Potential for Transport and Use of Mid West Hot Briquetted Iron

Mid West Western Australia – Geraldton Export Context

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Executive Summary

Direct Reduced Iron (DRI) and Hot Briquetted Iron (HBI) are increasingly central to global steel decarbonisation strategies, offering significant reductions in greenhouse gas emissions relative to traditional blast furnace–basic oxygen furnace (BF–BOF) routes. When paired with low-emissions reductants and renewable electricity, these pathways can materially lower emissions intensity toward net-zero steel production.

The **Mid West region of Western Australia** presents a compelling opportunity to produce and export **merchant DRI-derived products**, leveraging:

- substantial **magnetite resources**,
- rapidly expanding **solar and wind energy**, and
- established bulk export infrastructure at the **Port of Geraldton**.

Historically, seaborne DRI trade has been limited by safety, handling, and product stability considerations, leading to a narrow focus on premium DR-grade pellet chemistry. This study demonstrates that such constraints are **no longer absolute**. Modern product classification under the **International Maritime Solid Bulk Cargoes (IMSBC) Code**, combined with engineered briquetting and handling systems, enables **lower-grade magnetite ores to be converted into shippable, merchant-grade iron units**.

Ore mineralogy and chemistry primarily influence the **value-in-use (VIU)** and **pricing tier** of HBI rather than its fundamental shippability. By managing metallisation, carbon content, density, and fines generation, Mid West producers can supply a **portfolio of metallic products**, including:

- **Premium HBI**
- **Utility HBI**
- **Niche HBI / metallised fines (DRI(D))**
- **High-Purity Pig Iron (HPPI)**

China and broader Asian markets offer multiple demand pathways for these products across BF, BOF and EAF steelmaking routes. Importantly, emerging **green steel certification and carbon pricing mechanisms** may allow low-emissions HBI and pig iron to capture premiums that **outweigh conventional quality discounts**, improving project economics.

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1. Overview and Mid West Context

Direct reduction produces metallic iron without melting, using reducing gases (CO and/or H_2) at 800–1,050 °C. The resulting DRI is highly reactive and difficult to transport safely in bulk. **Hot briquetting** overcomes these limitations by densifying the product while hot, significantly reducing surface area, reactivity, and self-heating risk.

For Mid West Western Australia, integrating **beneficiation, direct reduction, and briquetting** with **renewable electricity** provides a credible pathway to low-carbon iron production. Export through **Geraldton** offers competitive shipping distances to Asia and compatibility with established bulk material handling systems.

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2. Effect of Ore Type and Process on HBI Properties

Ore Mineralogy

- **Magnetite (Fe_3O_4):** Higher oxygen content; typically higher residual FeO after reduction; capable of producing **high-density HBI** with sufficient carbon.
- **Hematite (Fe_2O_3):** Easier metallisation but often lower inherent briquette strength.
- **Goethite (FeOOH):** Higher porosity and fines risk if not tightly controlled.

Gangue Chemistry (SiO_2 + Al_2O_3)

Gangue is unreduced during DRI processing and becomes concentrated in HBI, affecting both metallurgical performance and physical integrity.

Indicative classification:

- **<3% gangue:** Premium HBI
- **3–5% gangue:** Utility HBI
- **>5% gangue:** Blending or niche placement required

High alumina promotes low-melting silicate phases that reduce briquette bonding strength and increase fines, raising handling and shipping risks.

Metallisation and Carbon

Metallisation is the principal stability control:

- **>92% FeMET:** Highly stable
- **88–92% FeMET:** Acceptable with adequate carbon
- **<88% FeMET:** Elevated oxidation and self-heating risk

Carbon improves melting performance and reduces metallisation loss during transport, but excessive Fe_3C formation lowers apparent density and briquette strength. Optimal carbon control is therefore critical for **utility-grade HBI**.

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3. Storage, Handling and Shipping

The assumption that only premium DR pellet chemistry can yield a shippable product is **no longer valid**.

Under the **IMSBC Code**:

- **Dense HBI (DRI(A))** can be shipped as a conventional bulk cargo.
- **Lower-strength HBI, fines and chips (DRI(D))** can be shipped safely with defined controls (ageing, moisture limits, temperature and gas monitoring).

With appropriate engineering and AMSA engagement, **Mid West-derived utility HBI** can be certified for safe export via Geraldton, even for hydrogen-based reduction pathways and higher-gangue ores.

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4. Market Positioning and Pricing

The realistic market value of HBI is determined by **customer selection, usage rate, and logistics**, not simply chemical specifications.

Indicative CFR Asia price structure:

Material	Indicative China Price
Steel Scrap (HMS delivered)	~US$330–340/t
Pig Iron (Fe ~92%)	~US$340–420/t
High-Purity Pig Iron (HPPI)	~US$420–520/t
Premium HBI	~US$380–480/t

Material	Indicative China Price
Utility HBI	−US$20 to −US$50/t vs Premium
HBI Fines / DRI(D)	−US$50 to −US$90/t vs Premium

For many BF and blended-EAF applications, **utility HBI delivers comparable VIU** to premium HBI when priced appropriately. Certification as **low-emissions or "green" iron** may enable price premiums that more than compensate for conventional quality discounts.

Conclusions

1. **Lower-grade magnetite ores from the Mid West can produce shippable, merchant-grade HBI** when the product form and handling protocols are engineered to match IMSBC classifications.
2. Ore chemistry primarily affects **pricing tier and value-in-use**, not technical feasibility.
3. **Utility HBI** represents a credible new product class, widening market access beyond limited premium pellet feed supply.
4. **Geraldton** provides a viable export hub for HBI, niche metallics and pig iron products into Asian markets.
5. Integration of **renewable solar and wind energy** materially improves emissions intensity and supports future green certification.
6. A **portfolio strategy**—Premium HBI, Utility HBI, Niche HBI/DRI(D), and HPPI—offers resilience against steelmaking cycles, pellet shortages, and pricing volatility.
7. Green premiums, carbon pricing mechanisms and supply constraints for high-grade pellet feed suggest **strong medium-term demand** for Mid West-produced low-emissions iron units.

Overall, the Mid West of Western Australia is well positioned to support a new generation of low-emissions iron production and export, providing pragmatic pathways to decarbonisation without reliance on scarce premium ores.