# National Environmental Science Program

## Sustainable Communities and Waste Hub research plan 2026 – Attachment B project plans

a

# Contents

## Project GIS.05 – To explore opportunities to use existing technology to manufacture green iron and steel using recycled waste products as an alternative feedstock for hydrogen and carbon.

| | |
|---|---|
| **Project type:** Hub research project | |
| **Project status: N**ew project submitted for approval | |
| **Cross-cutting initiative:** | No |
| **Project start date:** 01/10/2025-TBC<br>Upon DCCEEW approval | **Project end date**: 31/12/2026 |
| **Project leader details:** | Name: Professor Veena Sahajwalla<br>Organisation: UNSW Sydney<br><br>Name: Dr Samane Maroufi<br>Organisation: UNSW Sydney |

## Pathway to impact

| Outcomes |
| --- |
| The project will assess opportunities to utilise recycled feedstock, including non-ferrous feedstock such as waste polymers (rubber and plastic), and floc and ferrous feedstock in the form scrap metal, as alternative inputs in Australian iron/steel production. It will explore how this substitution could reduce carbon emissions while simultaneously diverting waste from landfill, offering a pathway to lower reliance on fossil-based inputs and accounting for avoided greenhouse gas emissions. The non-ferrous recycled feedstocks are rich in carbon and hydrogen, two critical elements in iron/steel production. Carbon acts as a reducing agent for iron oxide, while hydrogen serves as a clean reductant, generating water rather than $CO_2$. In addition, low grade ferrous feedstock can serve as a valuable source of iron in steelmaking process.<br><br>The project will examine the potential for the usage of theses secondary resources in iron/steel production, reducing both emissions from iron/steel manufacturing sector and landfill waste.<br><br>Hydrogen use in the iron/steel sector currently faces significant challenges. It is difficult to store and transport safely at industrial scale, existing infrastructure is largely designed for fossil-based inputs, and large-scale supply at competitive cost remains limited. While renewable hydrogen represents a long-term decarbonisation pathway, near-term deployment is constrained by high capital costs and the absence of clear price premiums for green steel. In this context, recycled feedstocks provide a great near-term opportunity to support lower-emission iron/steel production.<br><br>The project will also investigate the supply chain of secondary non-ferrous resources including waste polymers(rubber from tyre and plastics) floc) and ferrous resource of scrap metal identifying opportunities and limitations for their integration into the sector.<br><br>It will assess the emissions intensity of green iron/steel produced with recycled feedstocks compared with BF/BOF, gas DRI, and green $H_2$ DRI pathways, as well as other alternative feedstocks such as renewable hydrogen biochar and biomethane. This study will also explore methods to account for avoided emissions from landfill, and consider the emissions standards and frameworks required to recognise green iron/steel produced with recycled inputs. The outcomes will support the iron/steel sector in reducing emissions and contributing to Australia's transition towards a sustainable industrial future via shifting the wastes from landfill into green iron/steel manufacturing.<br><br>Given the distinct process configurations of the EAF, BF/BOF, and DRI routes, the application of secondary feedstocks, both ferrous and non-ferrous, will be examined from multiple perspectives. The incorporation of scrap and DRI as iron sources in the EAF process will be assessed, alongside the utilisation of non-ferrous, carbon-bearing materials as alternative feedstocks. In conventional EAF operations, fossil-based carbon resources are typically introduced as top charges or through injection, serving as reducing agents, carburisers, and for slag foaming. |

This project will explore the potential of non-ferrous resources to replace fossil fuel–based materials in EAF operations. The carbon and hydrogen contents of these materials are expected to function as reducing agents, carburisers, and slag enhancers, thereby contributing to key metallurgical reactions, improving process efficiency, and reducing reliance on fossil-derived reductants.

For the DRI pathway, the substitution of conventional carbonaceous materials with non-ferrous secondary resources in iron ore–carbon composite pellets will be investigated. The resulting degree of metallisation of the reduced iron will be analysed to evaluate process performance. Experimental investigations will be conducted in areas where reliable or comprehensive datasets are currently unavailable.

