LOCALIZING GREEN INDUSTRIES IN NAMIBIA

Namibia GH2 Forum - UNGA

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Republic of Namibia
MINISTRY OF INDUSTRIALIZATION, TRADE AND SME DEVELOPMENT

Ministry of Mines & Energy

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

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DIRECT ELECTRIFICATION AND GREEN HYDROGEN ARE CRUCIAL IN GLOBAL INDUSTRIAL DECARBONIZATION PROCESSES

POWER

- **Direct electrification** will be the **primary route to decarbonization** for many global sectors.
- Where direct electrification isn't viable, it becomes a **crucial foundation** for **generating cost-effective green hydrogen.**

Direct electrification is the most suitable option

GREEN HYDROGEN

- **Hydrogen** excels as an **energy carrier** over electricity in high-heat applications, offering superior performance.
- Beyond its role as an energy carrier, **hydrogen** serves as a **versatile chemical feedstock**, replacing traditional chemicals in various reduction processes.

NH₃

Hydrogen is the most suitable option

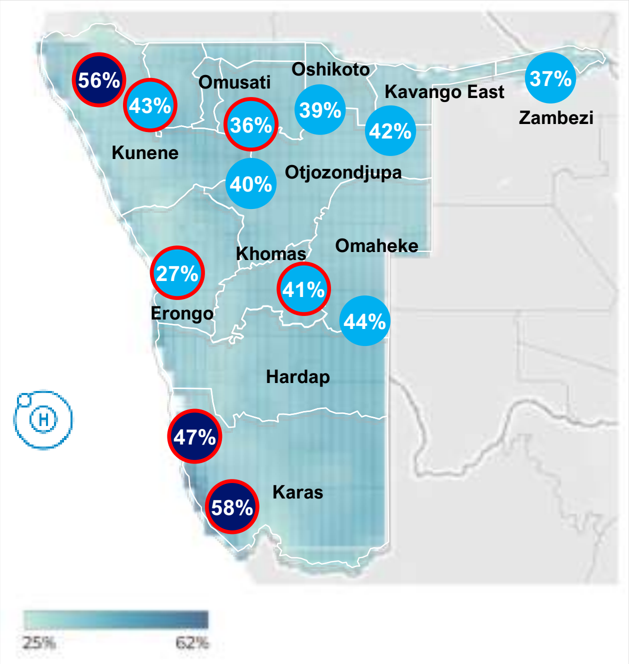
Note: * ETES: Electrothermal energy storage
Sources: Systemiq analysis from ETC (2021), *Global Hydrogen Report*

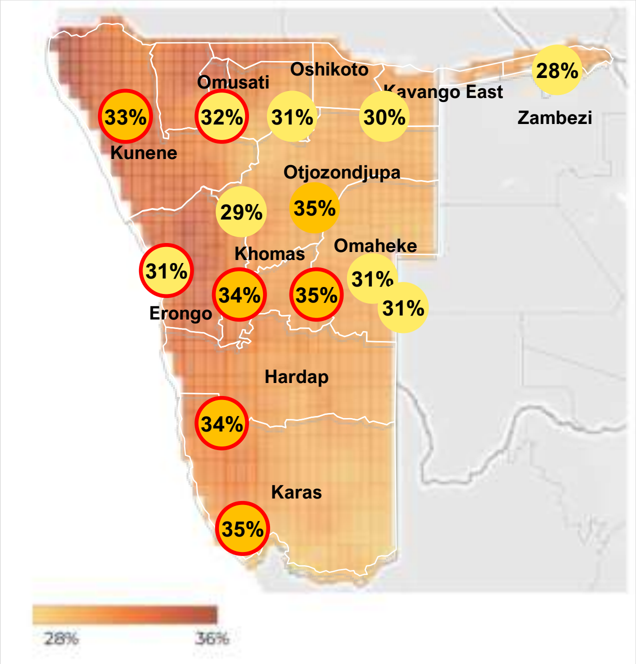
NAMIBIA IS WELL-POSITIONED TO PRODUCE LOW-CARBON ELECTRICITY, HYDROGEN AND ITS DERIVATIVES AT HIGHLY COMPETITIVE COST

Tremendous onshore wind and solar capacity factors (CF)…

Potential green hydrogen valley   xx% Existing plant

Capacity factors in % (as of 2020)

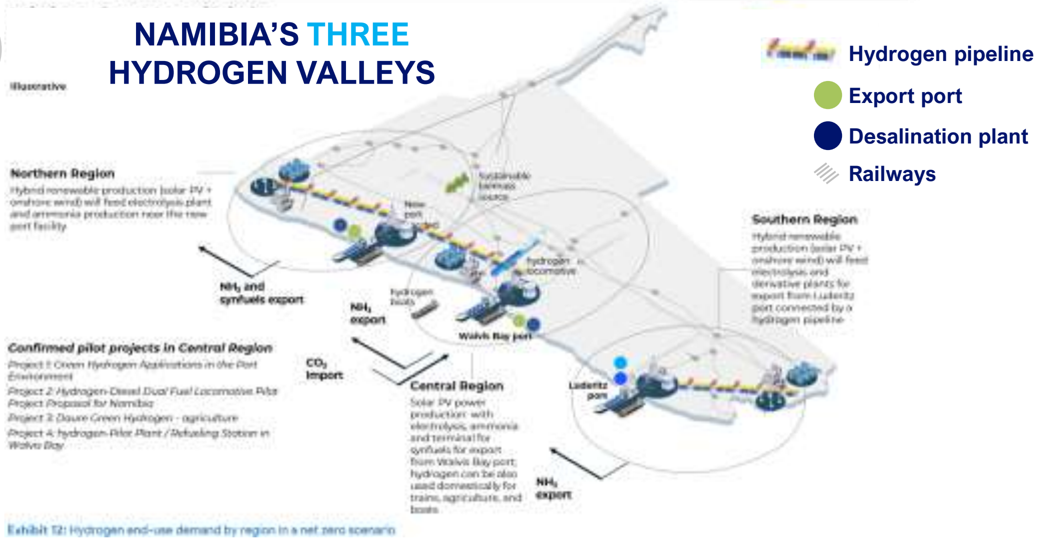




Offshore wind Europe CF: 35.9 %

Global average CF solar: 10-25%

…have laid the foundation for Namibia's green hydrogen vision



Source: IEA (2022), Africa Energy Outlook 2022; GH2 Namibia, Namibia Green Hydrogen and Derivatives Strategy; WindEurope capacity factors.

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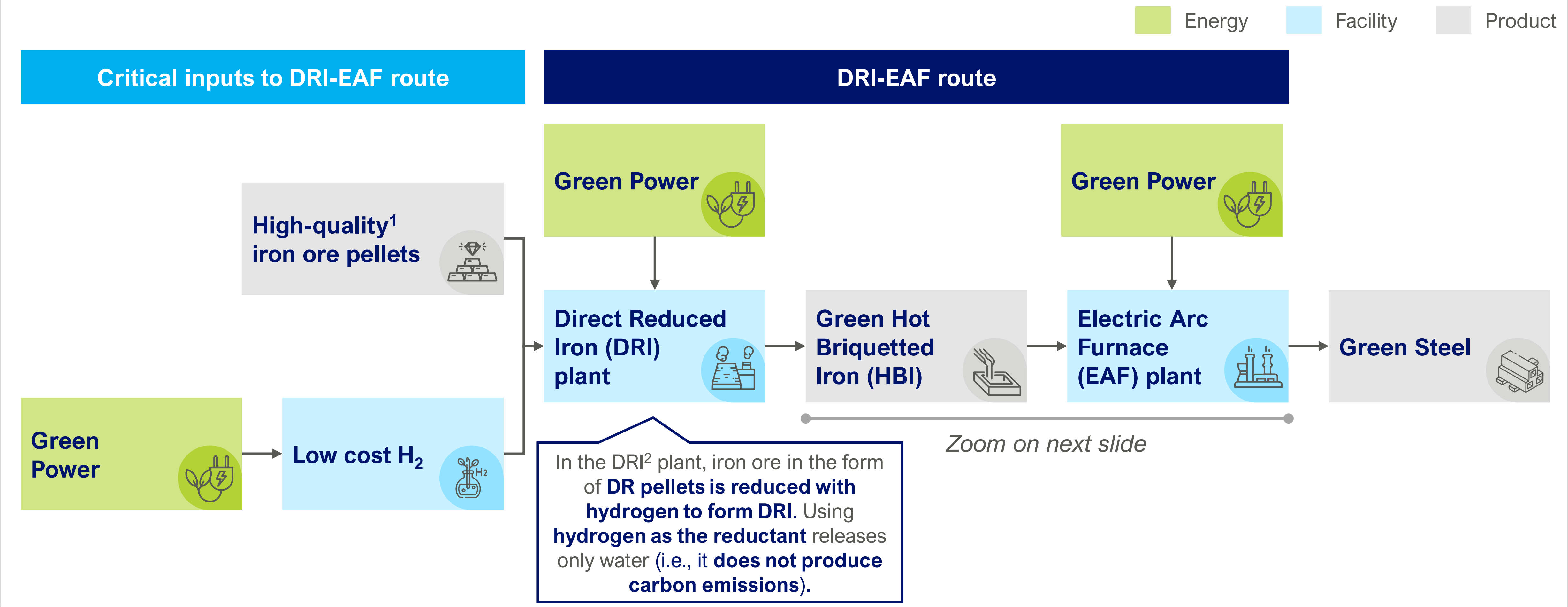
LOW-CARBON STEEL IS DERIVED FROM HIGH-GRADE IRON ORE THROUGH SEVERAL MANUFACTURING STEPS REQUIRING GREEN POWER AND GREEN H_2

