits-All"</b>	<ul style="list-style-type: none"> <li>Within the iron and steel sector each site location has its own unique mix of variables (such as iron ore quality, access to water and ability to produce and store renewable energy) hence there is no "one-size-fits-all" approach to the development of green iron and steel technologies.</li> <li>Government needs to develop policies and strategies that are technology-agnostic and allow market drivers to select appropriate technology solutions for each location.</li> </ul>
<b>Industrial Clusters</b>	<ul style="list-style-type: none"> <li>Focus efforts on promoting the development of industrial clusters and the sharing of clean energy infrastructure such as green hydrogen or renewable electricity.</li> </ul>
<b>Development of Demonstration Plants</b>	<ul style="list-style-type: none"> <li>Technologies like Hydrogen DRI (with large-scale trials underway in Sweden) are still at relatively low Technology Readiness Levels (TRLs) and will require substantial process research and development for full-scale commercialisation.</li> <li>Governments to provide additional targeted funding and/or grants that facilitate the development and subsidise the large costs of small-scale green iron and steel demonstration plants.</li> <li>Place incentives for international companies to develop pilot plants here in Australia.</li> </ul>
<b>Exploring Financial Support Beyond Grants</b>	<ul style="list-style-type: none"> <li>Federal and State Government can evaluate a broader spectrum of support mechanisms, including assisting with access to performance guarantee insurance to smooth project development.</li> </ul>

# Executive Summary – Next Steps for Government and Industry (3 of 3)

There are clear next steps that both State and Federal Government, and Industry can take under 22 themes which have emerged from stakeholder consultation.

Theme	Next Steps
5. Australia within the Global Policy Landscape	
Internationally Consistent Standards	<ul style="list-style-type: none"><li>• Work with governments from key international markets and international agencies to develop appropriate and coherent international agreements and standards for green iron and green steel products. Measures such as the European Carbon Border Adjustment Mechanism (CBAM) will help to promote the development of internationally recognised definitions and standards.</li><li>• Provide more certainty surrounding carbon pricing.</li></ul>
Incentivising Emissions Reductions	<ul style="list-style-type: none"><li>• Implement safeguard mechanisms for scope 1 and 2 emissions that also encourage reductions in scope 3 emissions for companies aiming to enhance the value-added aspects of their supply chain.</li><li>• Measures such as a Carbon Border Adjustment Mechanism (CBAM) can help to mitigate the offsetting of emissions through international portfolios.</li></ul>
International Support for Australian Projects	<ul style="list-style-type: none"><li>• Australian State and Federal Governments can signal clear strategic intent to domestic and international stakeholders and implement policies to facilitate these actions.</li><li>• Implementing demand-side policies such as a Carbon Border Adjustment Mechanism (CBAM) would encourage domestic development of projects and offtake.</li></ul>

Theme	Next Steps
6. Achieving and Maintaining Social License	
Diversification of Industrial Precincts	<ul style="list-style-type: none"><li>• Government and regional development authorities should work together to ensure projects located within industrial areas broadly support the community's development, leaving a lasting positive impact.</li></ul>
Water	<ul style="list-style-type: none"><li>• Industry should engage with communities and regional water authorities early within the planning process to provide guidance on the potential impacts to local water systems, especially in the context of green hydrogen production and supply.</li></ul>
A Whole of System Approach	<ul style="list-style-type: none"><li>• State and Federal Government need to ensure there is ample social infrastructure, such as housing, schools and hospitals to accommodate for increases in personnel to regions with investments in green iron and steel or supporting industries.</li><li>• Authorities should ensure that industry properly manages the storage of high-risk fuels (such as hydrogen) throughout the entire lifecycle of these projects.</li></ul>
Public Messaging	<ul style="list-style-type: none"><li>• Messaging surrounding the future economic benefits of developing a green iron and steel industry are important for ensuring public support for these projects and project funding.</li></ul>



# Consultation Findings.





# 1 | Supply-Side Push and Demand-Side Pull Measures (1 of 2)

Broader support beyond supply-side efforts is necessary to stimulate the iron and steel industry. This includes co-developing renewable energy production alongside green iron and steel offtakers to foster industry development.