The integration of alternative feedstocks such as waste polymers (rubber and plastics), floc, and scrap metals has the potential to enhance both cost competitiveness and emissions reduction in green and conventional iron and steelmaking. From a cost perspective, non-ferrous feedstocks can deliver value through avoided landfill fees and lower waste management expenses. The use of low-grade ferrous feedstocks offers further opportunities for cost savings by serving as a valuable secondary source of iron. At the same time, these materials can contribute to emissions reduction by displacing fossil-based inputs, avoiding emissions associated with primary resource extraction, and capturing the environmental benefits of circular material flows. This creates a dual advantage, improving economic performance while advancing decarbonisation across the iron and steel value chain.

This project will investigate how the utilisation of such secondary resources can simultaneously reduce costs and lower the overall carbon footprint of steelmaking.

The outcomes will support the iron/steel sector in reducing emissions and contributing to Australia's transition towards a sustainable industrial future via shifting the wastes from landfill into green iron/steel manufacturing.

**Key Benefits and Value**

***Environmental sustainability***;

Supports Australia's decarbonisation circular economy goals by reducing reliance on fossil-based inputs by using recycled feedstocks in iron/steel manufacturing.

Quantifies avoided emissions from diverting waste streams (e.g., scraps and floc, polymers and plastics) away from landfill, contributing to both industrial decarbonisation and national circular economy objectives.

***Industrial relevance and innovation***;

Identifies near-term, practical pathways to lower-emission iron/steel production via using recycled feedstock.

Evaluates supply chain opportunities and limitations for integrating recycled materials in iron/steel manufacturing process.

| |
|---|
| Provides iron/steel producers with insights into the availability, and opportunities/ limitation of the integration of the recycled feedstock, supporting more efficient, resilient, and sustainable operations.<br><br>Helps industry identify pathways to lower material and energy costs while maintaining production efficiency.<br><br>***Knowledge advancement***;<br><br>Explores technical potential and limitations of secondary resources in iron/steel production.<br><br>Scientific understanding on the emissions intensity of recycled feedstock-based iron/steel compared with conventional and hydrogen-based pathways.<br><br>Establishes frameworks for future research, industrial trials, and large-scale implementation, positioning Australia as a leader in circular and low-carbon steel innovation. |

| Research-user | Engagement and communication | Impact on management action | Outputs |
|---|---|---|---|
| Michael Bartlett<br>International Climate and Energy Division \| COP31 Clean Energy Economy Branch, DCCEEW<br><br>Lisa Richards<br><br>Waste Exports Policy \| Partnerships, Infrastructure & Analysis Branch \| Circular Economy Division \|DCCEEW<br><br>Amy Schebella, Max Littlemore, | Engaged in the development and outputs.<br><br>Findings and outputs to be communicated via project workshops, project update reports, emails and presentations.<br><br>Support the research project by acting as an advisor, providing advice when needed. | ***Environmental sustainability***;<br><br>Supports Australia's decarbonisation circular economy goals by reducing reliance on fossil-based inputs by using recycled feedstocks in iron/steel manufacturing.<br><br>Quantifies avoided emissions from diverting waste streams (e.g., polymer, floc and scrap metals) away from landfill, contributing to both industrial decarbonisation and national circular economy objectives.<br><br>***Industrial relevance and innovation***;<br><br>Identifies near-term, practical pathways to lower-emission iron/steel production via using recycled feedstock.<br><br>Evaluates supply chain opportunities and limitations for integrating recycled materials in | • Assessment of recycled feedstocks, evaluating their availability and supply chain, quantifying greenhouse gas reductions from landfill diversion.<br><br>• Report on decarbonisation pathways, outlining floc management options, and how recycled feedstocks can be integrated into iron/steel production, with comparative evaluation of the greenhouse gas emissions across BF/BOF, gas DRI, green $H_2$ DRI, and recycled feedstock routes, and providing guidance prioritisation to reduce carbon footprint and support circular economy strategies.<br><br>• Presentation slides and info-graphs and other communication tools to communicate the key findings of the project and use for briefing in workshops |