The DRI-EAF method, a proven production process used by Middle Eastern operators utilizing inexpensive natural gas, can be decarbonized by substituting the gas with green hydrogen



Note: 1. High-quality iron ore means DRI-read iron ore that has then be pelletized; DRI - direct reduced iron, EAF – electric arc furnace
Source: Systemiq analysis from Mission Possible Partnerships (2022), *Making Net-Zero Steel Possible*

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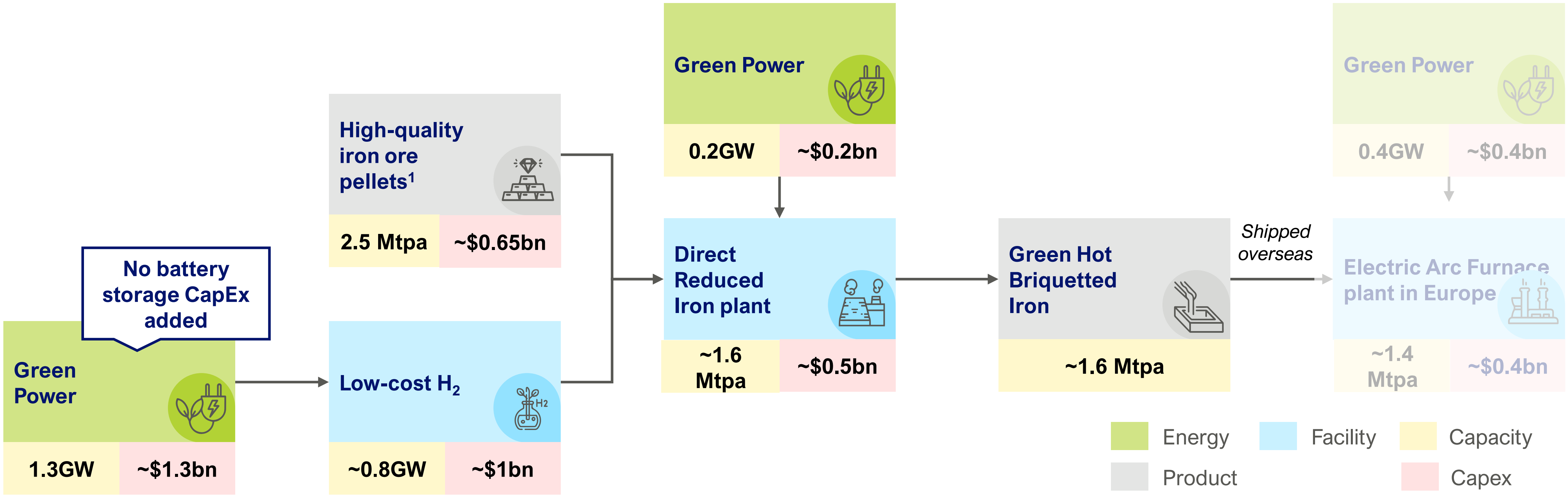
THE QUANTUMS OF GREEN POWER AND HYDROGEN REQUIRED TO DRIVE A SINGLE GREEN IRON PLANT ARE IMMENSE

Over 60% of the energy needs and CAPEX for a DRI-EAF plant are allocated to GH_2 production, highlighting the importance of identifying low-cost producers like Namibia

Overview of the energy & CapEx needs to develop a 2.5 Mtpa iron ore HBI plant



Thanks to its low-cost renewables, Namibia is ideally positioned to produce green HBI and export it to Europe

Notes: 1. Iron ore pellets step includes pelletization plant and the iron ore mine in Namibia. Renewables are estimated to cost ~$1 million per MW. 1.56 tons of iron ore (64% iron content) is assumed needed to produce 1 ton of iron at a DRI plant, this further translating into 0.9 tons of steel. The expected minimum size for a DRI plant is 2.5Mtpa of iron ore feed for a ~1.5 Mtpa iron output.
Sources: Systemiq analysis based on expert interviews

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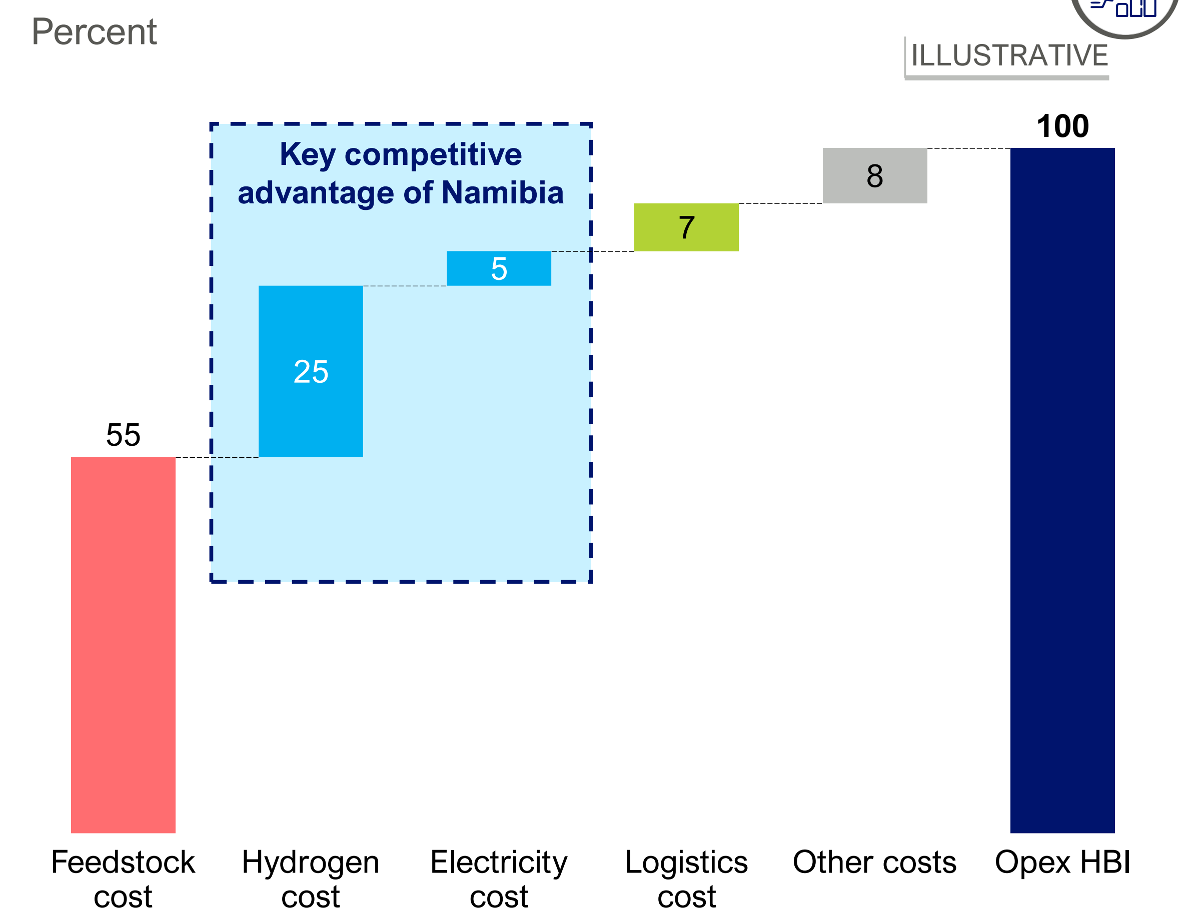
BREAKDOWN OF GREEN HOT BRIQUETTED IRON COST

How is Namibia positioning itself with the three essential elements to competitively produce green hot briquetted iron for export?