Theme	The Problem	Stakeholder Perspective	Next Steps
Revenue Support Mechanisms	The iron and steel industry relies on <b>long-term, large-scale projects</b> . Developing new technologies starts with small-scale projects that, due to economies of scale, require <b>revenue support to achieve financial viability</b> .	<ul style="list-style-type: none"> <li>State and Federal Government stakeholders have supported the introduction of a contract-for-difference (CFD) scheme in Australia, similar to Germany's H2Global Mechanism. This scheme would subsidize input costs like hydrogen or the costs of green iron production, bridging the gap between market prices and production costs. However, they caution that revenue support should be limited to small-scale applications to prevent potential government budget overruns from subsidies applied per tonne of product or similar metrics.</li> </ul>	<ul style="list-style-type: none"> <li>Design and implement a revenue support scheme at the national level to support Australian iron and steel projects in reaching FID and achieve scale-up.</li> </ul>
Supply-side Push Mechanisms	The green iron and steel industry requires the <b>co-development of green iron and steel and renewable electricity and renewable hydrogen infrastructure</b> .	<ul style="list-style-type: none"> <li>Stakeholders have voiced concerns that for these sectors to develop simultaneously, there must be incentives for using green hydrogen in the production of value-added products. They argue that current policies such as the \$2/kgH2 tax incentive and Hydrogen Headstart program should include incentives for integration into value-added products such as green iron and steel.</li> <li>Additionally, European stakeholders from Sweden have noted that as the green iron and steel industries develop, steelmakers are hesitant to rely on imports from a limited number of green iron providers, preferring to perform the green iron and steelmaking themselves.</li> </ul>	<ul style="list-style-type: none"> <li>Government to place incentives in on hydrogen production in addition to the \$2/kgH2 tax incentive and Hydrogen Headstart program which promote the development of value-added products such as green iron or steel , which can include processing obligations for ore producers.</li> <li>Industry to develop offtake agreements for first-movers to manage the limited supply of green iron products during the industry's early stages.</li> </ul>
Demand-side Pull Mechanisms	Ensuring <b>demand certainty</b> is necessary for achieving <b>Final Investment Decision (FID)</b> for green iron and steel projects.	<ul style="list-style-type: none"> <li>Currently only a few industries are willing to accept premiums associated with green iron and steel production (for example the German luxury car industry and German wind turbine manufacturers).</li> <li>Industry stakeholders emphasise that measures such as the EU Carbon Border Adjustment Mechanism (CBAM) are important in promoting the development of this industry.</li> <li>Initiatives such as the "First Movers Coalition" are helping to build demand for nascent industries.</li> </ul>	<ul style="list-style-type: none"> <li>Government to assess the feasibility of an Australian Carbon Border Adjustment Mechanism (CBAM) or encourage off-take for specific product types.</li> <li>Industry to evaluate the implications of demand-side pull mechanisms such as domestic and international CBAMs.</li> </ul>



# 1 | Supply-Side Push and Demand-Side Pull Measures (2 of 2)

Broader support beyond supply-side efforts is necessary to stimulate the iron and steel industry. This includes co-developing renewable energy production alongside green iron and steel offtakers to foster industry development.

Theme	The Problem	Stakeholder Perspective	Next Steps
Coordination of Infrastructure	The development of these industries requires the collocation of <b>large-scale industrial infrastructure</b> , including <b>electricity, rail and port</b> facilities as well as proximity to iron ore.	<ul style="list-style-type: none"><li>Industry stakeholders emphasise the need to locate green iron and steel facilities near iron ore reserves due to the high transport costs of iron ore, which contains only ~60% metallic iron. These needs are coupled with requirements to locate facilities near electricity, rail and port infrastructure.</li><li>Project location selection will likely depend on various market-driven technical and geographic factors. The Pilbara is noted for its effective coordination of renewable energy, iron ore reserves, and rail and port infrastructure, which is not necessarily the case for other potential locations in Australia.</li></ul>	<ul style="list-style-type: none"><li>Coordination of infrastructure is necessary for supporting the development of green iron and steel projects. State and Federal Government to ensure the development of new Renewable Energy Zones (REZ) and/or green shipping corridors are in strategic locations to promote the development of these industries.</li></ul>
Accessing Renewable Electricity and Renewable Hydrogen	<b>Grid connection costs</b> and <b>competition for renewable electricity and renewable hydrogen</b> will require prioritisation of planned renewable objectives to minimise <b>supply-side pressures</b> for providing the necessary resources to these projects.	<ul style="list-style-type: none"><li>Stakeholders identified that project development generally begins with grid-connected demand centers, eventually shifting to large-scale behind-the-meter solutions. Additionally, processes like Hydrogen DRI can perform grid balancing using stored hydrogen. However, high Transmission Use of System (TUOS) charges in Australia make electrification-dependent projects challenging to develop.</li></ul>	<ul style="list-style-type: none"><li>Competition for renewable electricity and renewable hydrogen will require prioritisation of planned renewable objectives with a cohesive strategy to ensure the appropriate co-development of these projects and infrastructure to minimise supply-side pressures for providing the necessary resources to these projects.</li></ul>



## 2 | Delivering Cohesive and Targeted Government Assistance (1 of 1)

Improvements to the methods through which Government assistance is provided would accelerate project delivery and assist investors and developers looking to enter the Australian market.