| Research-user | Engagement and communication | Impact on management action | Outputs |
|---|---|---|---|
| Brooke Hamilton - Heavy Industry Transition Division \| Green Metals Branch \|Green Iron and Steel Section, DISR | Support the coordination between industry and project stakeholders. | iron/steel manufacturing process.<br><br>Provides iron/steel producers with insights into the availability, and opportunities/ limitation of the integration of the recycled feedstock, supporting more efficient, resilient, and sustainable operations.<br><br>***Knowledge advancement***;<br><br>Explores technical potential and limitations of secondary resources in iron/steel production.<br><br>Scientific understanding on the emissions intensity of recycled feedstock-based iron/steel compared with conventional and hydrogen-based pathways.<br><br>Establishes frameworks for future research, industrial trials, and large-scale implementation, positioning Australia as a leader in circular and low-carbon steel innovation. | • Web-based version of the report with clickable sections, embedded media, and downloadable resources. Hosted on the SCaW Hub website and partner platforms. |

# Project Description

## Overview

Steel is one of the most essential materials for modern society, with applications spanning construction, transport, and manufacturing. Yet, it is also one of the most carbon-intensive industries, accounting for an estimated 7–9% of global greenhouse gas emissions [1]. The conventional blast furnace–basic oxygen furnace (BF-BOF) route remains dominant, generating the bulk of industry emissions [2]. While technologies such as hydrogen-based direct reduced iron (DRI), electric arc furnaces (EAF) powered by renewable electricity, and alternative reduction pathways are advancing, their widespread adoption is slowed by high costs, infrastructure limitations, and technological readiness barriers.

This project will investigate the potential of recycled feedstock, such as waste plastics, polymers, floc and scrap metal, as alternative sources of iron, carbon, and hydrogen for iron and steelmaking in Australia. Carbon from these recycled feedstocks can act as a reducing agent for iron ore, while hydrogen can serve as a clean reductant, generating water rather than $CO_2$. By recovering these critical elements from waste, the project will explore near-term opportunities to reduce emissions while also diverting waste from landfill. Shifting recycled feedstocks from landfill provides immediate emission savings, making this approach a practical near-term strategy compared with the longer-term deployment of renewable hydrogen via electrolysis.

Through an integrated approach combining sector analysis, resource mapping, technical evaluation, environmental assessment, and stakeholder engagement, the project will generate a holistic understanding of the feasibility and benefits of using recycled feedstocks. By examining supply chains, material performance, and environmental impacts, the project aims to identify practical pathways for decarbonising iron/steel production while integrating circular economy principles. The outcomes will support the iron/steel sector in reducing emissions and contributing to Australia's transition towards a sustainable industrial future via transferring waste from landfill into green manufacturing.

## The Problem

The steel industry faces a structural challenge: it is indispensable to economic development but highly carbon intensive. The BF–BOF route dominates global production and is responsible for most emissions, with the blast furnace alone accounting for more than 70% of $CO_2$ generated in integrated steel plants [1]. The DRI–EAF pathway offers a lower-carbon alternative, particularly when combined with hydrogen, but its adoption is constrained by cost and availability of green hydrogen. Even as new technologies such as molten oxide electrolysis and smelting reduction show promise, they remain at varying levels of readiness and face barriers to commercial deployment.

The challenge of decarbonising iron/steel production is one of the most pressing issues in the global effort to achieve climate neutrality. Despite decades of research, the vast majority of steel is still produced through carbon-intensive methods, and the pace of change is far slower than required to meet international climate goals. While alternatives such as green hydrogen and renewable electricity offer promise, they remain economically and technologically constrained at the scale required for immediate adoption.

As of 2025, Australia's EAF steelmaking capacity is approximately 1.53 million tonnes per year (Mtpa), primarily from two operational mills. InfraBuild's GFG Liberty Sydney Steel Mill (Rooty Hill, NSW) contributes around 0.75 Mtpa, while its Laverton Steel Mill (VIC) adds approximately 0.78 Mtpa (Global Energy Monitor). In contrast, Australia currently has no commissioned direct-reduced iron (DRI) plants, meaning operational DRI capacity remains at zero. Proposed DRI projects include Liberty Steel's planned 1.8 Mtpa facility at Whyalla, SA, and Green Steel WA's 2.5 Mtpa project at Geraldton, WA; however, both projects are not yet operational, with commissioning expected in the late 2020s [3].

