

Green iron trade

Unlocking opportunities for South Africa

November 2025

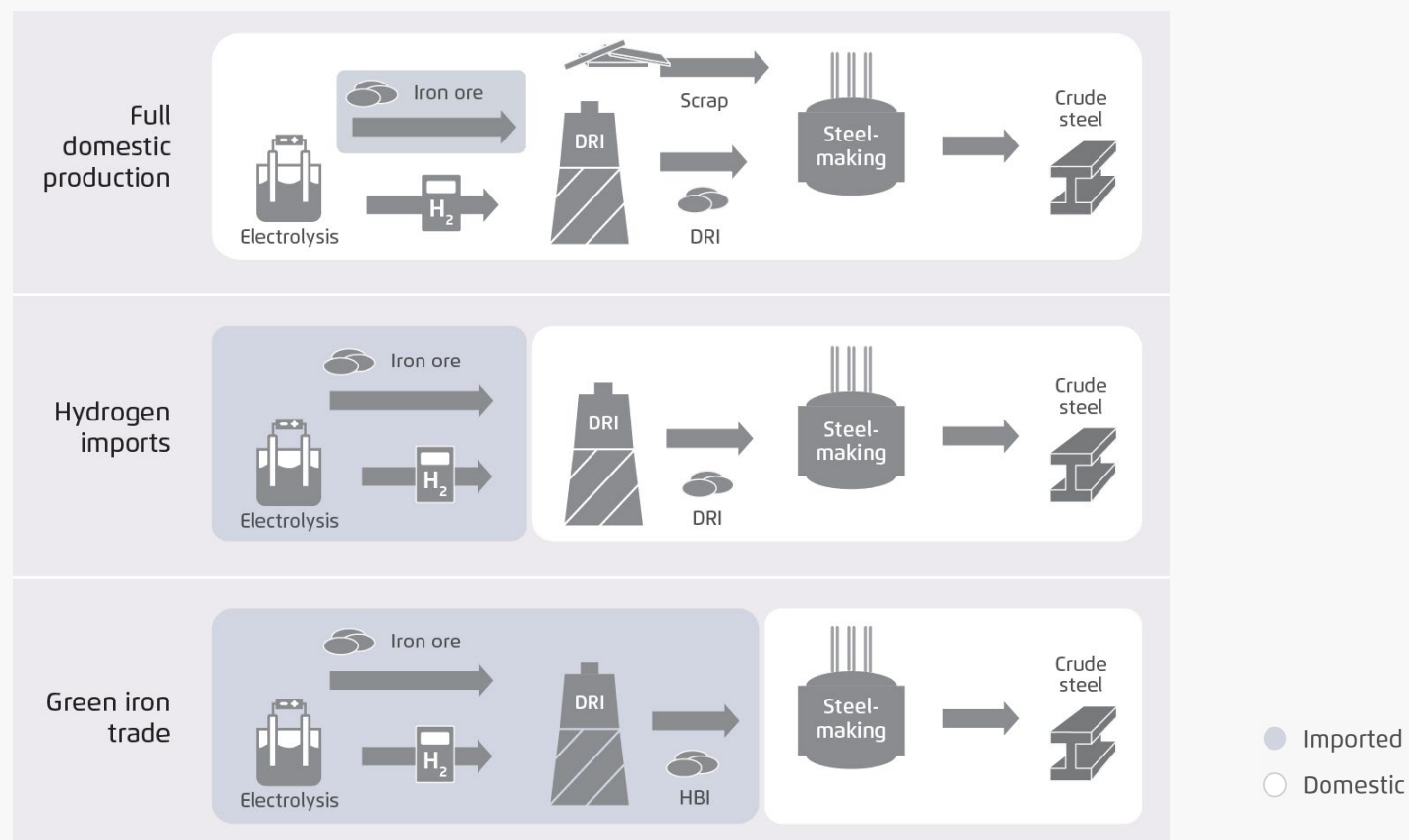


Key findings

- 1. South Africa's significant renewable resources potential, high-grade iron ore and strong industrial basis provide a solid foundation for large-scale green iron production.** To realise this potential, the government needs to unlock investment, scale up renewable energy and port infrastructure and de-risk projects to attract private capital. By tapping into its exceptional solar and wind resources and existing heavy-industry infrastructure, South Africa can become one of the world's most cost-competitive green iron producers.
- 2. Green iron trade offers a win-win opportunity for South Africa and its partners.** By producing 3 million tonnes (Mt) of green iron by 2040, South Africa could create around 12,000 new jobs and triple its current export revenues compared to iron ore. This would also avoid 3.8 Mt of carbon emissions, contributing to global decarbonisation efforts. For countries such as Germany, South Korea and Japan, sourcing green iron from South Africa could lower steelmaking costs by 12 to 15 percent by 2040, while safeguarding high-value steel production and downstream value chains.
- 3. Strategic international partnerships are key to unlocking South Africa's potential.** The Just Energy Transition Partnership (JETP) provides a strong foundation to link clean energy deployment with industrial transformation, while the upcoming EU-South Africa Clean Trade and Investment Partnership (CTIP) can turn this momentum into concrete investment and trade opportunities for green iron.
- 4. Targeted finance and policy coordination are essential to scale investment.** South Africa's high cost of capital and infrastructure gaps remain key barriers. Concessional finance, guarantees and blended instruments can improve project bankability, while cooperation with the African Development Bank can expand green finance and channel capital into industrial value chains. Aligning the Green Hydrogen Commercialisation Strategy, Steel Master Plan and related policies will also be important for turning investment momentum into bankable projects.

Green steel supply chains: a diversified approach

The value chain for both exporters and importers shifts from trading iron ore to trading green iron

