Institute for Energy Economics and Financial Analysis

Fact Sheet:

Iron Ore Quality and Zero Emissions Steel

Direct Reduced Iron (DRI) technology currently needs high quality iron ore with low impurities.

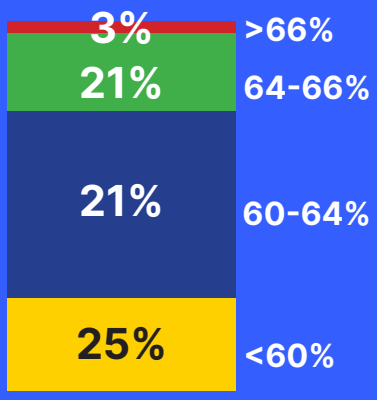
Fe (iron) ≥ 67%

Acid gangue

$(siO_2+Al_2O_3)$ < 2%

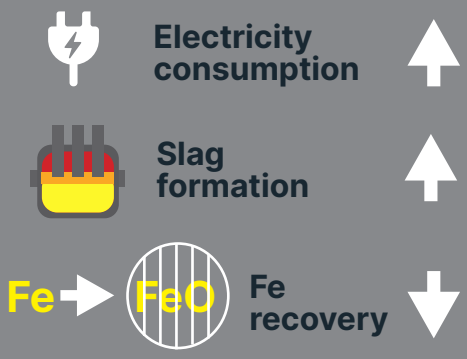
(Silicon dioxide + Aluminum oxide)

Seaborne iron ore supply by Fe% in 2020

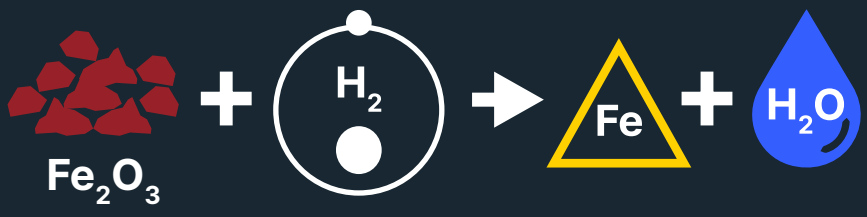


High quality iron ore reserves are scarce

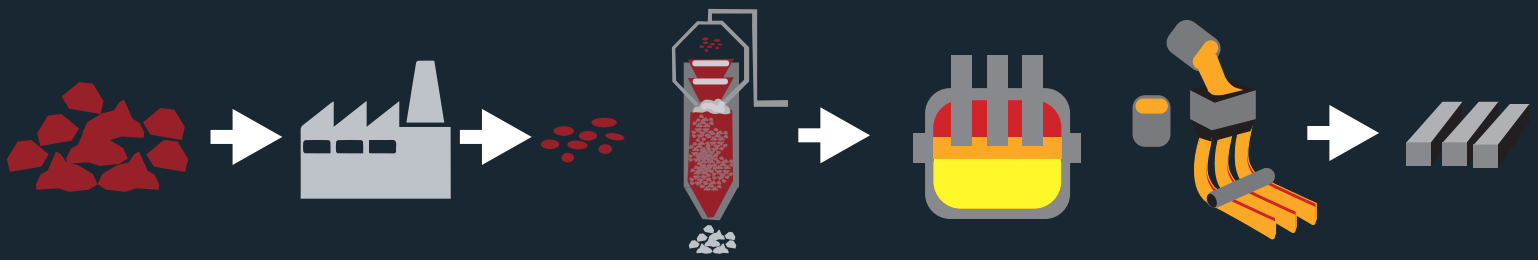
More impurities will reduce the efficiency of DRI-EAF steelmaking



Hydrogen-based Direct Reduction Technology



Hydrogen removes the oxygen and produces reduced iron and water. Without melting or refining, the impurities remain in the DRI.



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DRI-Melter-BOF

Some steelmakers are planning alternative configurations of existing technologies that allow the use of more plentiful, lower-grade iron ore in DRI processes.

This would get around the issue of limited supply of high-grade iron ore and allow wider uptake of DRI processes that don't use metallurgical coal.

A melting stage can be added to melt the DRI before being charged into a basic oxygen furnace (BOF) instead of an electric arc furnace (EAF) to produce steel.

BOFs are more flexible with regard to iron ore quality and impurities than an EAF.

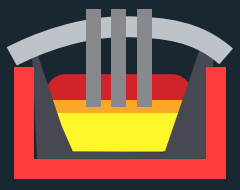
Fluidised Bed Reactor

Fluidised bed reactor (FBR) technology enables the use of fine ores directly without the need for iron ore pelletisation or agglomeration.

FBR technologies such as HyREX, HYFOR and Circored are designed to use hydrogen as a reducing gas.

As well as a solution to limited global pelletisation capacity, these processes may be able to use lower-grade iron ore. HyFOR is being tested with Fe content at or below 65%.

THYSSENKRUPP



- **Planning a submerged arc furnace (SAF) melting stage after DRI production, before using an existing BOF.**
- **This will allow the use of lower-grade iron ore in its DRI processes.**
- **Thyssenkrupp is planning to replace its blast furnaces with this technology, starting in 2025.**

ARCELORMITTAL

- **Global steel giant ArcelorMittal is also looking at the DRI-SAF technology route.**
- **It is examining implementation of this technology at its Dunkirk site using hydrogen as the reductant.**
- **Commissioning is planned for 2025.**

BLUESCOPE/RIO TINTO

- **BlueScope is also investigating the DRI-Melter-BOF technology route to allow use of lower-grade iron ore.**
- **BlueScope is working with Rio Tinto to investigate how this would allow the use of the latter's lower-grade Pilbara iron ore.**
- **For Rio this represents a potential pathway that allows continued use of its Pilbara iron ores in a decarbonised global steel industry.**

Technology innovations such as these could allow much greater use of DRI processes in steelmaking. Any wide-scale global switch from blast furnaces to DRI would have a significant impact on metallurgical coal demand.