Australia, as both a producer and consumer of iron/steel, must navigate these challenges carefully. The country has abundant secondary resources, including end-of-life plastics, polymer waste streams, floc and scrap metal, that could, if effectively utilised, reduce the sector's caron emissions. Shifting these wastes from landfill into industrial use would directly reduce their associated carbon footprint, providing both environmental and industrial benefits. However, these resources are currently fragmented across industries, poorly integrated into industrial supply chains, and insufficiently assessed in terms of technical performance and industrial applicability. Without a clear understanding of how these materials can contribute to steel decarbonisation, Australia risks lagging behind global innovation efforts and missing the opportunity to align its industrial practices with sustainability commitments.

## Background

Secondary resources such as waste plastics, polymers, and steel scrap including industrial and post-consumer scraps with floc represent a significant, yet underutilized, opportunity for the steel industry. These materials, often treated as waste, can be processed into valuable sources of carbon, hydrogen, or iron units. Redirecting these streams into steelmaking can reduce reliance on fossil fuels while simultaneously addressing waste management, aligning with both decarbonisation and circular economy objectives.

One technology that has been successfully implemented in Australian steelmaking is Polymer Injection Technology (PIT), which enables the use of polymer waste as a reducing agent. Since polymers are primarily composed of carbon and hydrogen, their injection into the furnace generates hydrogen gas and solid carbon, both effective in replacing traditional coke [4]. InfraBuild is among the pioneering companies applying PIT, successfully injecting recycled materials such as old tires and high-density polyethylene (HDPE) into EAFs. The technology offers a compelling combination of cost savings, improved energy efficiency, and reduced greenhouse gas emissions, making it a sustainable alternative for modern steelmaking [5, 6].

Another secondary resource with strong potential for the steel industry is biomass. Similar to polymers, biomass is primarily composed of carbon and hydrogen, making it suitable as a reductant in iron and steelmaking. In Australia, bio-bricks, carbon bricks manufactured from biochar, have already been trialed in EAFs. The results demonstrated that 100% bio-bricks performed comparably to conventional coke, without compromising process efficiency or steel quality [7].

Despite these advances, several critical gaps remain. The supply chains for secondary resources are often fragmented, feedstock properties are highly variable, and there is limited knowledge about their technical performance under Australian iron/steelmaking conditions. Furthermore, while the above-mentioned technologies demonstrate the potential of polymer waste, broader opportunities to integrate diverse secondary resources have not been systematically evaluated.

This project directly addresses these gaps by examining both the supply chain and the practical potential of secondary resources as alternative sources of carbon and hydrogen. Through a comprehensive assessment of availability, material properties, and process compatibility, the project will generate the knowledge required to enable large-scale, sustainable integration of these resources into Australian steelmaking.

## Our Response and Methodology

The project adopts a systems-based methodology to investigate the potential of recycled feedstocks in decarbonising Australian iron and steel production. It integrates sector analysis, resource mapping, and environmental assessment to provide a clear understanding of how secondary resources can be incorporated into existing iron and steelmaking processes. This project will investigate how the use of secondary resources can contribute to reducing the overall cost of steelmaking while simultaneously lowering its carbon footprint.

The approach begins with an in-depth analysis of current and emerging technologies in iron and steel production, including BF–BOF, DRI, EAF, and hydrogen-based reduction methods. It will compare the emissions intensity of green iron/steel produced with recycled feedstocks relative to BF/BOF, and DRI pathways. This analysis, combined with mapping of available recycled feedstocks, including volumes, distribution, and material properties, will identify key opportunities for substituting fossil-based inputs and assess their potential contribution to near-term greenhouse gas reductions.

Central to the methodology is engagement with industry stakeholders through workshops and consultations, ensuring findings are grounded in practical realities, reflect operational constraints, and align with national decarbonisation and circular economy priorities. By combining technical and environmental assessment with collaborative knowledge exchange, the methodology provides an integrated framework to guide the adoption of recycled feedstocks, supporting sustainable and lower-emission iron and steel production in Australia.