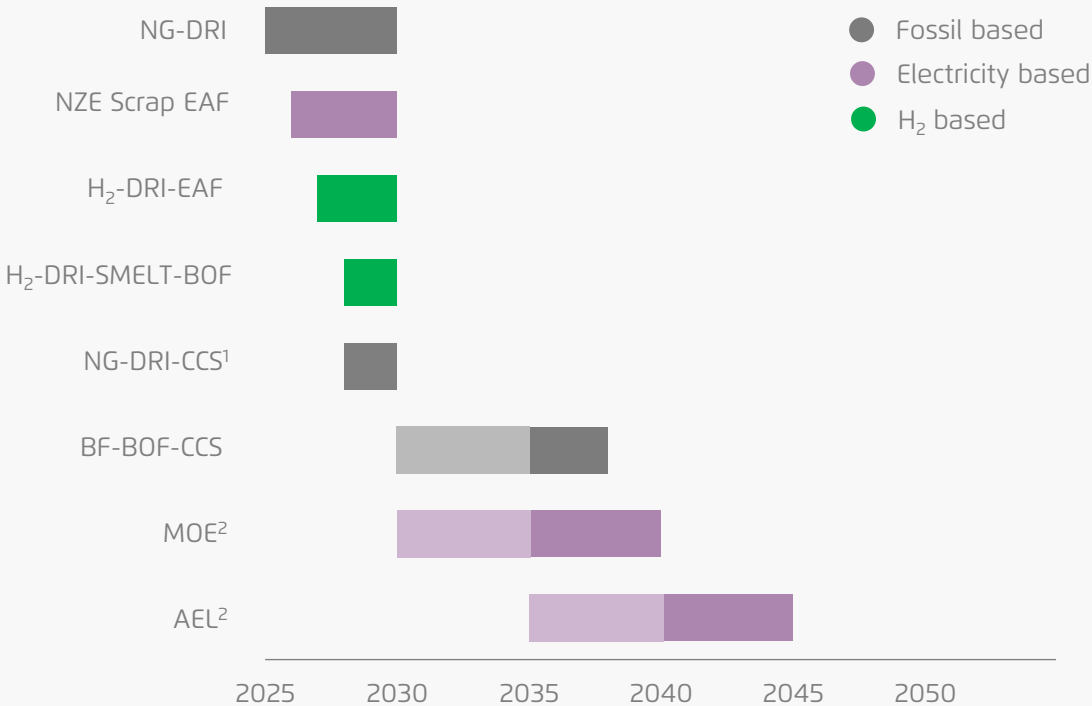


- Producing green steel via DRI shifts the energy inputs from coal to clean electricity and H₂.
- Green iron can be shipped as HBI, complementing domestically sourced metallic inputs (iron and steel scrap), thereby providing steelmakers some flexibility in their raw material inputs compared to the integrated coal-based BF-BOF route.
- This reduces the demand for domestic or imported H₂ and associated renewable energy and infrastructure.

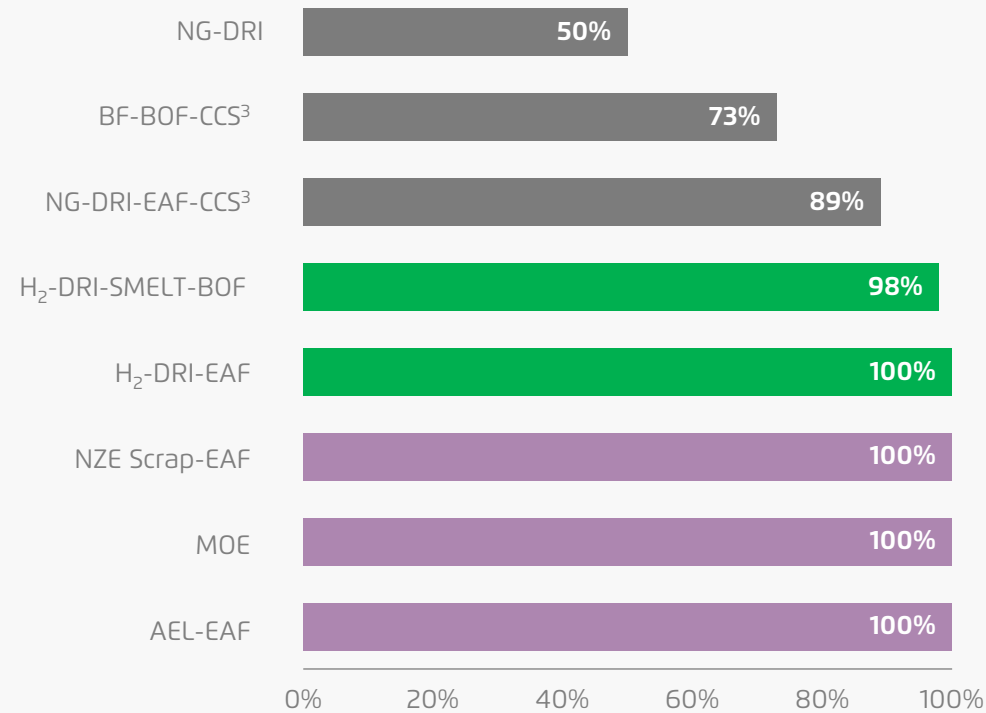
Next-generation steelmaking

By 2030, mature technologies like scrap-based EAF and hydrogen-based DRI routes will drive the decarbonisation of the steel sector

Expected market readiness⁴ of different breakthrough technologies for steelmaking

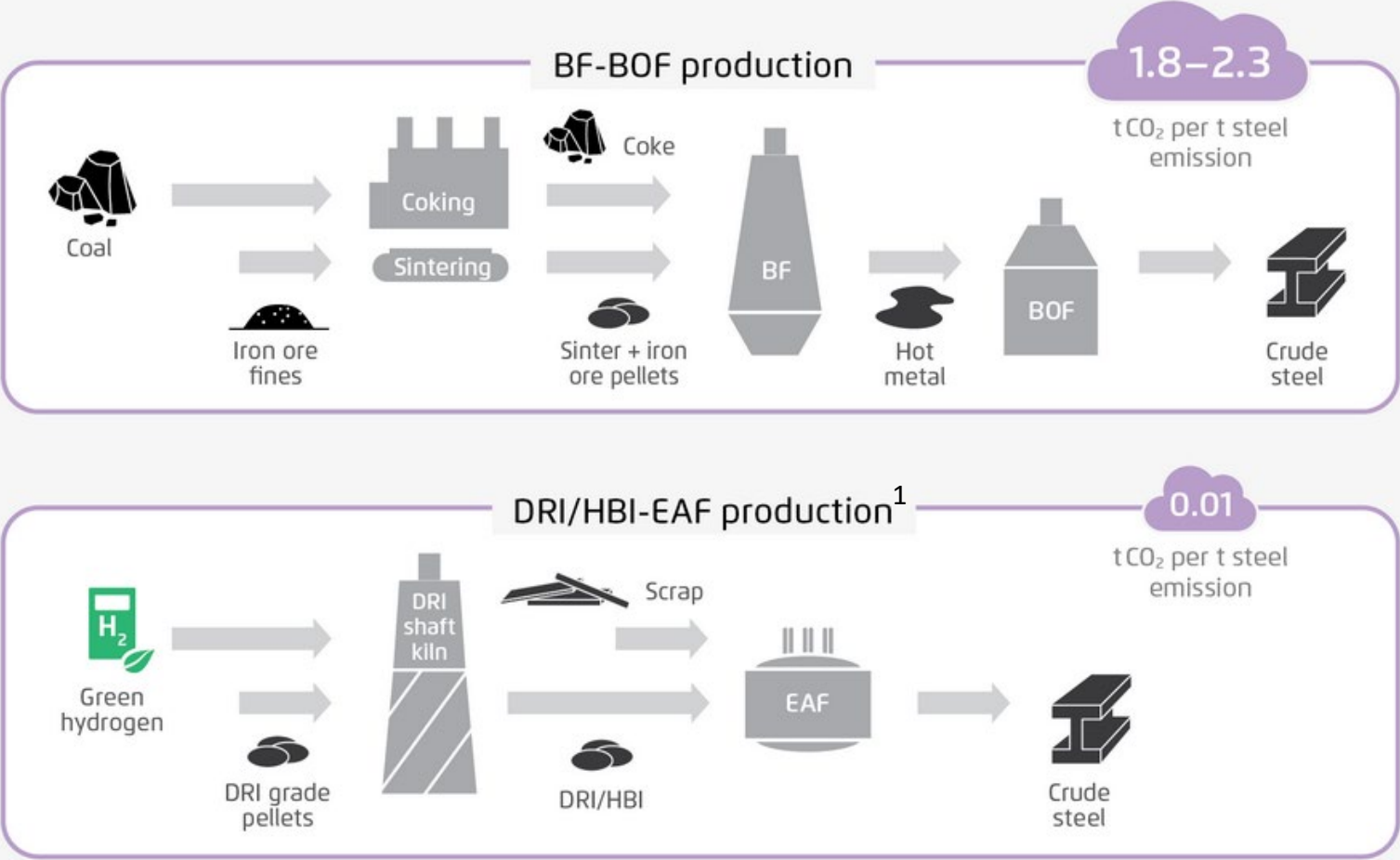


CO₂ abatement potential of different technologies compared to the integrated blast furnace route (BF-BOF)³



