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IKI International Climate Initiative

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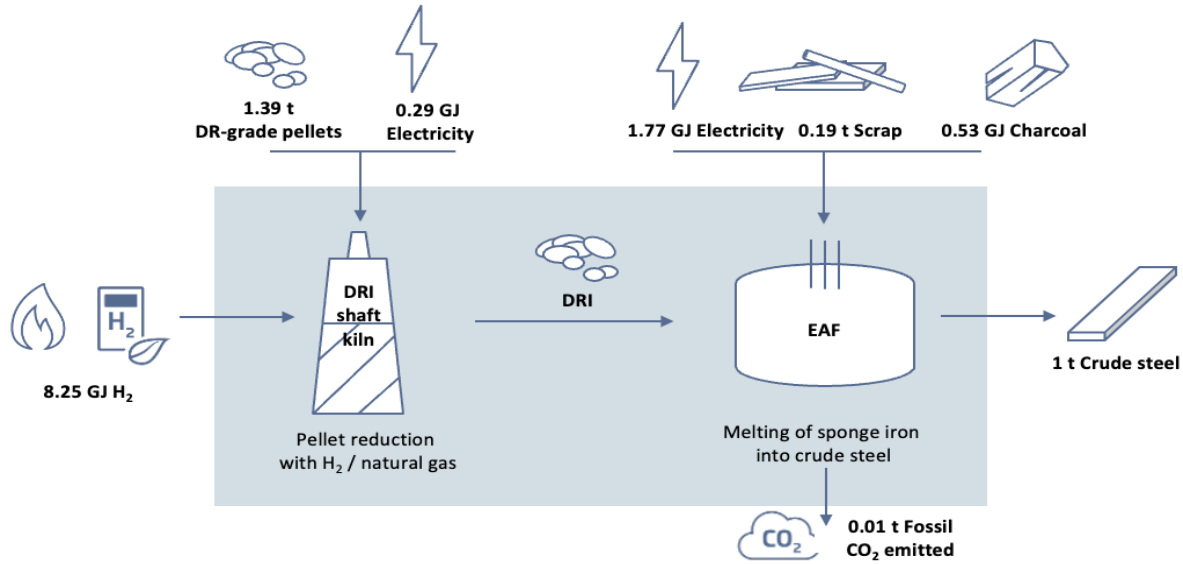
Steel

Direct reduction of iron with hydrogen and steelmaking in Electric Arc Furnace (H2_DRI-EAF)

Description | Iron ore is reduced in a vertical shaft furnace using hydrogen[1] as reducing agent at temperatures below the melting point of iron. The resulting direct reduced iron (DRI) is melted and processed into crude steel in a subsequent process step, the Electric Arc Furnace (EAF)[2]. The EAF can be charged with flexible shares of DRI and scrap.



Process inputs and outputs per t of crude steel[3]

	Unit	Value
Electricity demand	GJ	2.06
Hydrogen	GJ	8.25
Charcoal	GJ	0.53
High-grade pellets	t	1.39
Scrap	t	0.19
CO_2 emissions (scope-1)	t CO_2	0.01
CO_2 emissions (scope-2)*	t CO_2	1.99
CO_2 captured	t CO_2	-

*Assumed emission intensity of electricity: 516 g CO_2/ kWh_{el}

Key characteristics:[4]

- Replacement of conventional plants
- CO_2 emission reduction (scope-1) compared to conventional BF-BOF: 99%
- Cost increase of steel production compared to BF-BOF (w/o CO_2 costs): 85%-115%
- CO_2 avoidance costs: 190-250 $/t CO_2

Key requirements:

- High-quality iron ore pellets (at least 66 w-% Fe)
- (Green) hydrogen

Applicability to the Kazakh context:

- Green electricity is essential to avoid high scope-2 emissions from hydrogen production
- KZ has good conditions for renewable electricity
- (Local) water availability for hydrogen production requires consideration
- Hydrogen infrastructure required if hydrogen production is distant from iron reduction

[1] Besides hydrogen further reducing gases can be used: natural gas, coal-derived syngas, bio-based syngas

[2] Another route processes the DRI in a smelting furnace and then in a basic oxygen furnace

[3] The system boundary for the shown values is iron and steel production up to crude steel

[4] More information and assumptions are provided in the final report of the DeKaMe project (https://epub.wupperinst.org/frontdoor/index/index/docId/8779)

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