Theme	The Problem	Stakeholder Perspective	Next Steps
<b>Political Certainty</b>	Lack of <b>long-term political certainty</b> hinders the <b>development of large-scale, long-term projects</b> such as those seen by the iron and steel industry	<ul style="list-style-type: none"> <li>Long-term political certainty is necessary for the development of large-scale, long service life industries such as iron and steelmaking</li> </ul>	<ul style="list-style-type: none"> <li>Policy to include long-term incentives to provide more certainty to iron and steelmakers and off-takers.</li> </ul>
<b>Clearly Communicate Implication of New Regulation with Industry</b>	As <b>new regulation</b> is developed and implemented, changes will need to be <b>clearly communicated</b> to local iron and steel makers and other relevant stakeholders.	<ul style="list-style-type: none"> <li>As new regulation is implemented, clear guidelines on their implications for existing iron and steelmakers must be communicated to ensure any changes to existing operations are well understood by all parties.</li> </ul>	<ul style="list-style-type: none"> <li>Collaborate with organizations like the Australian Steel Institute to ensure any implications of new regulations are properly communicated to relevant industry stakeholders.</li> </ul>
<b>Streamlining Project Approval Pathways</b>	The development of projects are complex, requiring considerations of <b>cumulative risk</b> whereby multiple co-located projects face additive risks in the storage and handling of hazardous materials. Furthermore, these locations are likely to experience multiple project developments over similar timelines, impacting the <b>capacity of approval pathways</b> .	<ul style="list-style-type: none"> <li>Project Approvals in Australia currently take a long time to process, with current approvals taking up to 24 months for the first approvals to be made, compared to USA where approval processes take as little as 12months start to finish.</li> </ul>	<ul style="list-style-type: none"> <li>State and Federal Governments can assign single contact points for developers and learn from international cases on addressing cumulative risk which arises from multiple co-located large-scale hazardous processes. Furthermore, governments could introduce measures such as “Fast 41” in the USA, which allows project approvals to be streamlined for projects that have significant national interest.</li> </ul>
<b>Stackable Policies</b>	As <b>State and Federal Governments</b> develop work to implement policies to incentivise green iron and steel production, there is risk of <b>conflicting policy</b> .	<ul style="list-style-type: none"> <li>Industry stakeholders have highlighted the risk that State and Federal Governments could implement policy that could be incoherent or conflicting. Suggesting that government policy should be “stackable” in nature, where state government policy is effectively an “addition” to any federal government policy.</li> </ul>	<ul style="list-style-type: none"> <li>Government policy at both State and Federal levels should be designed to be stackable, allowing Federal policies to operate independently while also complementing any existing state-level policies.</li> </ul>



### 3 | Overcoming Project Development and Market Challenges (1 of 2)

Global supply chain and labour market challenges are constraining project delivery, with uncertainty over standards delaying projects once equipment is received from international suppliers