5 | Agora Industry and Wuppertal Institute (2022, 2023). ¹ Current commercial NG-DRI-CCS projects are not considered breakthrough technologies, as they do not achieve substantial CO₂ emission reductions. ² Due to their low TRL at the time of modelling, MOE was not expected to reach market readiness before 2035, and AEL before 2040. ³ CCS calculations are based on ambitious assumptions. Achieving high CO₂ capture rates at a BF-BOF plant is technically and economically challenging due to the many CO₂ point sources at the site. Note that upstream methane emissions (out of scope of this analysis) can substantially increase the full carbon footprint of steel, both for BF-BOF and NG-DRI with CCS. ⁴This implies that TRL 9 is reached, transitioning from small commercial trials to full market deployment. Technology deployment will depend on the availability of renewable electricity and hydrogen.

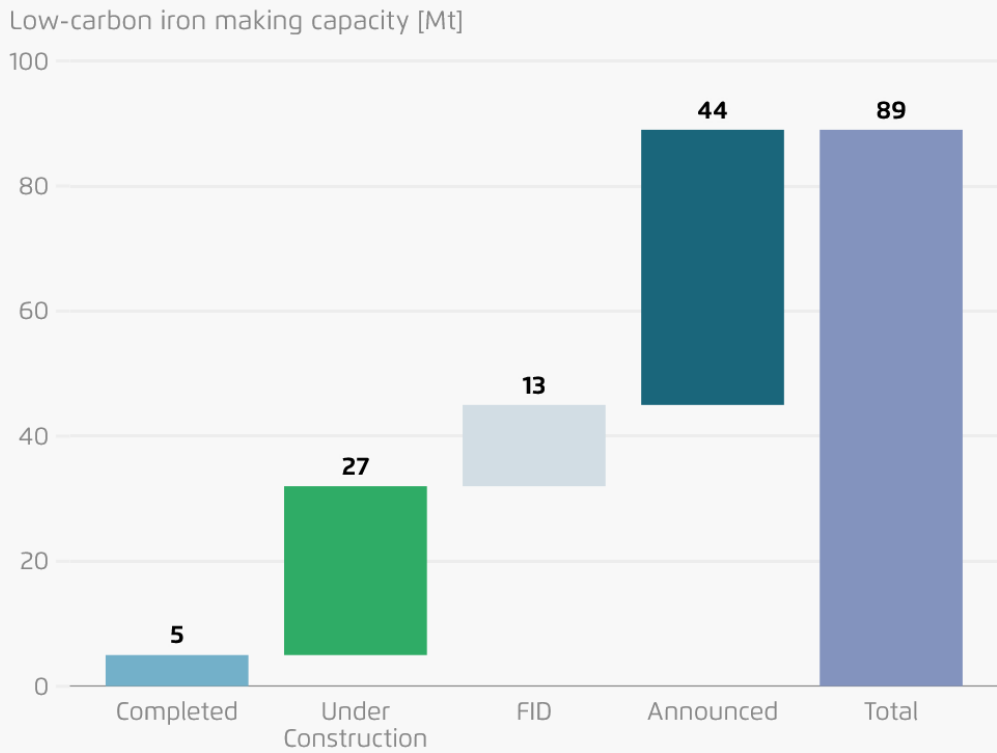
Steelmaking via the green hydrogen-DRI/HBI-EAF route can eliminate the vast majority of carbon emissions compared to the coal-based BF-BOF route



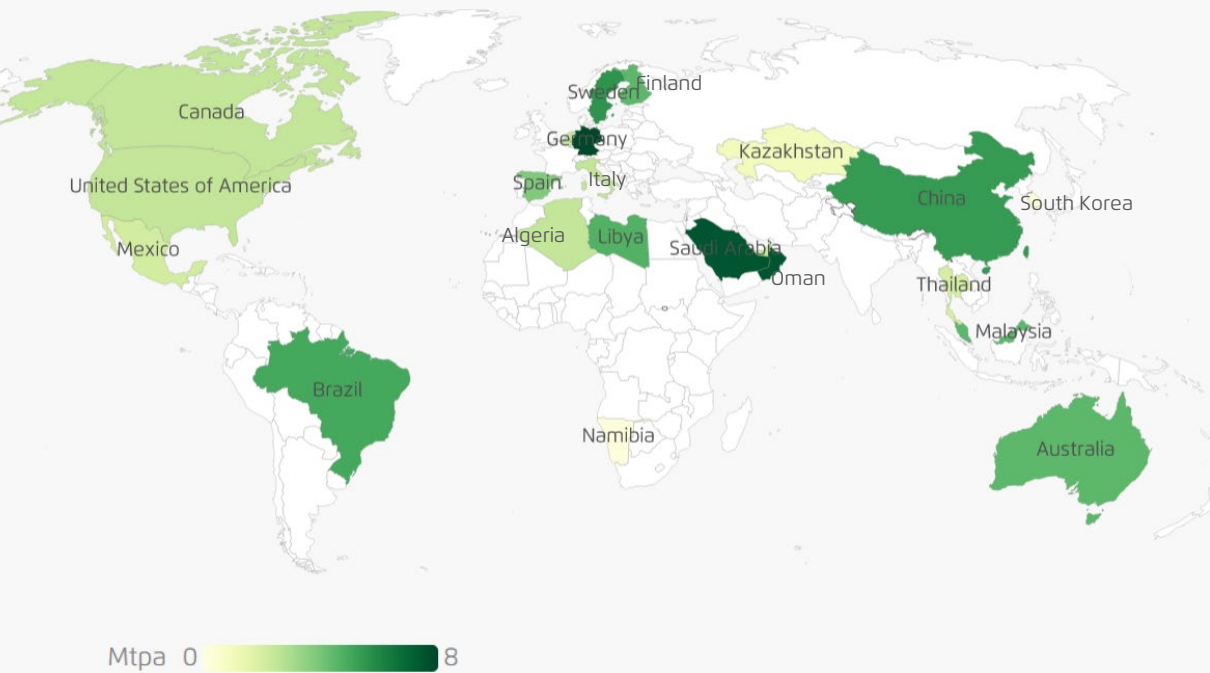
6 | ¹ The DRI-SMELT-BOF route (not pictured here) is another viable route for green iron trade, which is described further in [Agora Industry and Wuppertal Institute \(2023\)](#).

The transition to green steel is gaining momentum, with the EU and MENA regions emerging as front-runners in the shift to hydrogen-based DRI by 2030

2030 low-carbon steel announcement pipeline by project status



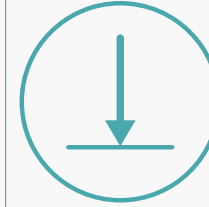
2030 low-carbon steel announcement pipeline by country



7 | Agora Industry (2025) “Low-carbon” also includes announced projects that are initially based on fossil gas. The large majority of the projects have plans to switch to renewables based hydrogen in the future but many have unspecified timelines on when that switch will occur.