OPEX breakdown of green HBI



Source: Systemiq modelling

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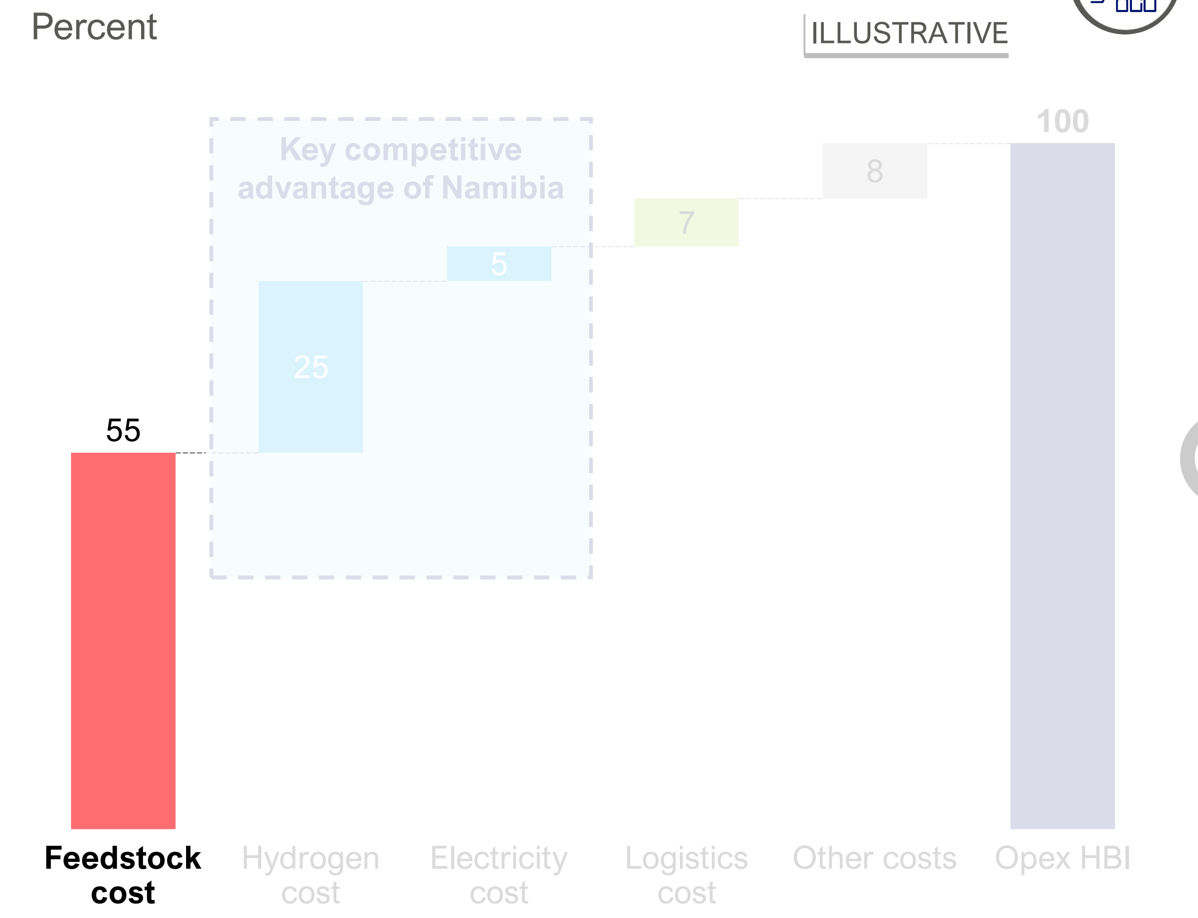
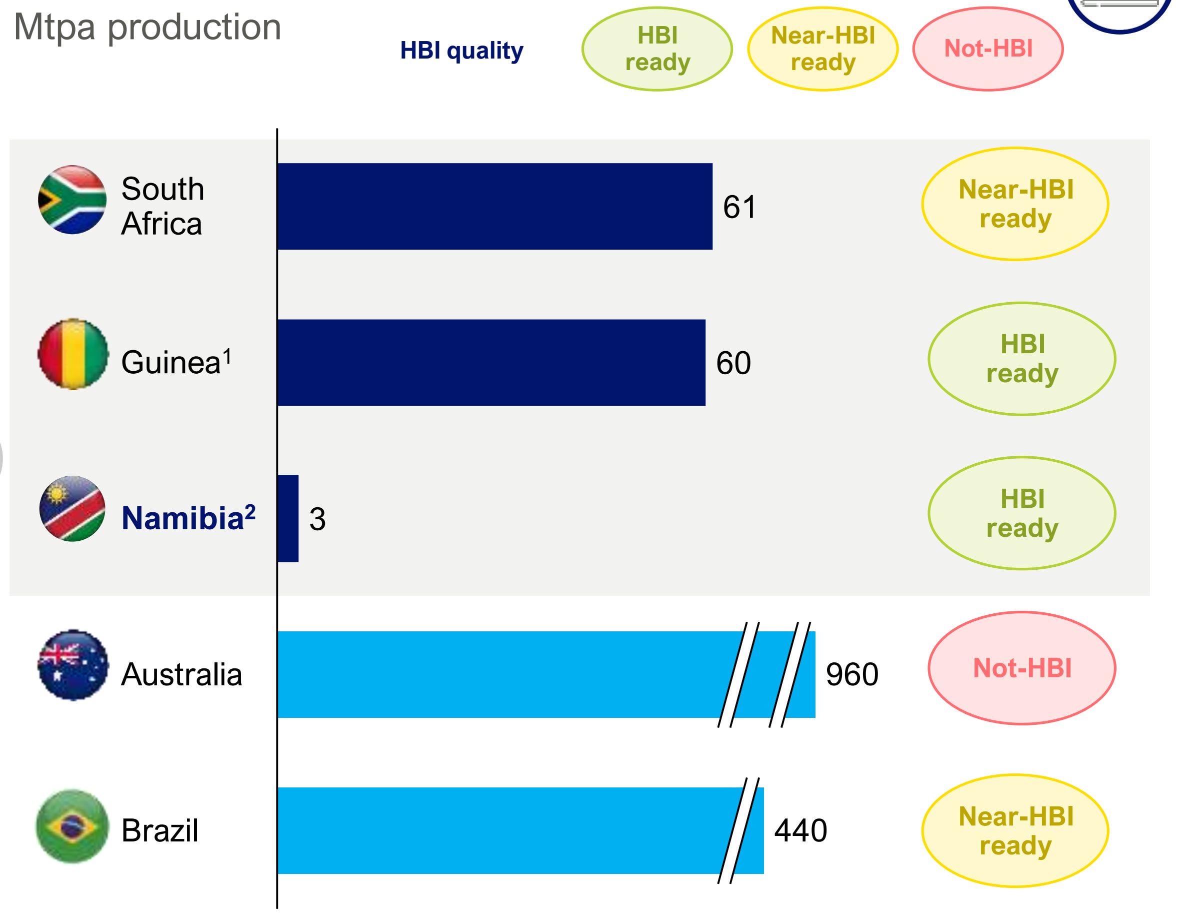


Iron ore quality and quantity



Note: 1. Yearly output of Simandou mine will be ~60 Mtpa; 2. Potential output based on Lodestone resources; more iron ore resources may be discovered in the future.