Theme	The Problem	Stakeholder Perspective	Next Steps
Industry Dominated by Large-Scale, Global Companies	The iron and steel industry is characterised by <b>large-scale, long-life and high-cost projects</b> , and is <b>dominated by global companies</b> whose actions <b>significantly influence</b> change within the industry.	<ul style="list-style-type: none"> <li>The iron and steel industries are largely driven by large-scale, global companies making it difficult for smaller SMEs to enter the market, compete on price and promote change within the industry.</li> <li>Furthermore, change within the industry is largely driven by the actions of these large-scale companies.</li> <li>Under time pressure to ensure investment in green iron and steel production is made in Australia, otherwise, there is risk that once the capital investments are made elsewhere, there will be little incentive to buy Australian made green iron and steel.</li> </ul>	<ul style="list-style-type: none"> <li>Government to provide ample funding support for the development of demonstration plants and technologies, support SMEs developing new technologies for green iron and steel production and apply incentives for large-scale iron and steelmakers to decarbonise.</li> <li>Need to work quickly to ensure first mover advantage in the development of Australian made green iron and steel products.</li> </ul>
Development of New Markets	There is <b>international appetite for green iron and steel</b> , but only <b>certain industries can absorb the associated green premiums</b> .	<ul style="list-style-type: none"> <li>While there is demand for green iron and steel products, even at a premium, Australia lacks many industries capable of absorbing the associated green premiums from their production.</li> </ul>	<ul style="list-style-type: none"> <li>Australian industry to target international markets which have the industries that are willing and able to pay premiums for green iron and green steel products. One such means of doing so is through the supply of intermediate products such as green iron.</li> </ul>
Immature Supply Chains and Capacity Building	Challenges in equipment supply and costs could mean Australia <b>could lose competitive edge</b> if renewable energy and green hydrogen <b>prices are not met</b> .	<ul style="list-style-type: none"> <li>Brownfield players highlighted the competitiveness of the international market for electrolyzers given limited global manufacturing capacity, with long leads times of 18-24 months. This creates issues for capital investment, with orders for electrolyzers often having to come before completing project approvals.</li> <li>Supply chain and market disruptions such as inflation are distorting investment decisions, with investors contending with locking-in present prices or potentially facing higher prices later.</li> </ul>	<ul style="list-style-type: none"> <li>Industry players can explore the development of buyer's coalitions, working together to purchase key equipment from international organisations to support procurement and overcome a lack of vendor interest in the Australian market.</li> <li>Another strategy to mitigate supply chain risk is to invest in domestic manufacturing capacity for supply chain equipment (e.g. electrolyzers) to assist in meeting demand in Australian bottlenecks.</li> </ul>

# 3 | Overcoming Project Development and Market Challenges (2 of 2)

Global supply chain and labour market challenges are constraining project delivery, with uncertainty over standards delaying projects once equipment is received from international suppliers

Theme	The Problem	Stakeholder Perspective	Next Steps
Attracting Investment	Private investment community is very <b>risk-averse</b> , this is problematic for getting <b>capital onto those markets</b> .	<ul style="list-style-type: none"><li>As many of these projects involve processes that have yet to be proven, be able to account for process risk whilst being able to provide capital at a low enough rate is a challenge for making these projects economically viable.</li></ul>	<ul style="list-style-type: none"><li>Government backed “special finance providers” such as the Clean Energy Finance Corporation (CEFC) can help to bridge this gap by providing lower-cost capital which can then be used to off-set risk premiums associated with investing in riskier processes.</li><li>The Australian Renewable Energy Agency (ARENA) stage-gated funding pathway can also support early-stage and emerging technologies, yet process trial funding requirements are substantial.</li></ul>
Labour Markets	Ample <b>access to skilled labour</b> is necessary in transitioning to these industries.	<ul style="list-style-type: none"><li>High-wage and remote locations such as the Pilbara pose challenged in ensuring ample labour markets. Where possible, existing iron ore producers and iron and steelmakers are retraining as many of their own personnel as possible for these transitions. However, as these projects are multidisciplinary (involving the development of both renewable energy and iron and steelmaking), brownfield and greenfield iron and steel project developers highlighted the challenge of sourcing experienced engineers and workers.</li></ul>	<ul style="list-style-type: none"><li>State and Federal Government should investigate establishing regional training programs and facilities designed to reskill existing workers and drive new employees to these regions across all levels of education.</li></ul>



## 4 | Supporting Early-Stage and Emerging Technology Development (1 of 1)

Targeted support for emerging technology players is necessary to promote domestic R&D and advanced manufacturing in the iron and steel sector.