Opportunities of green iron trade: the case of South Africa

South Africa's steel sector faces significant headwinds, with cheap steel imports outcompeting local production



In 2024, South Africa's crude steel production declined by 4.8% year-on-year, totalling 4.7 million metric tonnes.

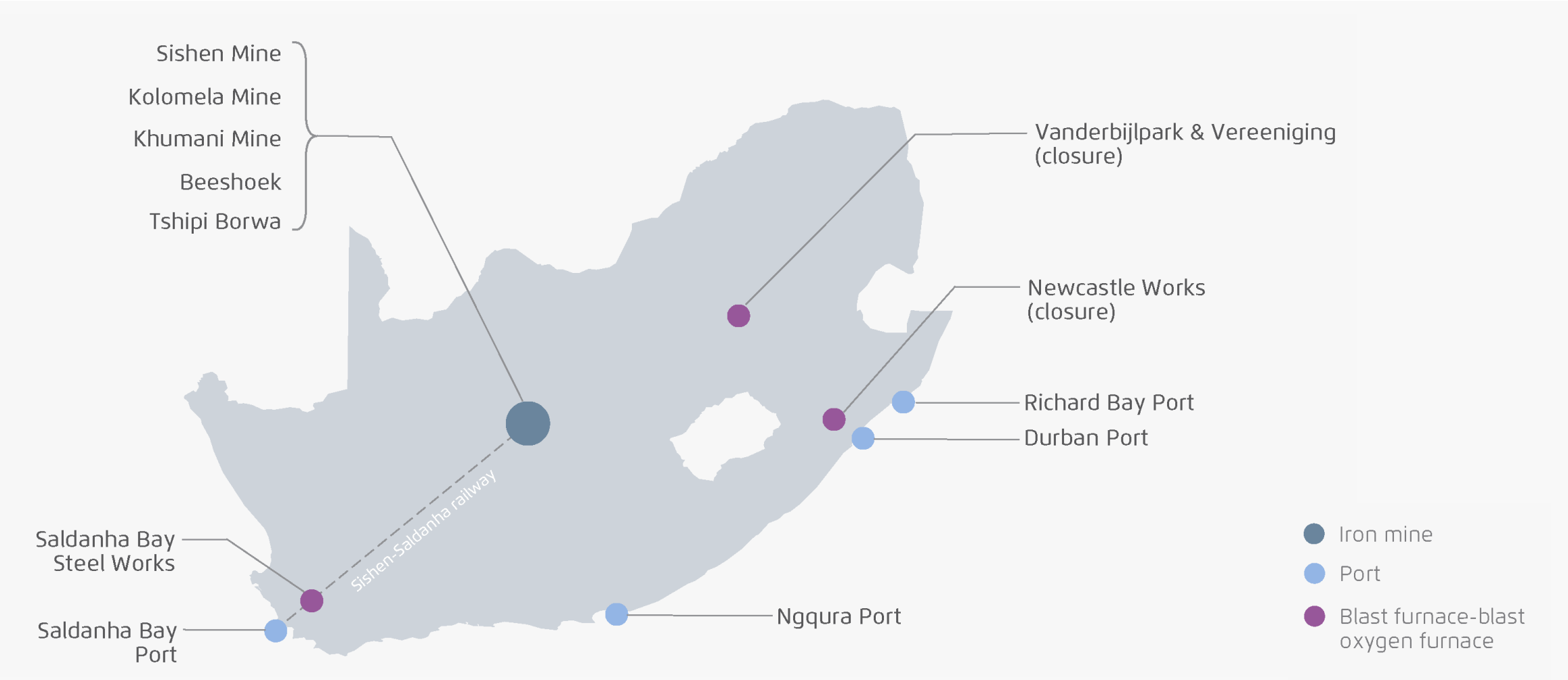


By 2024, steel imports reached their highest recorded levels, accounting for 34% of domestic consumption.



One of South Africa's largest steelmakers reported a loss exceeding ZAR 5 billion in 2024 and announced plans to close several plants, affecting around 3,500 jobs.

South Africa’s high-quality renewables potential, DRI-grade iron ore and existing steel and logistics infrastructure give it a globally competitive edge for H₂-DRI production



The mothballed Saldanha steel plant presents a key opportunity for South Africa to produce HBI for export



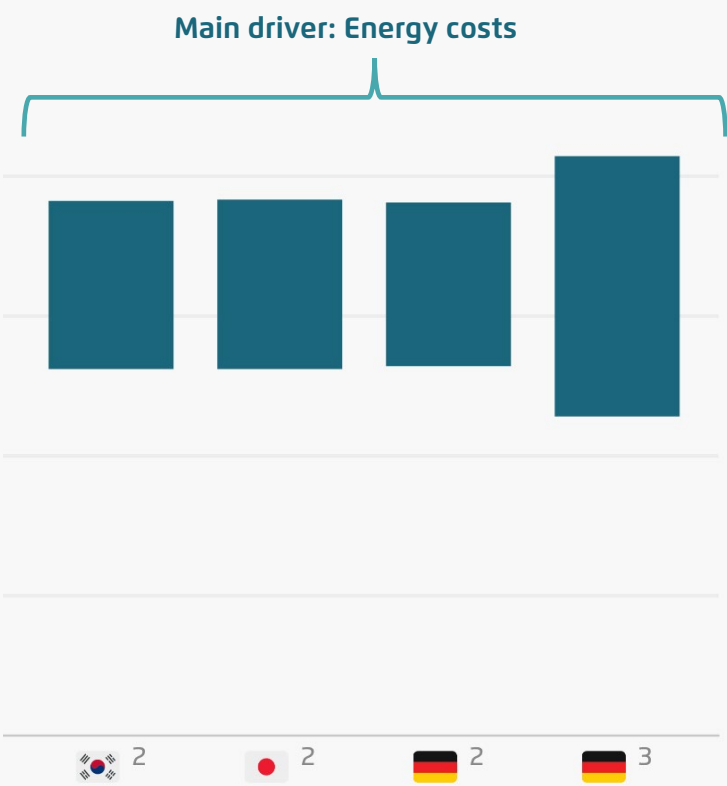
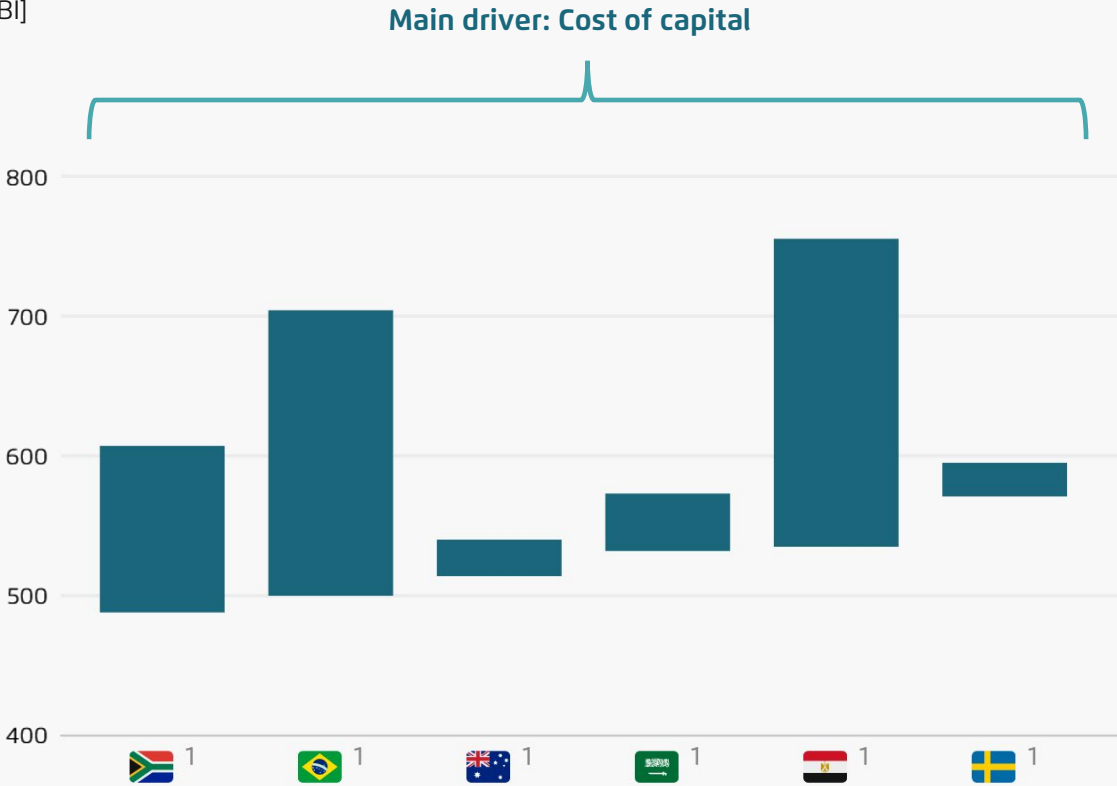
Saldanha steel plant has been identified as one of the best locations in the world to manufacture green iron. Important opportunities exist to retrofit legacy steel plants, for example:

- Mothballed Corex-Midrex direct reduction plant with adaptation potential – retrofit required to run on renewable hydrogen
- Deep-water port and logistics infrastructure for global integration
- Industrial ecosystem with transferable workforce skills
- Strategic importance in both South African and European policy contexts
- Requires commercial partners to sufficiently de-risk investment costs

Green HBI production costs are mainly driven by cost of capital in potential exporting countries and by hydrogen costs from high energy costs in potential importing countries

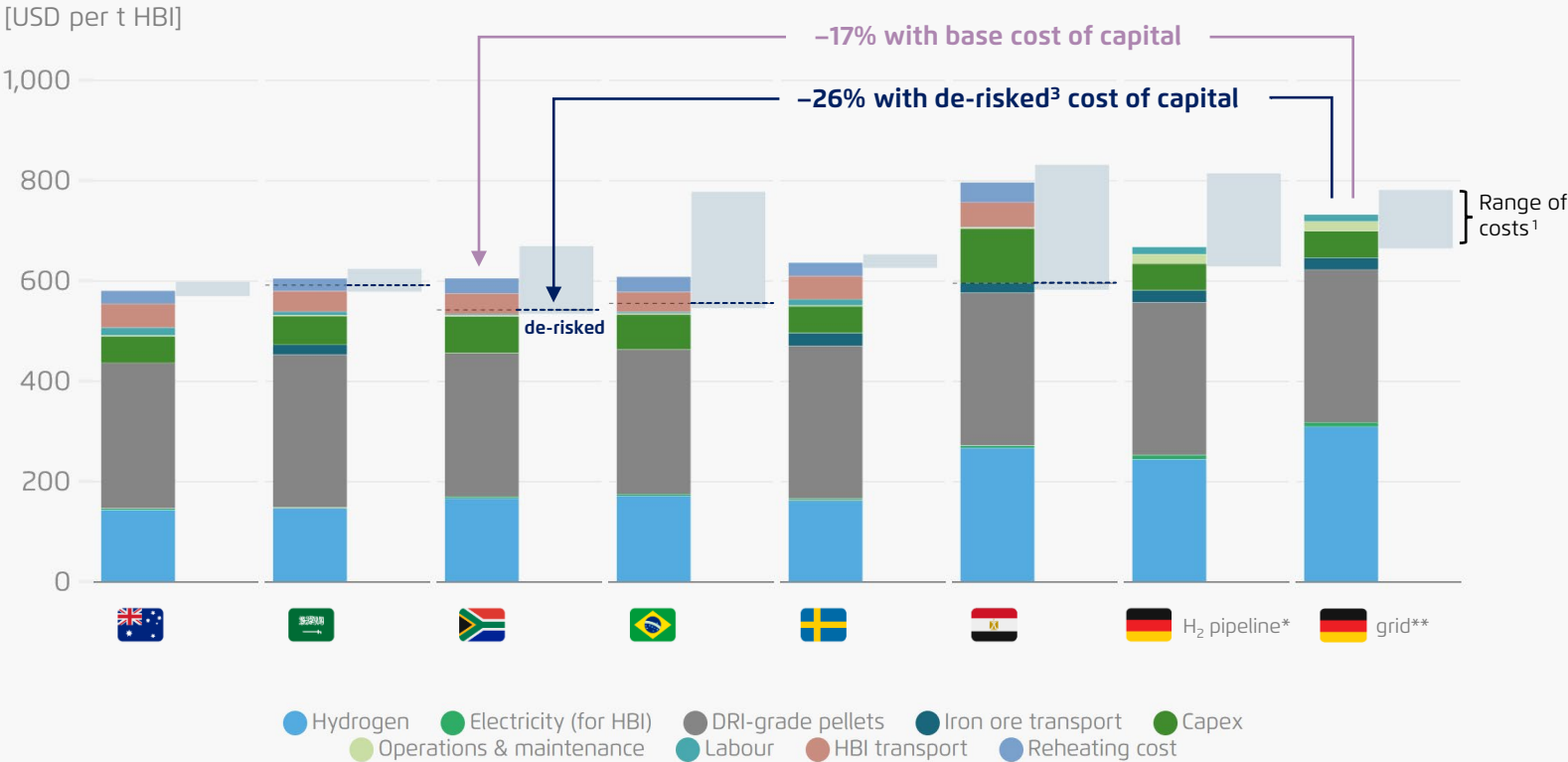
Range of HBI production costs in 2040

[USD per t HBI]