## Aims and Objectives

The aims of the project are:

1. Understand the supply chain, potential, and limitations of secondary resources
    - Investigate the availability, distribution, and logistics of recycled feedstocks as potential substitutes in iron and steel production
    - Identify opportunities and constraints within the supply chain, assess material quality and consistency for integration at industrial scale.
2. Assess the technical potential and process interactions
    - Analyse how recycled feedstocks could interact with iron and steelmaking processes, focusing on their role as valuable source of hydrogen (reducing agent) and their influence on operational efficiency and process stability
    - Examine potential integration with current and emerging technologies, including BF/BOF, gas DRI, EAF, and hydrogen-based reduction methods
3. Evaluate environmental sustainability and support strategic adoption
    - Quantify the greenhouse gas savings of using recycled feedstocks, including reductions in emissions compared with BF/BOF, gas DRI, and green $H_2$ DRI pathways.
    - Assess the environmental implications of diverting waste from landfill, energy use, and overall carbon footprint.
    - Translate findings into actionable insights to inform industry practices and support broader decarbonisation and circular economy objectives

## Activities

The project will be delivered in several interconnected stages:

**Stage 1: Study of the emerging technologies to provide pathways to the Australian iron and Steelmaking sector**

The first stage will involve investigation of the current and emerging technologies in Australian iron and steelmaking. This includes assessing the current production capacity and mapping the distribution of facilities. By analysing current practices, energy inputs, and emission profiles, the project will establish a clear picture of existing challenges and limitations. This study can detect the potential opportunities for green iron/steel manufacturing and provide the foundation for evaluating where and how secondary resources could be integrated most effectively.

**Stage 2: Stakeholder Engagement and Knowledge Exchange**

Co-design workshops will be organised at different stages of the project to gather feedback from steelmakers and waste management companies, collaboratively brainstorm the project goals and activities and provide update of the progress of the project. This collaborative approach will ensure that the research remains grounded in industrial reality and that stakeholders are involved in achieving the milestones of the project and shaping the evaluation of practical pathways for implementation.

**Stage 3: Secondary Resource Mapping and Characterisation**

The third stage will focus on gathering data on the availability, quality, and characteristics of different categories of recycled feedstocks, including waste polymers (rubber and plastic) coming from different sources and floc and scrap metal. Each resource stream will be explored in detail, considering its supply chain, volume, geographical distribution, collection and processing requirements, and material properties. Experimental evaluation will be conducted when relevant data are unavailable. Their technical potential to serve as alternative sources of iron, carbon, or hydrogen will be examined alongside the specific advantages and limitations of using them at different stages of steelmaking, whether in DRI processes or EAFs.

This stage will investigate how the use of secondary resources can contribute to reducing the cost of steelmaking, including potential savings on raw materials, energy consumption, and waste management, while simultaneously lowering the carbon footprint of the process.

It will investigate the potential reductions in greenhouse gas emissions achieved by substituting conventional fossil-based inputs with recycled feedstocks, including avoided emissions from diverting waste from landfill. In addition, logistical and economic barriers that could hinder large-scale adoption will be carefully assessed. This stage will also examine the potential unintended outcomes of using recycled feedstocks. Issues such as feedstock contamination, variable quality, or unexpected emissions could impact environmental performance, operational efficiency, and regulatory compliance. These challenges may also affect stakeholder perception and community acceptance, which are important for maintaining a social licence to operate.

## Outcomes

The project is expected to deliver three key outcomes that will advance knowledge and practice in sustainable iron/steel manufacturing in Australia:

.1. Enhanced stakeholder collaboration

Several workshops and engagement activities will be organised throughout the project to strengthen collaboration across the iron/steel and recycling sectors. These interactions will ensure the research aligns with industry needs, incorporate industry insights, and monitor project progress to achieve milestones and overall objectives.

2. Assessment of recycled feedstocks and supply chains

A detailed evaluation of the availability, quality, and processing requirements of different recycled feedstocks, including waste polymers (rubber and plastic) and floc and scrap metal. This assessment will quantify potential greenhouse gas reductions, including emissions avoided from diverting waste from landfill and reductions in the carbon intensity of iron/steel production. The findings will provide clear guidance on which feedstock streams can be effectively utilised and how to prioritise resources to achieve measurable carbon reductions and support circular economy objectives.

