Pathways to Low-carbon Iron & Steelmaking Open Forum 2026

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Breakthrough Technology Conference 2025

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2025 Highlights

The 2nd iteration of Conference

- Continued the debate of accelerating decarbonisation of steelmaking, emphasising **deployable solutions capable of significant CO_2 reductions**
- The event expanded discussions to cover energy systems, breakthrough process technologies, feedstock innovation, and regional implementation dynamics.

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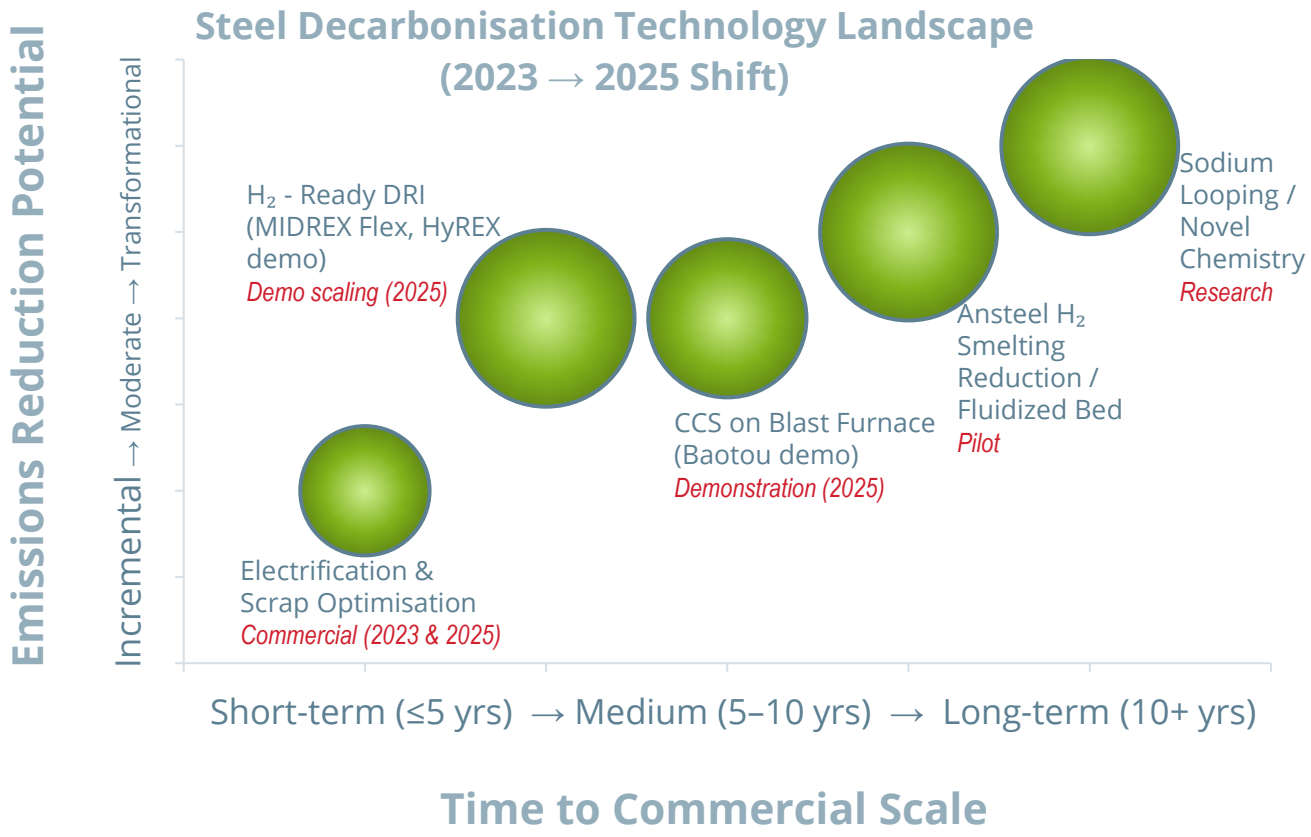
Portfolio Overview

Portfolio Maturity Map



Observations

- 2023 = Technology validation
- 2025 = Scaling pathways emerging
- 2030 constraint = Energy + infrastructure, **NOT TECHNOLOGY**