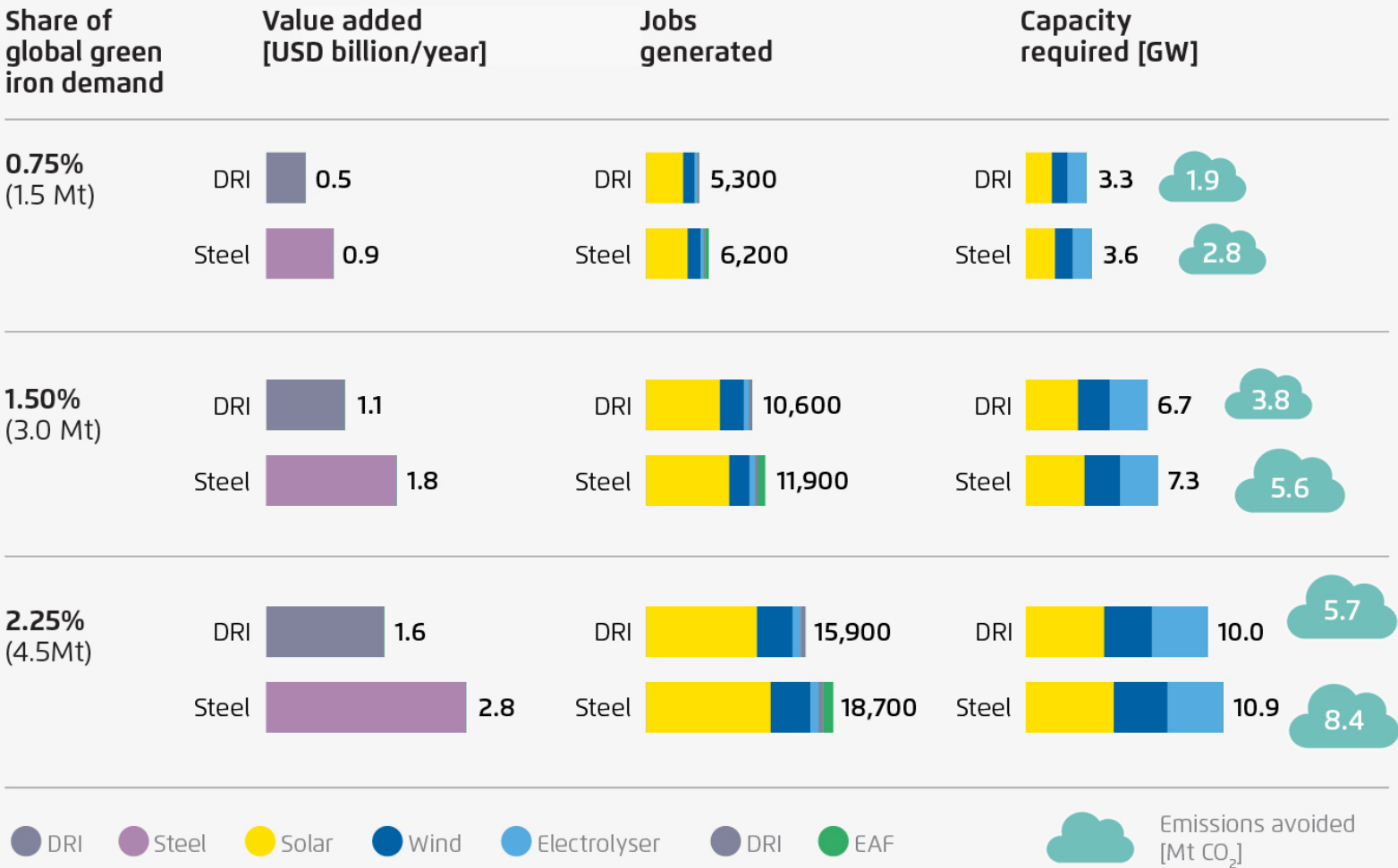
Unlocking production in regions with high renewables potential could create significant opportunities to reduce costs

HBI production and import² costs in 2040 based on medium cost scenario



- Projects in many exporting countries will need supporting de-risking⁴ measures.
- As a global green iron market develops, access to cost-competitive HBI imports would enable more cost-effective steel production.
- Using imported green HBI with up to 26% lower production costs can reduce the cost of overall steelmaking in Germany by up to 15%.

Supplying 1.5% of global green iron demand¹ by 2040 could create around 11,000 green jobs in South Africa and triple current iron ore export revenues; transitioning the steelmaking value chain could generate even greater benefits.



14 | ¹ 0.75% (1.5 Mt), 1.5% (3 Mt) and 2.25% (4.5Mt) represents shares of projected global iron demand in 2040, based on estimates from Bataille, Stiebert and Li (2024), “Facility-Level Global Net-Zero Pathways Under Varying Trade and Geopolitical Scenarios”. CO₂ emissions avoided assuming 1 tonne HBI is equivalent to 1 tonne crude iron. Jobs generation includes temporary and permanent direct jobs. Temporary jobs were annualised to the lifespan of the project (20 years).

South Africa's gains from green iron exports by 2040

Gross revenues from iron ore exports today



0.6

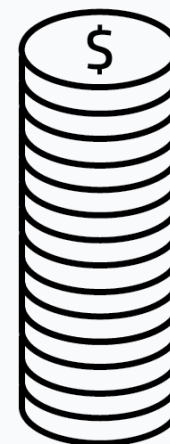
USD billion per year

0.40

USD billion per year

Investment

Gross revenues from green iron exports from 2040



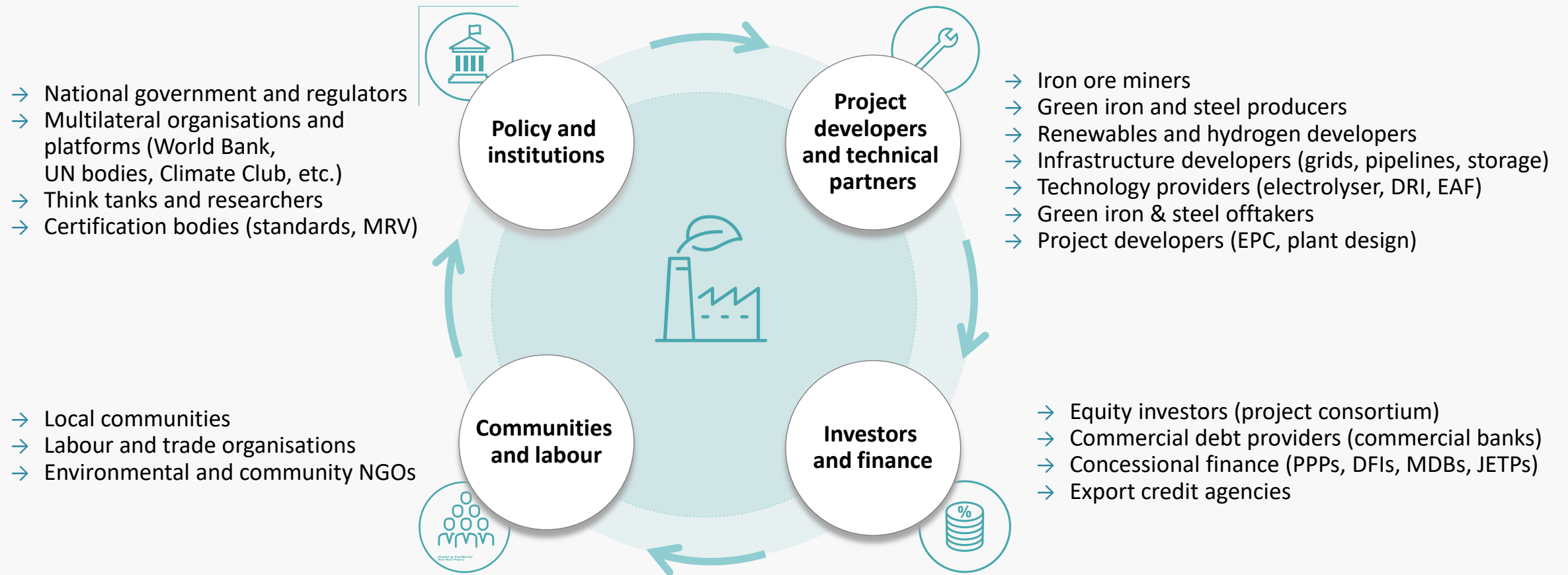
1.8

USD billion per year

And also:
3.8 Mt CO₂ avoided
and 11,000 jobs generated

South Africa policy recommendations

Key players must come together to create the enabling environment required to enable H₂-DRI project implementation