3. Report on decarbonisation pathways

A report outlining pathways for integrating recycled feedstocks into iron/steel production. The report will combine technical findings, comparing the emissions intensity of green iron/steel produced with recycled feedstocks against BF/BOF, gas DRI, and green $H_2$ DRI pathways, as well as other alternative feedstocks such as renewable hydrogen biochar. Insights from stakeholder engagement will also be incorporated, ensuring that the outcomes are grounded in industry realities and support circular economy and low-emission strategies. The report will guide the industry in identifying which recycled feedstock streams can be effectively utilised, which require further development, and how to prioritise resources for maximum impact.

Ultimately, the project will generate new scientific and technical knowledge while bridging the gap between research and industry practice, positioning Australia as a leader in developing low-emission and circular solutions for one of the most energy- and carbon-intensive sectors.

***Linkages***

No linkage

## Is this a cross-hub project?

NO

## Does this project contribute to a cross-cutting initiative?

NO

## Indigenous consultation and engagement

Indigenous consultation and engagement are integral to our project, guided by our hub's Indigenous Partnerships Strategy. We will work with our Indigenous facilitator to identify the most effective ways to demonstrate the hub's impact for Indigenous communities and to capture the contributions of Indigenous-led projects within the hub. This approach highlights the value of Indigenous leadership and the benefits of collaboration between Western and Indigenous knowledge systems.

To ensure our work is communicated appropriately, our Indigenous facilitator will play a central role in guiding how project outcomes are shared. Their expertise will ensure communications are culturally respectful, accessible, and aligned with community priorities. This will allow us to clearly demonstrate the hub's contributions to sustainable community development and waste management.

Furthermore, all project team members will undertake *Our Mob* cultural awareness training and *Indigenous Cultural and Intellectual Property (ICIP) True Tracks* training. These requirements will help ensure that engagement with Aboriginal and Torres Strait Islander communities is informed, respectful, and aligned with best practice.

| Which updated Three-category approach the project meets | **Communicate (3)** | **Co-design (2)** | **Indigenous led (1)** |
|---|---|---|---|
| | ☒ | ☐ | ☐ |

## Project milestones

**GIS.05:** To explore opportunities to use existing technology to manufacture green iron and steel using recycled waste products as an alternative feedstock for hydrogen and carbon.

### Year 2026

| Milestones | Due date | Responsible person |
|---|---|---|
| Milestone 1 –Workshop to discuss the aim and milestones of the project, gathering stakeholder's insight and feedback to inform research direction | 30 January 2026 | Veena Sahajwalla / Samane Maroufi |
| Milestone 2 – Progress update on the evaluation of recycled feedstock | 30 March 2026 | Veena Sahajwalla / Samane Maroufi |
| Milestone 3- Co-design workshop with stakeholders and experts to share project findings, gather insight and ensure the research reflect industry needs. | 30 June 2026 | Veena Sahajwalla / Samane Maroufi |
| Milestone 4-Workshop with stakeholders and experts to share the latest finding of the project | 30 September 2026 | Veena Sahajwalla / Samane Maroufi |
| Milestone 6- Final Report on the decarbonisation of iron and steel making using recycled feedstock in Australia along with environmental assessment | 15 December 2026 | Veena Sahajwalla / Samane Maroufi |

## Data and information management

The information presented below is specific to 2025 and 2026. For each stage of a multiyear project, the table will be updated to reflect the specific outcomes.

Knowledge products, co-designed with stakeholders and the Hub knowledge broker, that are generated through the project phase may be made publicly available through the Hub website, and in accordance with the Hub data management and communications strategies, and subject to ethics approvals and any relevant Indigenous Cultural and Intellectual Property (ICIP) arrangements. The co-design process identified, and will continue to identify, detailed knowledge products to be delivered over the life of the projects and detailed data and information management plans will be developed for each of these. The data products developed through 2025 and beyond will be co-designed with the Data Wrangler and Knowledge Broker to meet the FAIR and CARE guiding principles.