Source: Systemiq analysis from USGS (2023), Mineral Commodity Summaries 2024; Systemiq modelling

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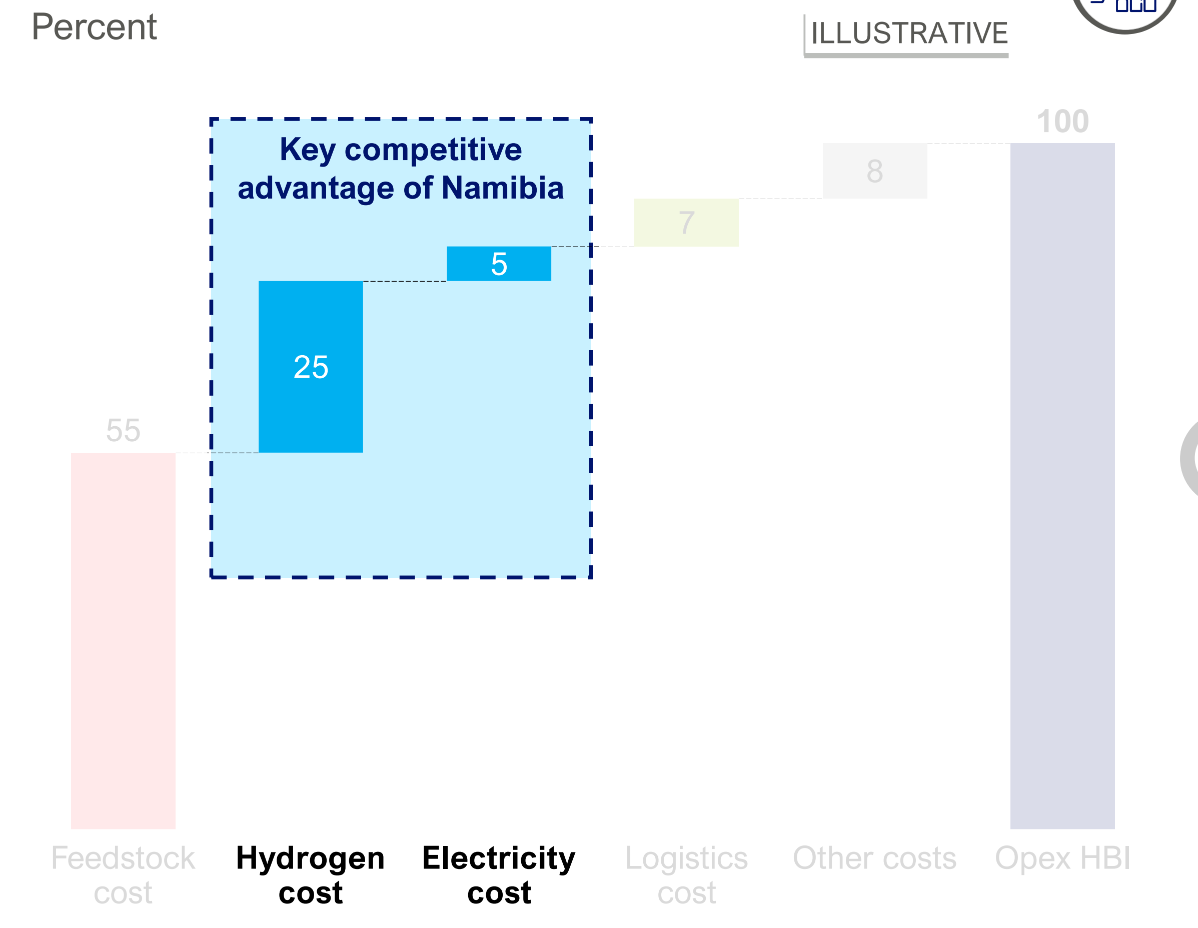
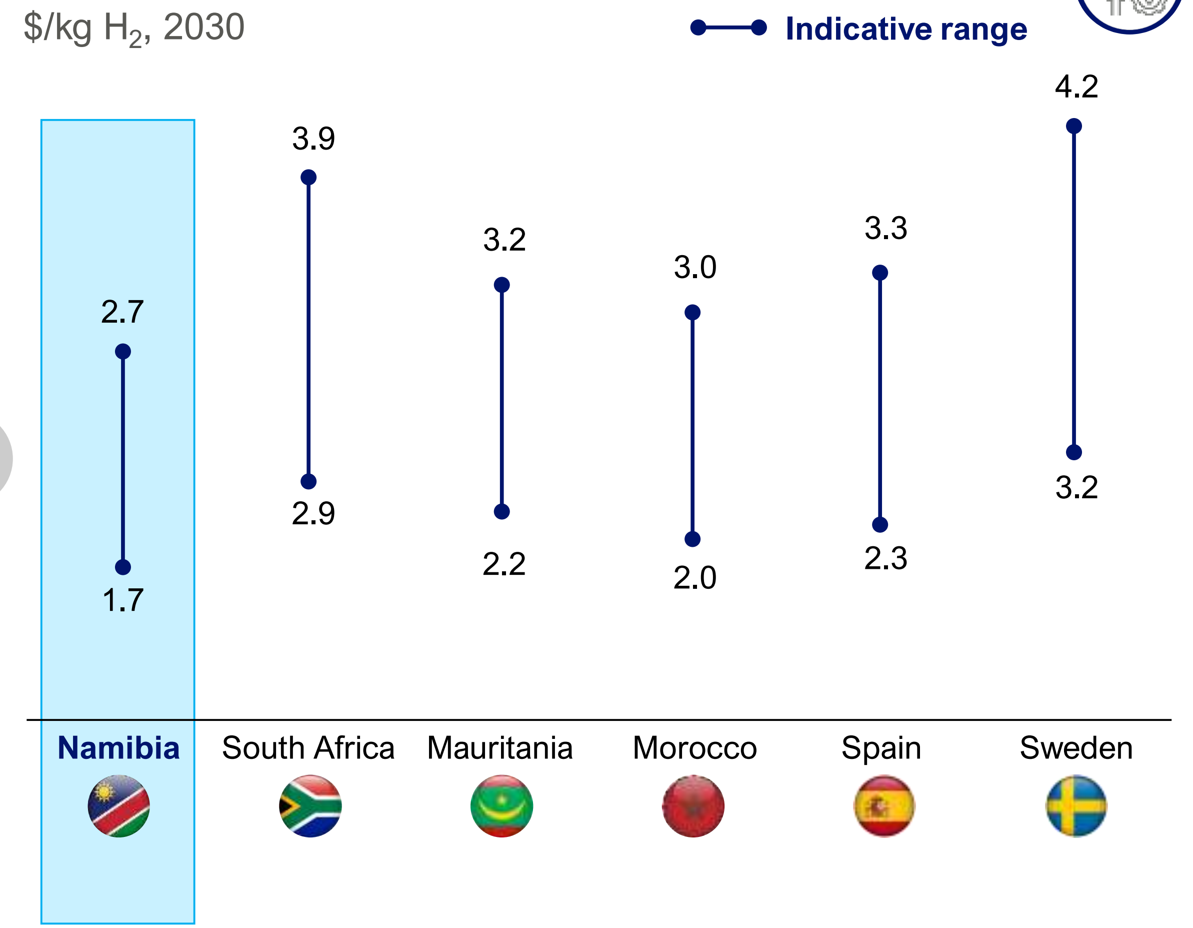