1) Domestic industrial policy: strengthening national enablers for green industrial transformation in South Africa

1. Scale renewable energy and hydrogen infrastructure

- Coordinate and de-risk the expansion of renewable energy, grids and hydrogen infrastructure
- Harmonise South Africa's Green Hydrogen Strategy with energy, mining and industrial plans to scale infrastructure and ensure coordinated implementation

2. Create lead markets for green iron

- Establish a national certification system aligned with international standards to secure market access
- Use public procurement, private incentives and targeted finance to drive early demand and improve competitiveness
- Integrate green iron and steel goals into industrial and climate strategies to build a coherent domestic market

3. Incentivise new industrial projects

- Strengthen investor confidence through clear policy alignment across hydrogen, energy and industrial development
- Align the Green Hydrogen Commercialisation Strategy, the Steel Master Plan and the South African Renewable Energy Masterplan to unlock bankable projects, grow domestic markets and enable integrated infrastructure development

2) International collaboration: leveraging trade to drive investments into green supply chains

1. Develop strategic international partnerships

- Expand frameworks like the EU-South Africa Strategic Partnership, Global Gateway programme. Initiate Clean Trade and Investment Partnerships (CTIPs) with a focus on clean industrial supply chains
- Use harmonised green product criteria, trade agreements and CBAM to align energy, industrial and climate policies

2. Establish offtake mechanisms and supply security

- Engage with international demand-side platforms and procurement coalitions to aggregate early demand
- Include green iron in international market-maker schemes (such as H2Global) to develop cross-border offtake agreements
- Highlight regional “corridors of cooperation,” for example between South Africa and Namibia, to leverage complementary strengths and enhance regional integration

3. Enable financing for green iron projects and value chains

- Deploy de-risking instruments and blended-finance tools through public banks and multilateral institutions to lower capital costs
- Leverage the Just Energy Transition Partnership (JETP) and international climate finance to mobilise concessional funding and attract private investment
- Expand international trade and investment cooperation to improve market access for green iron exports

4. Set global standards and support technology transfer

- Work through bilateral and multilateral platforms to harmonise standards for green steel, hydrogen, carbon accounting
- Promote technology cooperation and local capacity building to accelerate the global diffusion of clean industrial solutions