Theme	The Problem	Stakeholder Perspective	Next Steps
<b>No “One-Size-Fits-All”</b>	Each site location has its own <b>unique mix</b> of variables (such as iron ore quality, access to water and ability to produce and store renewable energy) hence there is <b>no “one-size-fits-all”</b> green iron and steel technology.	<ul style="list-style-type: none"> <li>Multiple technology pathways are currently under development for green iron and steel production. It is likely that no one technology pathway will dominate global production in this sector.</li> <li>Industry stakeholders also highlight that one of the challenges in using DRI processes for ironmaking with Australian ore qualities is the need for beneficiation, which results in the loss of a significant amounts of iron ore.</li> </ul>	<ul style="list-style-type: none"> <li>Federal and State Governments needs to develop policies and strategies that are technology-agnostic and allow market drivers to select appropriate technology solutions for each location.</li> </ul>
<b>Industrial Clusters</b>	<b>Industrial clusters</b> are important for achieving <b>efficient use of infrastructure</b> and cost competitiveness.	<ul style="list-style-type: none"> <li>Stakeholders highlight the importance of developing industrial clusters, where clean energy infrastructure can be shared, promoting economic and operational efficiency.</li> </ul>	<ul style="list-style-type: none"> <li>Focus efforts on promoting the development of industrial clusters and the sharing of clean energy infrastructure such as green hydrogen or renewable electricity.</li> </ul>
<b>Development of Demonstration Plants</b>	Emerging technology players identified targeted <b>support for early-stage technologies</b> as necessary to promote domestic R&D and advanced manufacturing in the green iron and steel sector, with emphasis on the need for <b>government support for demonstration plants</b> .	<ul style="list-style-type: none"> <li>Technologies like Hydrogen DRI (with large-scale trials underway in Sweden) are still at relatively low Technology Readiness Levels (TRLs) and will require substantial process research and development for full-scale commercialisation.</li> <li>Industry stakeholders emphasise the large costs associated with the development of demonstration plants and the importance of government funding support to advance commercial technology and facilitate crucial learning in technology development.</li> </ul>	<ul style="list-style-type: none"> <li>Federal and State Governments to provide additional targeted funding and/or grants that facilitate the development and subsidise the large costs of small-scale green iron and steel demonstration plants.</li> <li>Place incentives for international companies to develop pilot plants here in Australia.</li> </ul>
<b>Exploring Financial Support Beyond Grants</b>	<b>Other mechanisms beyond grants can smooth project development</b> for small emerging technology providers, facilitating scale-up.	<ul style="list-style-type: none"> <li>Whilst financial support for emerging technology SMEs and start-ups is critical, industry players also highlighted the need for alternative support. For example, capital intensive businesses require assistance with accessing performance guarantee insurance, required in establishing supply contracts. Emerging technology providers in the advanced stages of development are struggling to access this at a reasonable cost.</li> </ul>	<ul style="list-style-type: none"> <li>Federal and State Government can evaluate a broader spectrum of support mechanisms, including assisting with access to performance guarantee insurance to smooth project development.</li> </ul>

# 5 | Australia within the Global Policy Landscape (1 of 1)

International standards for green iron and steel are crucial for fostering international cooperation.

Theme	The Problem	Stakeholder Perspective	Next Steps
Internationally Consistent Standards	Global green iron and steel supply chain development is <b>hampered by uncertainty surrounding green iron and green steel standards</b> .	<ul style="list-style-type: none"><li>There is currently no internationally recognised definition or certification for green iron and green steel as well as a global uncertainty surrounding carbon pricing.</li></ul>	<ul style="list-style-type: none"><li>Work with governments from key international markets and international agencies to develop appropriate and coherent international agreements and standards for green iron and green steel products. Measures such as the European Carbon Border Adjustment Mechanism (CBAM) will help to promote the development of internationally recognised definitions and standards and promote more certainty surrounding carbon pricing.</li></ul>
Incentivising Emissions Reductions	Many iron ore producers have <b>international portfolios</b> and incentivising the <b>reduction of scope 1 and 2</b> emissions can have the negative effect of <b>disincentivising the production of value-added products</b> like iron and steel.	<ul style="list-style-type: none"><li>As businesses strive to meet government mandates by reducing their scope 1 and 2 emissions, they may be incentivised to reduce their production of value-added products such as iron and steel to meet these goals.</li><li>Many iron ore producers have international portfolios and can leverage overseas operations as a means to reduce the overall company emissions.</li></ul>	<ul style="list-style-type: none"><li>Need to implement safeguard mechanisms for scope 1 and 2 emissions that also encourage reductions in scope 3 emissions for companies aiming to enhance the value-added aspects of their supply chain.</li><li>Measures such as a Carbon Border Adjustment Mechanism (CBAM) can help to mitigate the offsetting of emissions through international portfolios.</li></ul>
International Support for Australian Projects	The iron and steel industry is a <b>global industry</b> necessitating both <b>domestic and international investment</b> .	<ul style="list-style-type: none"><li>As Iron and steel value chains are span multiple countries and involve large-scale multinational companies, the development of large-scale industry in Australia would require both international cooperation and investment.</li></ul>	<ul style="list-style-type: none"><li>Australian State and Federal Governments can signal clear strategic intent to domestic and international stakeholders and implement policies to facilitate support for green iron and steel projects.</li><li>Implementing demand-side policies such as a Carbon Border Adjustment Mechanism (CBAM) would encourage domestic development of projects and offtake.</li></ul>



## 6 | Achieving and Maintaining Social License (1 of 1)

Gaining community support to maintain social license to operate for green iron and steel projects is crucial, with consideration of the sustainability of inputs such as renewable electricity, water as well as a whole of system approach necessary to mitigate safety risks and minimise negative community impacts.