| Project output | Data management and accessibility |
|---|---|
| Reports/brief/outcomes reviewing the current state of knowledge on the multiple benefits arising from the project | According to the Hub's data management strategy, information will be made publicly available on website.<br>• It is expected that these will be derived from publicly available information, and there should be limited sensitives |
| Reports and other written documentation | According to the Hub's data management strategy, information will be made publicly available on-website.<br>• The report / document will be identified by a unique code for identification. Dates and other metadata should follow ISO standards. Key words should also be included in the title and included as 'tags' to improve findability. Metadata should also clearly define the type of document, such as whether it is a report, a fact sheet etc.<br>• The metadata my include a preview picture to improve findability if appropriate.<br>• Each type of document (report, fact sheet, etc) will follow relevant standards in terms of structure, identification, and format. This will streamline how the documents are presented and increase interoperability.<br>• The reports should include publicly available information to prevent sensitive information from spreading and to maximise accessibility. A data usage license should be included on the website and referenced at the beginning of the document to clarify reusability.<br>• Where data cannot be accessed without authorisation, a clearly defined procedure will be outlined to provide a methodology for requesting authorisation and providing the data securely. Specific safeguards will be implemented to protect privacy and data security. A data usage license should be included on the website and referenced at the beginning of the document to clarify reusability.<br>• A separate spreadsheet will be included providing raw data in an organised and clearly defined format, following a selected standard in terms of data organisation and identification.<br>• All documents will be communicated under the relevant sections on the website in consultation with the knowledge broker and communications manager.<br>• A title page should be appended to the beginning of each document, providing detailed metadata including globally unique and persistent identifier, related data spreadsheet with its own unique and persistent identifier, data usage license reference, domain-relevant community standards and detailed provenance. |

| | |
|---|---|
| | • Indigenous data gathered for regional and remote communities will be co-designed with the Indigenous facilitator to ensure compliance with CARE principles and ICIP. |

## Location of research

| **GIS.05: To explore opportunities to use existing technology to manufacture green iron and steel using recycled waste products as an alternative feedstock for hydrogen and carbon.** | | | |
|---|---|---|---|
| **At which spatial scale is the project working** | **National**<br>☒ | **Regional**<br>☐ | **Local**<br>☐ |
| **Location(s) – gazetted region /place name** | Desktop Studies: UNSW Sydney, Kensington | | |
| **Aboriginal or Torres Strait Islander nation or traditional place name(s)** | NA | | |

## Project keywords

Iron and Steelmaking, wase recycling, Circular economy, Sustainability, Carbon footprint

References


1. J. Kim, B.K. Sovacool, M. Bazilian, S. Griffiths, J. Lee, M. Yang, and J. Lee, Decarbonizing the iron and steel industry: A systematic review of sociotechnical systems, technological innovations, and policy options. *Energy Research & Social Science*, 2022. **89**: p. 102565.
2. A. Hasanbeigi, M. Arens, and L. Price, Alternative emerging ironmaking technologies for energy-efficiency and carbon dioxide emissions reduction: A technical review*. Renewable and Sustainable Energy Reviews*, 2014. **33**: p. 645-658.
3. https://international.austrade.gov.au/en/news-and-analysis/success-stories/liberty-steel-to-transform-whyalla-steelworks-into-green-steelmaking-facility?utm_source=chatgpt.com
4. S.M. Veena Sahajwalla , Geoffrey Bell, Philip Bell, *Alternative sustainable carbon sources as substitutes for metallurgical coal* IEA Bioenergy 2019. www.ieabioenergy.com/wp-content/uploads/2020/01/IEA-Bioenergy-Task-Lignin-as-a-met-coal-substitute-December-2019-Final-191218-1.pdf
5. L. Cornish. *An Australian solution turning waste into steel for developing countries*. 2017; Available from: https://www.devex.com/news/an-australian-solution-turning-waste-into-steel-for-developing-countries-89764.
6. Inrfrabuild. *Driving the future: Polymer Injection Technology*. 2020; Available from: https://www.infrabuild.com/resources/sustainability-resources/polymer-injection-technology-pit/
7. https://greensteelworld.com/biocarbon-how-converting-low-value-biomass-can-pave-the-way-towards-sustainability