Appendix

List of abbreviations

AEL: Alkaline iron electrolysis

BF: Blast furnace

BOF: Basic oxygen furnace

Capex: Capital expenditures

CCS: Carbon capture and storage

DRI: Direct reduced iron

EAF: Electric arc furnace

Fe: Iron

GHG: Greenhouse gases

H₂: Hydrogen

HBI: Hot briquetted iron

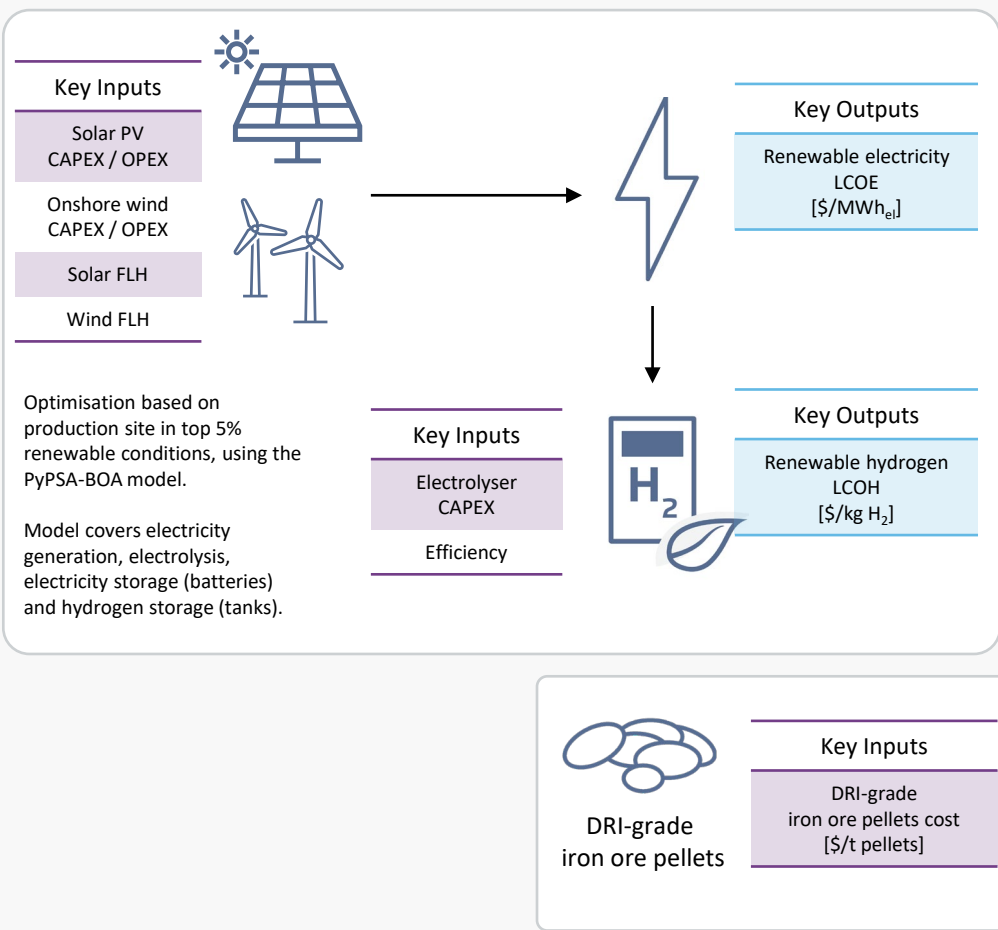
MOE: Molten oxide electrolysis

NZE-scrap-EAF: Near-zero emissions scrap electric arc furnace

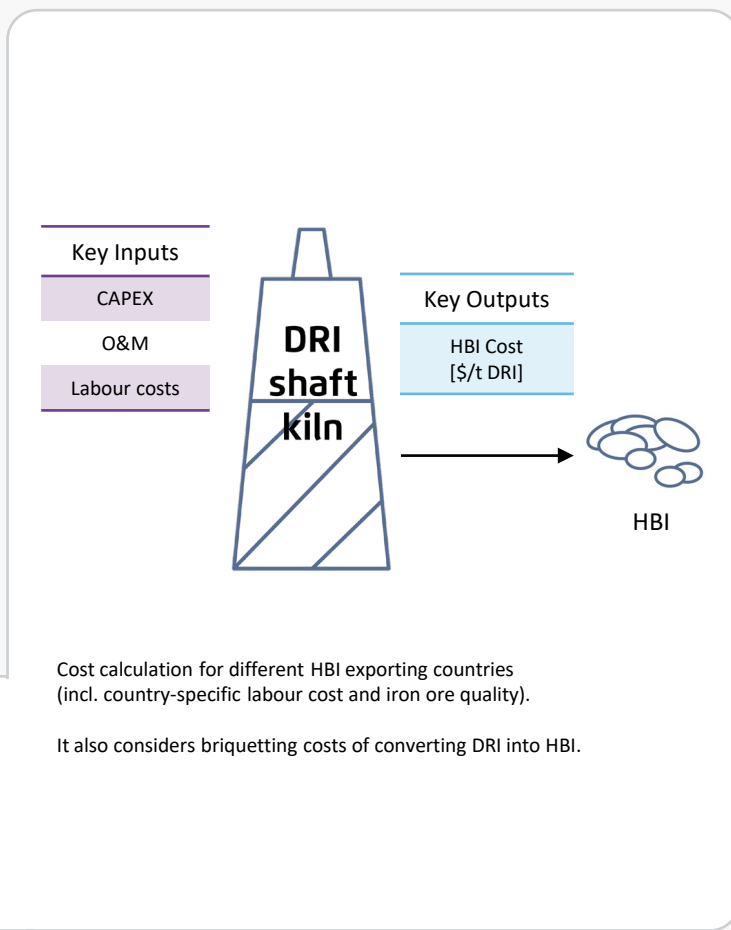
Opex: Operating expenditures

HBI production cost – calculation methodology

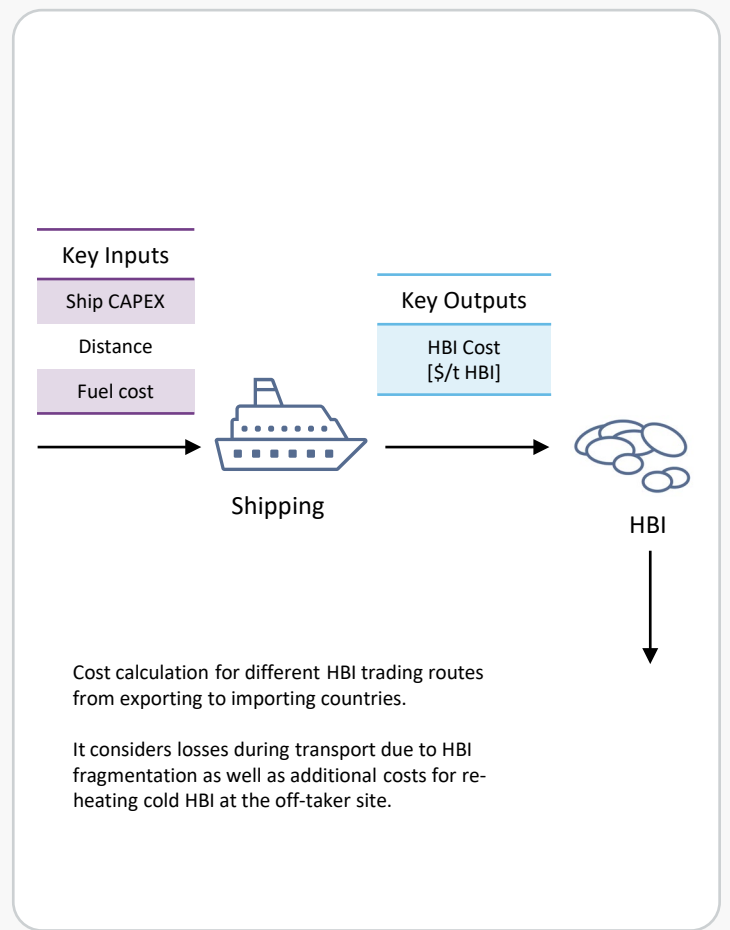
PTX Business Opportunity Analyser ¹



Exporting Country



Importing Country



Appendix – key assumptions

Overall values

Parameters		Value	Reference	Comment
Amortisation time (years)		20	Own assumption	-
Capacity utilisation (%)		90	Own assumption	72% for EAF charged with cold HBI ¹
DR grade iron pellets (USD ₂₀₂₄ / tonne)		207	<u>1, 2</u>	Price for countries without DR grade iron ore. Countries with DR can produce pellets with lower costs.
DRI plant	CAPEX (USD ₂₀₂₄ / tonne DRI per year)	633	<u>2</u>	<u>Recent</u> announcements values
	Fixed OPEX (% of CAPEX per year)	3	<u>2, 4</u>	-
	Electricity consumption (kWh / tonne DRI)	93	<u>2, 3</u>	Including DRI briquetting
	Hydrogen consumption (kg H ₂ / tonne DRI)	69	<u>2, 4</u>	Including H ₂ pre-heating
EAF plant	CAPEX (USD ₂₀₂₄ / tonne CS per year)	468	<u>2</u>	<u>Recent</u> announcements values
	Fixed OPEX (% of CAPEX per year)	3	<u>2, 4</u>	-
	Electricity consumption (kWh / tonne HBI)	651	<u>2, 4, 5</u>	Including re-heating of cold HBI (150 kWh / ton HBI)

Appendix – key assumptions

Overall values

Parameters		Value	Reference	Comment
BF-BOF plant	CAPEX (USD ₂₀₂₄ / tonne CS per year)	326	<u>10</u>	-
	Fixed OPEX (% of CAPEX per year)	3	<u>10</u>	-
	Coking coal (USD ₂₀₂₄ / tonne)	257	<u>2</u>	-
Alkaline electrolyser	CAPEX (USD ₂₀₂₄ / kW _{el})	657	<u>8</u>	-
	Fixed OPEX (USD ₂₀₂₄ / kW _{el} -year)	13	<u>8</u>	-
	Efficiency	71.5%	<u>8</u>	-

Appendix – key assumptions

Country-specific values

Parameters	Case	Australia	Brazil	Egypt	South Africa	Saudi Arabia	Germany*	Germany**	Japan	South Korea	References
Discount rate*** (%)	High	4.3	14.6	14.3	10.8	5.1	4.3	4.3	5.3	4.9	<u>6,7</u>
	Medium (default)	4.3	7.7	14.3	8.3	5.1	4.3	4.3	5.3	4.9	<u>6</u>
	Low	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	<u>6</u>
CAPEX of wind onshore (USD ₂₀₂₄ / kW)	High	1176	910	1269	868	1482	1456	-	-	-	<u>8</u>
	Medium (default)	1037	802	1119	765	1307	1624	-	-	-	<u>8</u>
	Low	977	756	792	721	1232	1531	-	-	-	<u>8</u>
CAPEX of solar PV (USD ₂₀₂₄ / kW)	High	698	564	628	303	977	1042	-	-	-	<u>8</u>
	Medium (default)	528	426	475	389	357	434	-	-	-	<u>8</u>
	Low	411	332	370	515	278	505	-	-	-	<u>8</u>

Appendix – key assumptions

Country-specific values

Parameters	Case	Australia	Brazil	Egypt	South Africa	Saudi Arabia	Germany*	Germany**	Japan	South Korea	References
Cost of renewable energy (USD ₂₀₂₄ / MWh)	High	37	64	77.1	70	26	105	105	105	105	8,9
	Medium (default)	32	38	55.5	29	21	90	90	90	90	8,9
	Low	29	27	22.6	21	16	70	70	70	70	8,9
Cost of renewable hydrogen (USD ₂₀₂₄ / kg)	High	2.3	4.0	4.3	4.5	2.4	4.6	5.2	5.2	5.2	8,9
	Medium (default)	2.1	2.5	3.9	2.5	2.1	2.9	4.5	4.5	4.5	8,9
	Low	1.9	1.9	2.0	2.0	1.8	2.8	3.5	3.5	3.5	8,9

Imprint

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