Theme	The Problem	Stakeholder Perspective	Next Steps
<b>Diversification of Industrial Precincts</b>	<b>Industrial precincts</b> based on current fossil fuel industries are <b>facing international scrutiny to diversify and decarbonise</b> .	<ul style="list-style-type: none"> <li>Many of these projects are being developed in existing industrial precincts (such as the Gladstone Green Iron project), where there is little resistance to their development. This aligns with a trend where many precincts are diversifying away from fossil fuel-dependent industries and welcome the transition towards lower-carbon processes.</li> </ul>	<ul style="list-style-type: none"> <li>Government and regional development authorities should work together to ensure projects located within industrial areas broadly support the community's development, leaving a lasting positive impact.</li> </ul>
<b>Water</b>	<b>Resource allocation</b> of water is a contentious issue, with varying perspectives on the most economically and socially beneficial uses of freshwater. Furthermore, there is uncertainty about <b>how climate change will affect water</b> resources in key green iron and steelmaking regions.	<ul style="list-style-type: none"> <li>Academic stakeholders identified the water requirements for green hydrogen production are not insignificant, with overall water. Industry players also identified that only so many locations are appropriate for the development of desalination plants, with significant planning and legislative issues related to these projects.</li> </ul>	<ul style="list-style-type: none"> <li>Industry should engage with communities and regional water authorities early within the planning process to provide guidance on the potential impacts to local water systems, especially in the context of green hydrogen production and supply for green iron and steel production.</li> </ul>
<b>A Whole of System Approach</b>	Failure to consider <b>broader local community impacts</b> from developing green iron and steel projects (such as ample social infrastructure), will have negative social licensing outcomes. <b>Social license can be lost easily with accidents.</b>	<ul style="list-style-type: none"> <li>Stakeholders identified that regional development require integration of not just the green iron and steel project infrastructure but also broader social infrastructure to build these areas to attract and support labour, with risk to project social licensing if these are not appropriately managed.</li> <li>Additionally, proposed green iron production processes rely on large amounts of green hydrogen production and storage. However, the production and storage of green hydrogen (in densely populated areas such as Port Kembla) can pose safety risks for residents living near these projects. Industry bodies highlighted the hydrogen industry is only "as safe as our next accident", with safety of the industry a strong factor in maintaining the social license to operate.</li> </ul>	<ul style="list-style-type: none"> <li>State and Federal Government need to ensure there is ample social infrastructure, such as housing, schools and hospitals to accommodate for increases in personnel to regions with investments in green iron and steel or supporting industries.</li> <li>Authorities should ensure that industry properly manages the storage of high-risk fuels (such as hydrogen) throughout the entire lifecycle of these projects</li> </ul>
<b>Public Messaging</b>	<b>Public opinion</b> is paramount to achieving and maintaining social license.	<ul style="list-style-type: none"> <li>Stakeholder opinion is that if the public were aware of the future economic benefits of developing a green iron and steel industry in Australia, there would be less chance of opposition to the development of RE projects or green iron and steel plants.</li> </ul>	<ul style="list-style-type: none"> <li>Messaging surrounding the future economic benefits of developing a green iron and steel industry are important for ensuring public support for these projects and project funding.</li> </ul>

# Appendix A- Stakeholders Consulted.





# Appendix A – Stakeholders Consulted (1 of 1)

Stakeholders Consulted	
BlueScope Steel	Steel Research Hub
Greenhouse	University of Newcastle
Fortescue	Metso
Liberty Steel / GFG Alliance	Australian Steel Institute
Calix	Private Energy Partners (Investment and Project Development Affiliate of Quinbrook)
Hazer Group	Clean Energy Finance Corporation (CEFC)
University of Technology Sydney (UTS)	Australian Renewable Energy Agency (ARENA)
Monash University	State of Play Global Research Group