Levelized cost of H_2 from selected regions



Source: Systemiq modelling

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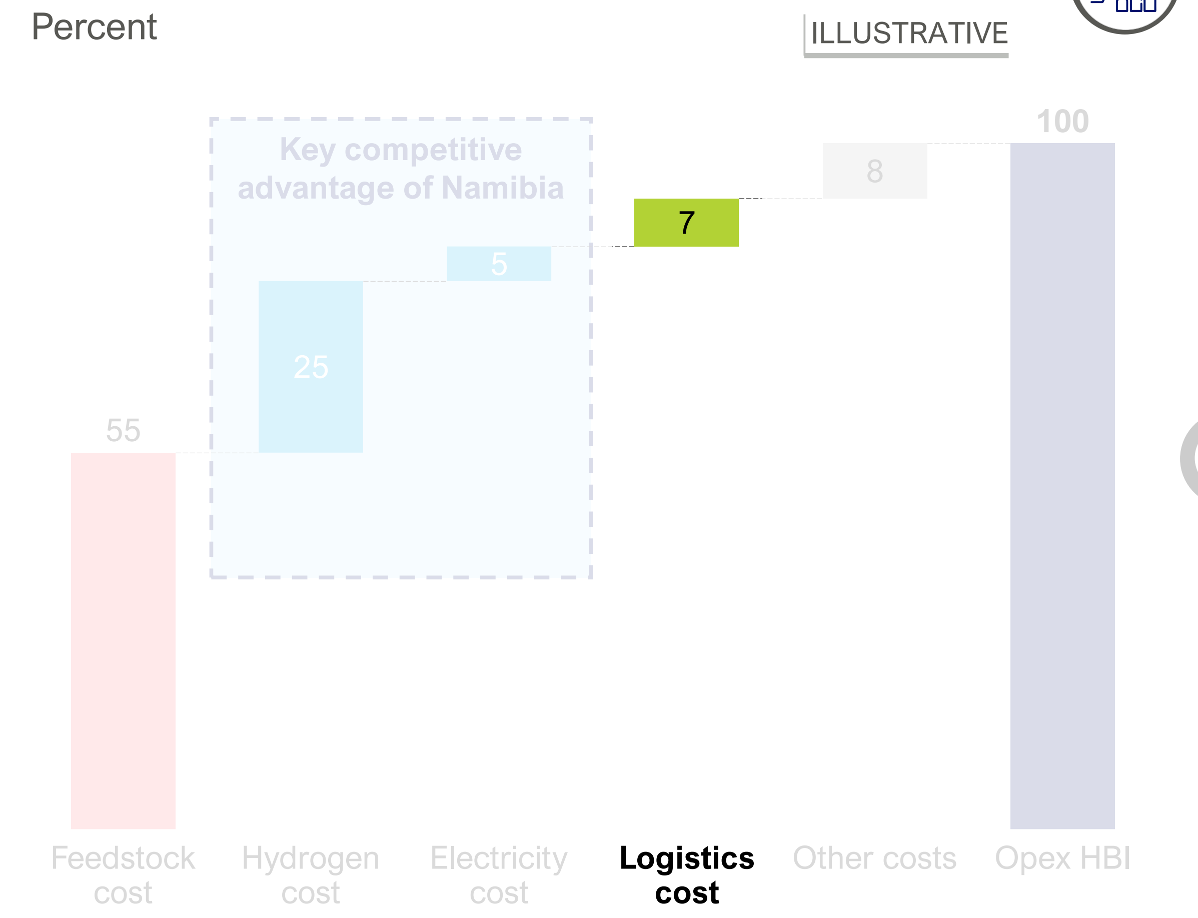
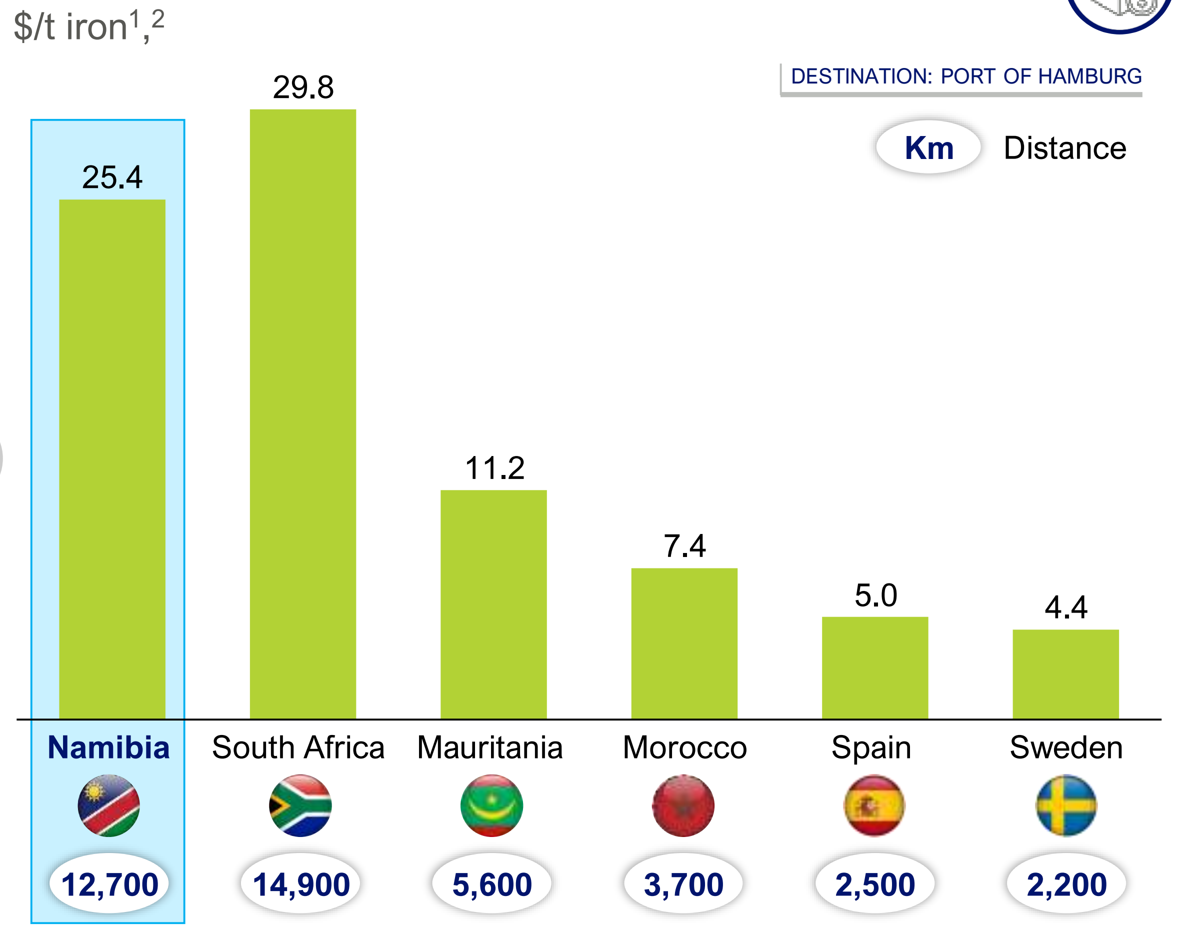


Shipping cost to Port of Hamburg



Note: 1. Shipping cost assumed at ~$0.002/ t / km; 2. No other rail, transshipments or port costs assumed here (see later slide).

Source: Systemiq modelling

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FOUR POTENTIAL VALUE CHAINS TO PRODUCE GREEN HOT BRIQUETTED IRON IN NAMIBIA

NON-EXHAUSTIVE

Green H_2 and green iron/steel opportunity in Namibia

Logistics and export hubs

- Sea port
- Shipping
- Road/railway

Key assets

- Iron ore mines
- Iron ore basins
- Iron/steel plants
- Renewables potential areas

Note: Lodestone Namibia is the parent company currently exploring the Dordabis project.
Sources: Systemiq analysis; World Bank

Comparative analysis of iron ore import routes to Namibia

	Route	PROS	CONS
A	Namibia iron ore to Namibia	Lower transportation costs due to proximity	Restricted iron ore supply may not meet feedstock demand for DRI plant
B	South African iron ore to Namibia	Superior ore quality suitable for Direct Reduced Iron (DRI) processes; Potential strategic partnership with South African suppliers; no shortage of supply	Higher importation complexity and infrastructure investments required for new railway lines
C	Gabon iron ore to Namibia	Greater ore availability compared to domestic sources	Infrastructure development necessary for rail or maritime transport
D	Guinea iron ore to Namibia	Exceptional ore quality with extensive reserves at Simandou mine	Increased distance inflates transportation costs and overall expenses

