Low Temperature Direct Electrochemical Reduction for Zero Emissions Iron

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Abstract

Fortescue will develop a low-temperature direct electrochemical reduction (DER) technology to reduce Pilbara iron ore into iron metal (the Project). The technology being developed is an iron ore electrolyser designed to use intermittent renewable energy to produce green iron feed for steelmaking. The Project will demonstrate this technology at a pilot scale using 100kg of Pilbara iron ores. Fortescue will partner with Deakin University and Curtin University to deliver the Project.

	1. Raw material mining/preparation	2. Raw material processing	3. Ironmaking	4. Steelmaking and casting	Total
BF-BOF*	0.5t 17%	0.6t 21%	1.5t 51%	0.3t 11%	2.9t CO2/t crude steel
DRI-EAF*	0.3t 20%	0.2t 12%	0.8t 51%	0.3t 17%	1.5t CO2/t crude steel
Fortescue DER with zero emissions mining (ZEM)	0.0t 0% (ZEM)	0.0t 0% (ZEM)	0.0t 0% (DER)	0.3t 100%	0.3t CO2/t crude steel

* CO2 emissions across the steelmaking sector for blast furnace-basic oxygen furnace (BF-BOF) and direct reduced iron-electric arc furnace (DRI-EAF) processes.
Source: IEA (2022) Achieving Net Zero Heavy Industry Sectors in G7 Members, IEA, Paris

Objectives

- Demonstrate alternate electrochemical pathway for iron ore reduction, avoiding use of hydrogen gas
- Show conversion of iron ores to iron metal using electricity and enabling a pathway to green iron production when using renewable electricity
- Accelerated commercialisation of the DER iron ore electrolyser process
- Demonstrate low grade Pilbara goethite and hematite ores can be converted to a high-grade iron for steelmaking without use of hydrogen

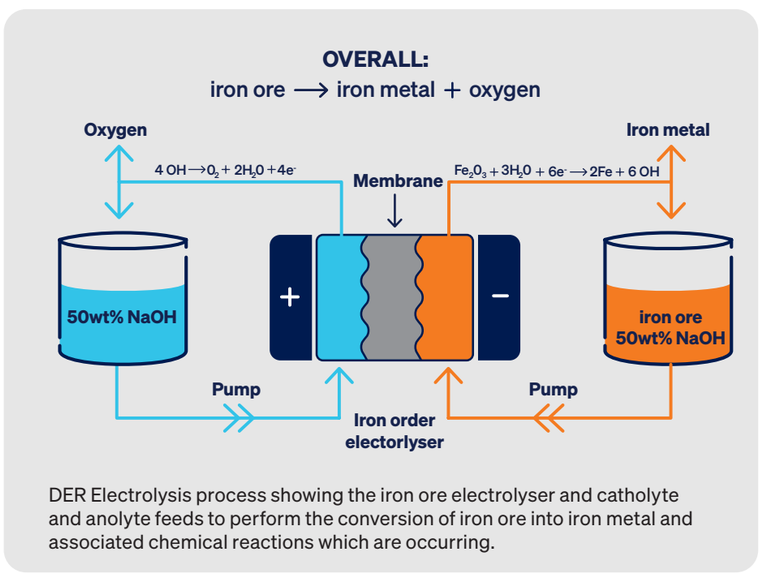
Technical Activities

Research and Development (R&D) Stage:

- **Fortescue:** Design & construct iron ore electrolyser and testing and evaluation using Pilbara iron ore
- **Curtin University:** Modelling and simulation of electrode and electrolyser flow to enable design optimisation
- **Deakin University:** Designing and evaluation of electrode materials

Research Commercialisation Stage:

1. Scale up engineering of electrolyser designs
2. Construct, commission and evaluate a pilot scale iron ore electrolyser plant
3. Fortescue will demonstrate a DER electrolyser plant at a technology readiness level (TRL) of 6 with a 50% conversion rate of hematite feed into magnetite and/or iron metal

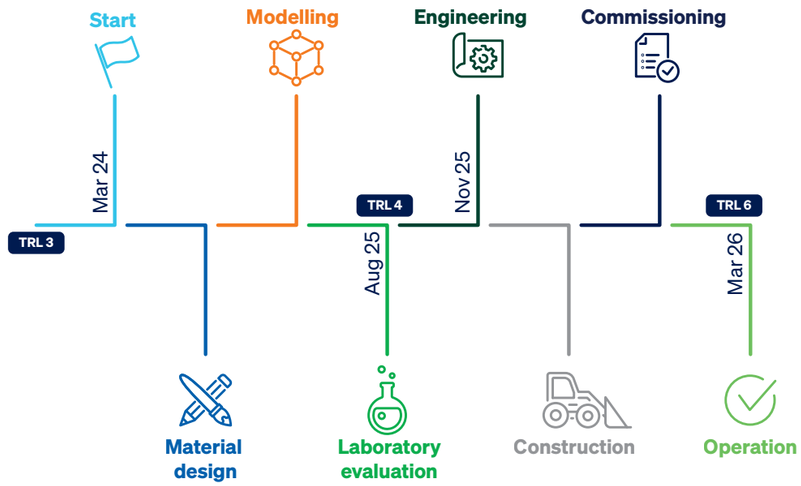


DER Electrolysis process showing the iron ore electrolyser and catholyte and anolyte feeds to perform the conversion of iron ore into iron metal and associated chemical reactions which are occurring.

Outcomes

1. Develop electrolyser materials to process iron ores
2. Scale up R&D and design iron ore electrolyser
3. Perform electrochemical conversion of iron ores at a scale of 100kg feed showing at least 50% conversion of Pilbara iron ore to iron and/or magnetite

Research Plan



Research Team

Curtin University

IFM INSTITUTE FOR FRONTIER MATERIALS

DEAKIN UNIVERSITY

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