Legend:

Incremental retrofit

↓

Structural plant redesign

Quantified Emissions

Relative Abatement Potential by Pathway

Pathway	Residual Emissions (tCO_2/t CS)	% Reduction vs BF	Capital Intensity	Strategic Role
BF Optimisation (efficiency, electrification of auxiliaries)	1.6–1.9	5–15%	Low	Incremental improvement
BF Fuel Switching (biomass, NG injection)	1.4–1.8	10–25%	Low–Medium	Existing assets + bolt-on
BF + Hydrogen Injection (partial substitution)	1.2–1.6	20–35%	Medium	Existing assets + bolt-on
BF + Top Gas Recycling (no CCS)	1.2–1.5	25–35%	Medium–High	Efficiency-focused
BF + CCS (60% capture)	0.8–1.0	50–60%	High	Regional fit
BF + CCS (90% capture)	0.2–0.5	75–90%	Very High	Deep decarbonisation
Scrap-based EAF (current grid)	0.6–1.0	40–70%	Medium	Fast deployment
Scrap EAF (renewable grid)	0.1–0.3	85–95%	Medium	Near-zero pathway
Hydrogen DRI + EAF (green H_2)	0.1–0.4	80–95%	Very High	Structural transition
Novel Smelting	<0.2	>90%	Very High	Infancy, Long-horizon

Baseline: Traditional BF-BOF = ~1.8–2.2 tCO_2 per tonne steel

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Capital Requirement (Order-of-Magnitude)

Technology	Capex Range (USD / annual tonne capacity)	Relative Capital Burden	Retrofit or New Build?
BF Efficiency / Electrification	20 – 80	Low	Retrofit
Biomass / Fuel Injection	50 – 150	Low–Medium	Retrofit
Hydrogen Injection in BF	100 – 250	Medium	Retrofit
Top Gas Recycling	150 – 300	Medium–High	Retrofit
BF + CCS	250 – 600	High	Retrofit + infrastructure
New EAF Plant	300 – 700	Medium–High	New build
Hydrogen-Ready DRI + EAF	800 – 1,400	Very High	New build
Hydrogen Smelting (novel)	> 1,200	Very High	New build

Capital Efficiency

Lowest cost per % abatement:

- BF optimisation
- Scrap/EAF expansion *(if grid decarbonises)*

Highest absolute decarbonisation:

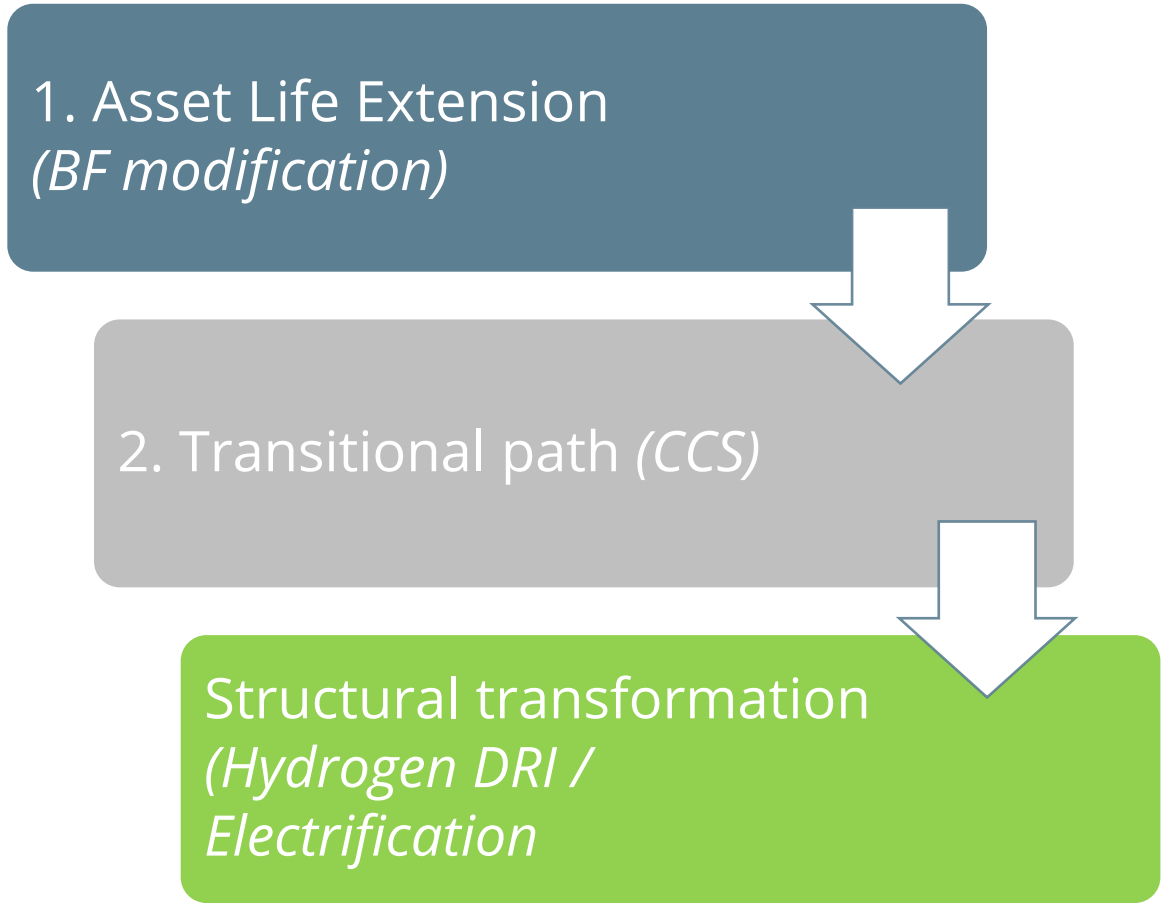
- Hydrogen DRI
- CCS (if capture >80%)

Capital intensity is the main constraint between 2030–2040.

Key Takeaway

By incorporating blast furnace modification pathways:

- There seem to be **3 layers of decarbonisation strategy**



Conference summary

The conferences show a trend:

- 2023: Technology validation
- 2025: Scaling pilots
- 2030–2040: Transformation governed by energy economics

The emissions calculus:

- Electrification can reduce emissions faster
- Hydrogen removes them most
- CCS depends largely on geography

Scrap has high utilisation but availability / supply constrained

Regional Decarbonisation Workshop 2025

Steel Sector Climate Strategies by Region

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Workshop Overview

Region	Covered by
1. Japan	Nippon Steel / JISF
2. China	CISA
3. ASEAN	SEAISI
4. North America	ArcelorMittal
5. Europe	ESTEP
6. Latin America	Alacero
7. India	Indian Steel Association

Focus Areas Across All Presentations

- Net-zero ambitions
- Milestones
- Technology pathways
- Policy dependencies
- Investment & infrastructure barriers

Cross-Regional Comparison

2050 Net-Zero Alignment

- Strong: Europe, Japan, North America
- Conditional/Longer horizon: China (2060), India (2070)
- Emerging frameworks: ASEAN, Latin America

Technology Convergence

- All regions reference:
  - Hydrogen (long-term core solution)
  - EAF expansion
  - CCS for residual emissions

Key Differences

Region	Speed	Policy Strength	Hydrogen Readiness
Europe	Fast	Very strong	Early commercial
Japan	Moderate	Strong	Pilot phase
North America	Moderate	Incentive-driven	Scaling
China	Gradual	Central planning	Pilot scale
India	Gradual	Developing	Early stage
ASEAN	Early roadmap	Fragmented	Limited
Latin America	Efficiency-first	Mixed	Long-term

Summary

Common Barriers

- Cost premium of green steel
- Hydrogen availability & price
- CO_2 transport & storage infrastructure
- Scrap availability constraints
- Investment needs during asset transition
- Maintaining global competitiveness

Strategic Takeaways

- 2030 = Pilot & partial deployment phase
- 2035–2045 = Major asset replacement cycle
- Hydrogen could become viable after 2030
- CCS remains essential for BF-heavy regions
- Policy clarity strongly correlates with deployment speed

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