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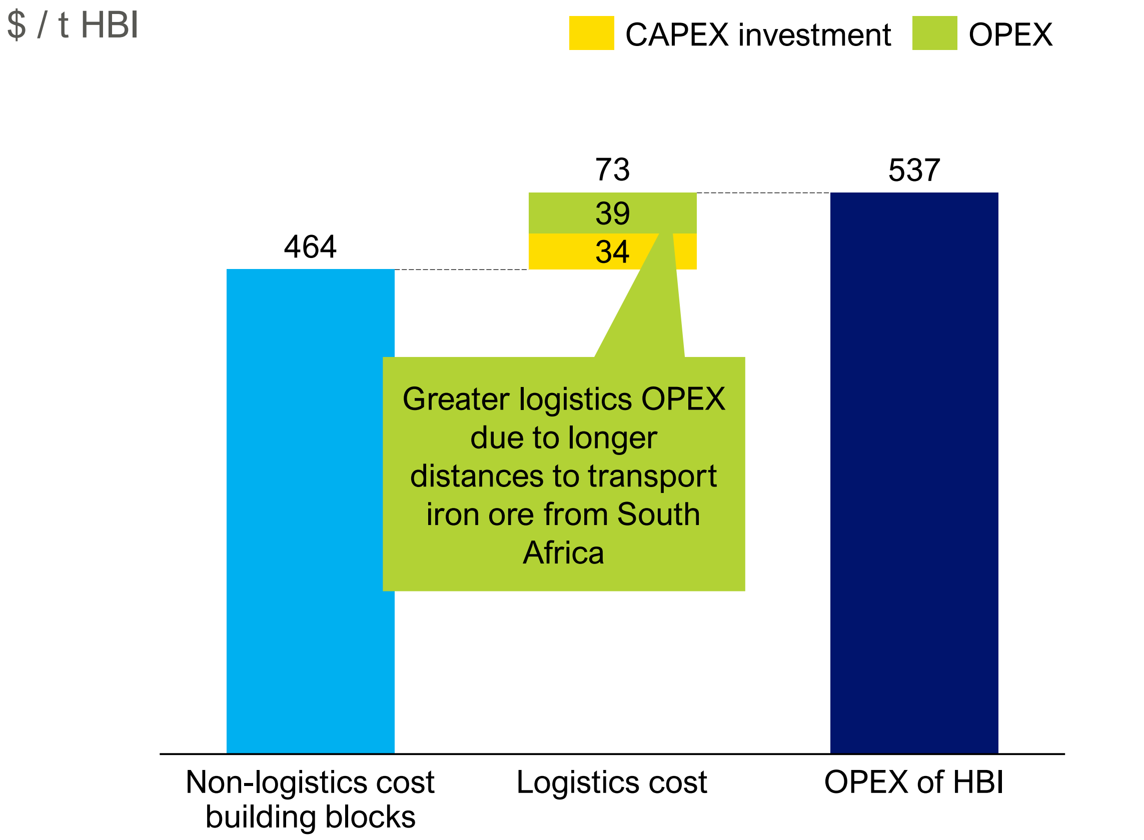
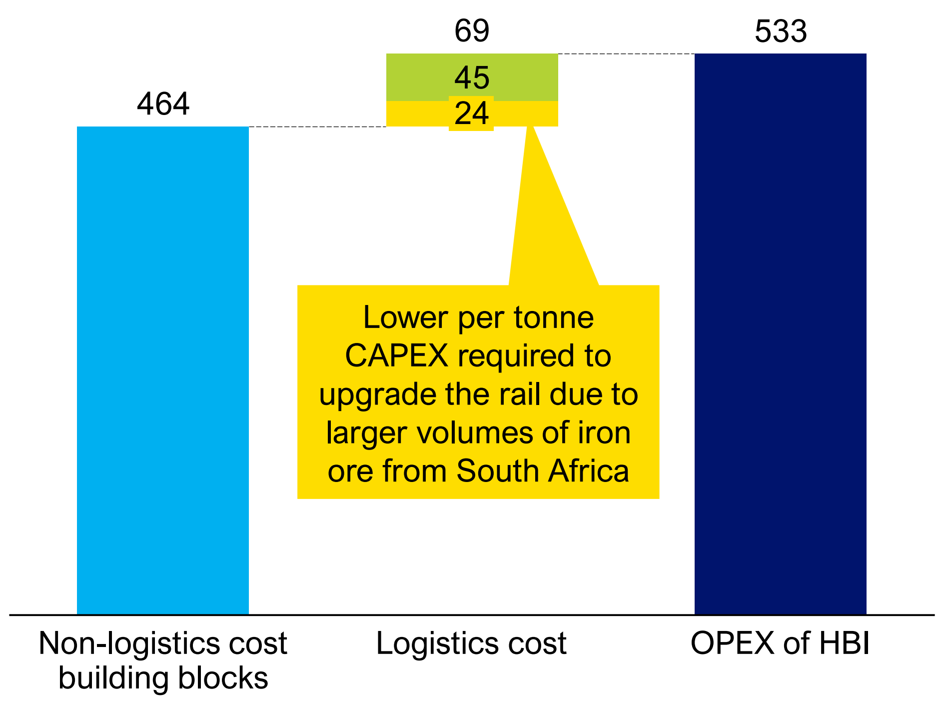
HIGHER CAPEX REQUIRED TO UPGRADE RAIL INFRA FOR IMPORTING SOUTH AFRICAN IRON ORE IS OFFSET BY HIGHER UTILIZATION POTENTIAL

ILLUSTRATIVE

Value chain A:
HBI production in Namibia using **Namibian iron ore**



Value chain B:
HBI production in Namibia using **imported South African iron ore**



Note: Analysis includes rail transport costs for Dordabis-Lüderitz/Sishen-Lüderitz (700km/1,000km) and Lüderitz-Hamburg shipping (12,700km). Investment for rail upgrades based on a CAPEX of $1.3M/km, diesel locomotives, and $65,000 per rolling stock, excluding carbon costs. Total iron ore transpored is 2.5 Mtpa for the Namibian option and 5 Mtpa for the South African option. Assumes an LCOH of $2.4/kgH2; $0.02/km for rail and $0.002/km for shipping. Carbon cost has not been included in other costs.
Source: Systemiq analysis

THE EU CBAM WILL RESHAPE SUPPLY AND DEMAND FOR MANY INDUSTRIES, IRON BEING ONE OF THE FIRST TO BE AFFECTED

The **EU CBAM seeks to address the risk of carbon leakage** by ensuring **equivalent carbon pricing for imports and domestic products.** Meanwhile, the mechanism also **encourages producers from third countries to use technologies that generate fewer emissions.**

When would one pay?

October 2023
Transitional periods
Importers only have reporting obligations, without financial obligations

January 2026
Payments start
Importers start to face financial obligations, which will ramp up progressively

By 2030
Extension
EU aims to extend the CBAM to all sectors covered by the bloc's Emissions Trading System

2034
Full implementation
The CBAM will reach full effect by 2034 in the initial sectors

Initial sectors covered

- Electricity
- Hydrogen
- Cement
- Fertilizers
- Aluminium
- Iron & Steel

Sectors to be covered by 2030

- Oil refining
- Upstream (fuel combustion)
- All metals
- Pulp & paper
- Glass & ceramics
- Acids & organic chemicals
- Aviation
- Maritime
- Lime

The initial scope is mostly limited to embedded emissions in basic materials and key intermediates. The EU will assess whether to include indirect emissions and to cover additional projects.

How does it work?

The proposed mechanism is relatively straightforward:

1. **Assessment:** Determine the carbon content of imported goods.

2. **Comparison:** Compare the carbon price paid by EU producers with that paid by the producer of the imported good.

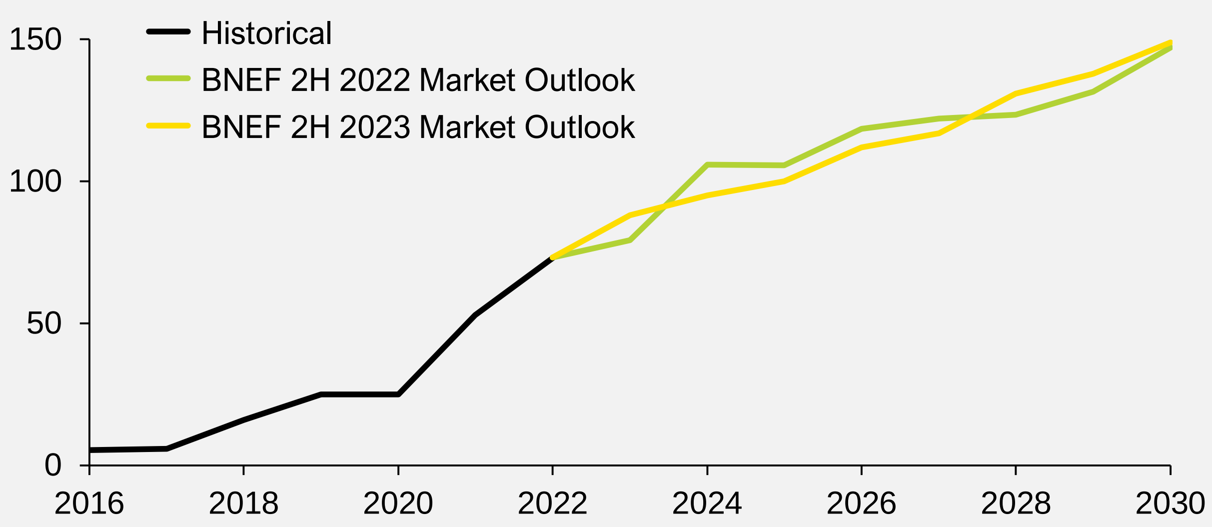
3. **Adjustment:** If the imported product has not incurred a carbon cost equivalent to the EU's Emissions Trading System price, a CBAM will be levied to make up the difference.

Source: Wood Mackenzie (2023), *How the CBAM will change the world.*

EU CBAM PROGRESSIVELY COMING INTO PLAY: CARBON PRICE PROJECTED TO REACH ~150 EUROS PER TONNE CO2 BY 2030

Historical and forecast price of EU emission allowances

EUR/metric ton CO_2, nominal



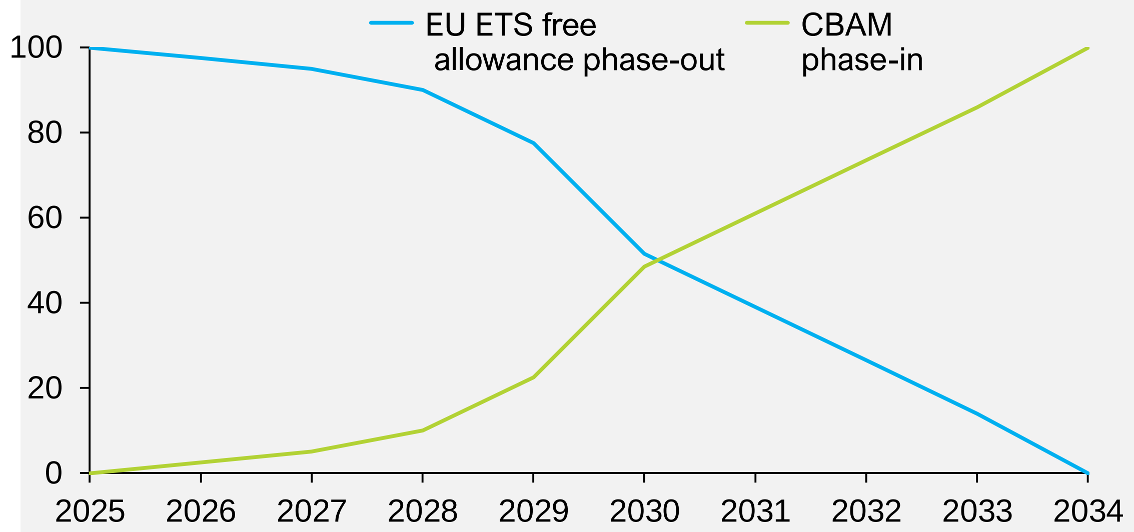
ETS Price according to BNEF: €88/t (2023) → €95/t (2024) → €149/t by 2030

ETS Free allocations: phasing out from 2026-2034

- Full carbon price only felt in 2034 but in 2030 with ~50% free allocation an effective price of ~€80/t would influence investment

EU ETS free allowances phase-out and CBAM phase-in

% of EU ETS price



CBAM transitional period: Oct 2023-Jan 2026 (reporting) with full CBAM taking effect from Jan 2026

- Initially covers **several specific products** at risk of "carbon leakage": **iron and steel, cement, fertilizers, aluminium, electricity and H_2**

Source: BNEF (2023), 2H 2023 EU ETS Market Outlook; S&P Global Commodity Insights (2023), Developing economies hit hardest by EU's carbon border tax; European Commission

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UNLOCKING NAMIBIA'S STEEL POTENTIAL: KEY STEPS FOR A SUCCESSFUL DIRECT REDUCED IRON PLANT

Critical success factors for a DRI plant in Namibia

Secure High-Quality Iron Ore Reserves

Minimum 3 Mtpa of DRI-grade iron ore (e.g., Fe% > 65%)

Establish Robust Green Energy Supply

~2 GW of green electricity (IPP + baseload) to produce green power and green hydrogen

Modernize Rail Infrastructure

Rail capable of moving 10,000 tonnes of iron ore per day

Streamline Governmental Processes

Consolidated planning & permitting + green iron certification with proactive government support

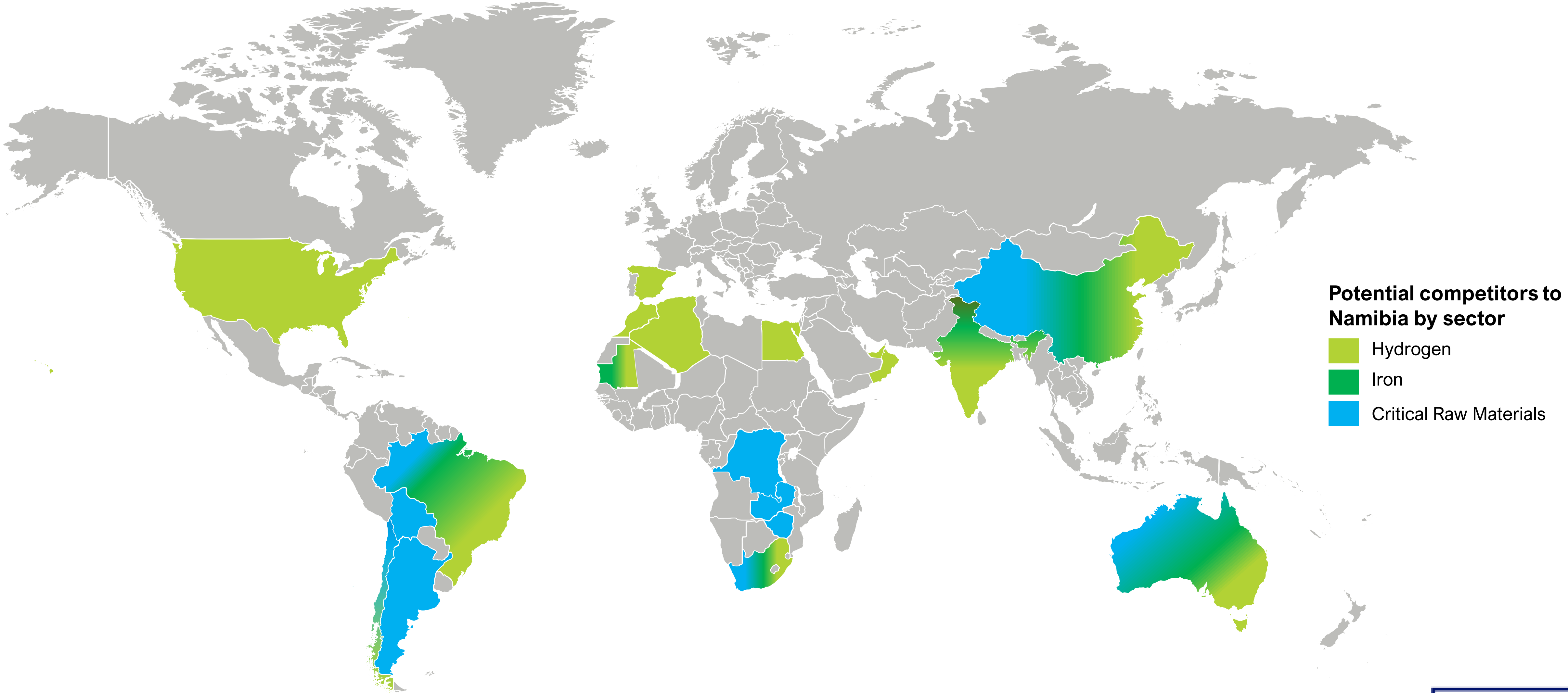
Secure an Offtaker

Engage downstream stakeholders; streamline processes with carbon certificates

DRI – Direct Reduced Iron; IPP – independent power producer

NAMIBIA'S GREEN INDUSTRIALIZATION COMPETITION EXPANDS GLOBALLY BEYOND ITS TRADITIONAL BENCHMARKS IN THE SADC REGION, OFFERING POLICY INSIGHTS WORLDWIDE

NON-EXHAUSTIVE



SADC – Southern African Development Community
Source: Systemiq analysis

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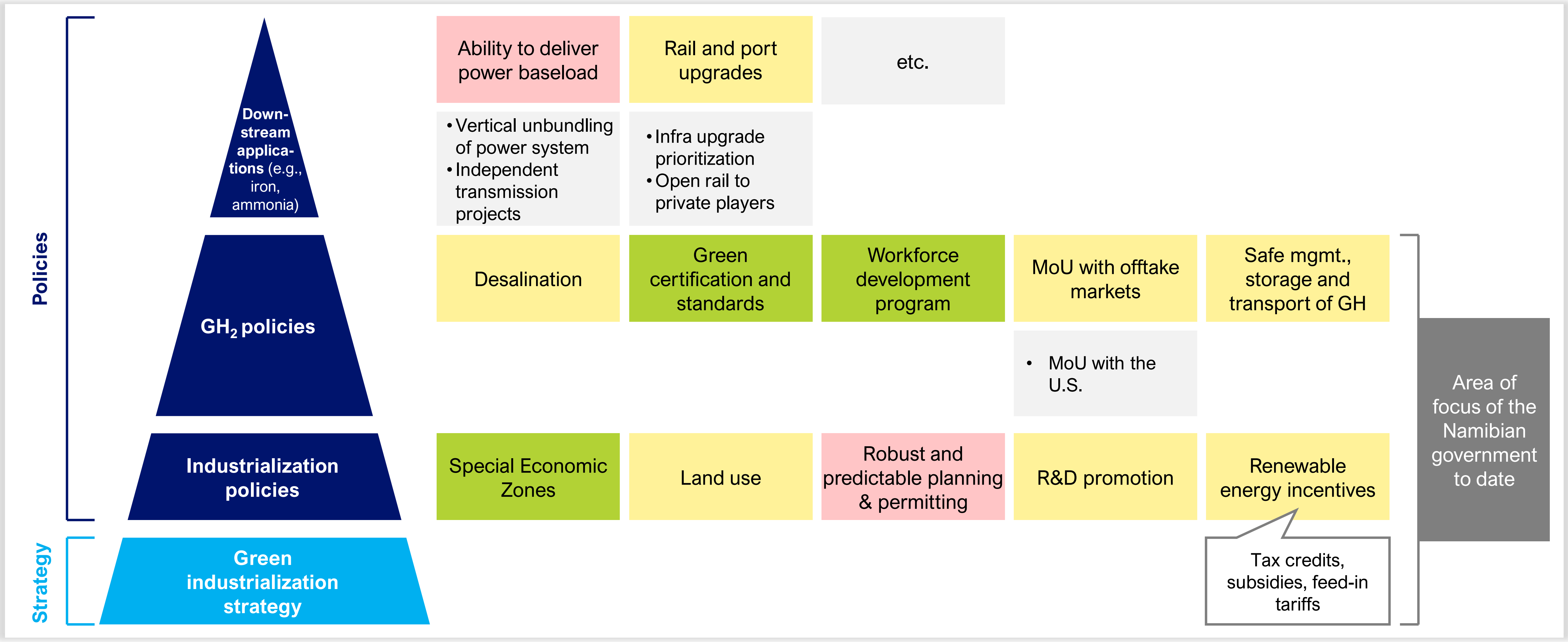
GREEN IRON WILL RELY ON ONGOING POLICY PUSHES FOR GREEN INDUSTRIALIZATION AND HYDROGEN, WITH NECESSARY ADDITIONS

Getting attention | Getting attention but could use more | Needs more scoping | Suggestions

Non-exhaustive list



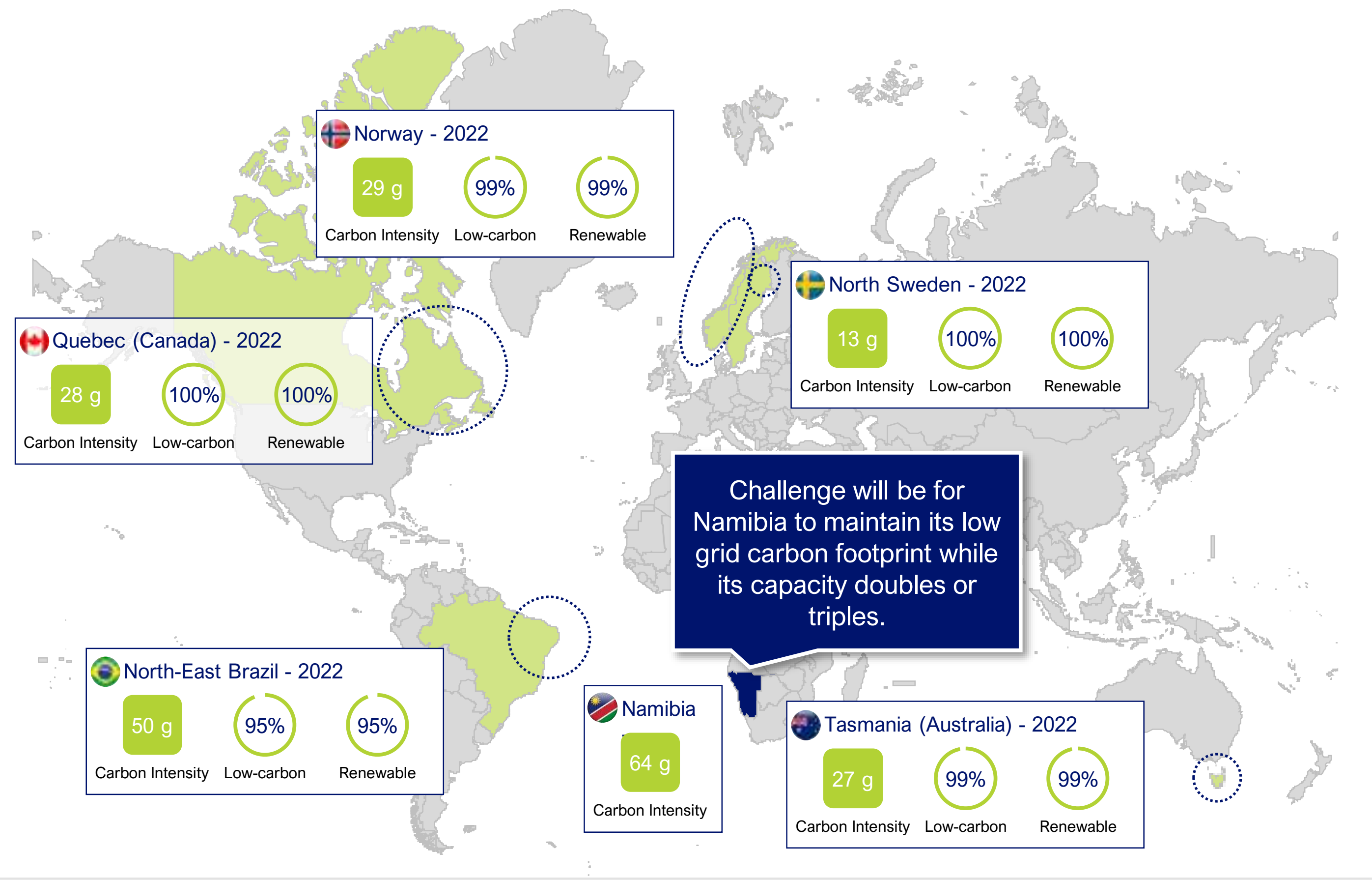
Source. Systemiq analysis from MME (2023), *Green Hydrogen Regulatory Inception Workshop Report*

3 HIGH BASELOAD GRID CARBON INTENSITY CAN BE A DEALBREAKER FOR GREEN INDUSTRIES AND THEREFORE MUST BE KEPT LOW

A

H2green steel — Kajsa Ryttberg-Wallgren, Head of Growth and Green Hydrogen Business: **"No green power, no project"**

Comparative grid carbon intensity: Namibia vs. other suitable regions for green direct reduced iron plants



Strategic green energy solutions for Namibia's DRI production

Renewables coupled with batteries

Proposal: Utilize Southern regions for low-cost solar and wind.

Challenges:
- Need to integrate with scalable battery systems
- Renewables will need to be oversized
- Battery CAPEX may break the business case economics

Renewables coupled with round-the-clock hydro purchase

Proposal: Harness hydro resources from neighbouring countries like Angola and Zambia.

Challenges:
- Good relations with neighbouring countries to be continually fostered
- PPA agreement required
- Boost in cross-border transmission line capacity required

Source: Renew Economy (2024), *""No green power, no project:" Can Australia compete on green steel?"*; Systemiq analysis from Electricity Maps (2022), GET.Transform (2024), *Namibia Country Window: Energy System Transformation Outlook (ESTO)*

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