Forging pathways: Insights for the green steel transformation

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Key findings

1. There is **palpable momentum** towards global steel decarbonisation: 50% of the projects key steelmakers have invested in have significant emissions reduction potential.
2. Steel does not have a ‘climate problem’, it has a **coal problem**. Eliminating coal-dependent processes from ironmaking is crucial to steel decarbonisation.
3. Not all processes labelled as ‘green’ have the same decarbonisation potential. 40% of the projects steelmakers have invested in still focus on solutions with limited potential to reduce emissions.
4. Context for iron ore miners: Scope 3 emissions account for more than 95% of their total emissions. Iron ore miners can actively change their processes and technologies to significantly reduce their Scope 3 emissions.

Background

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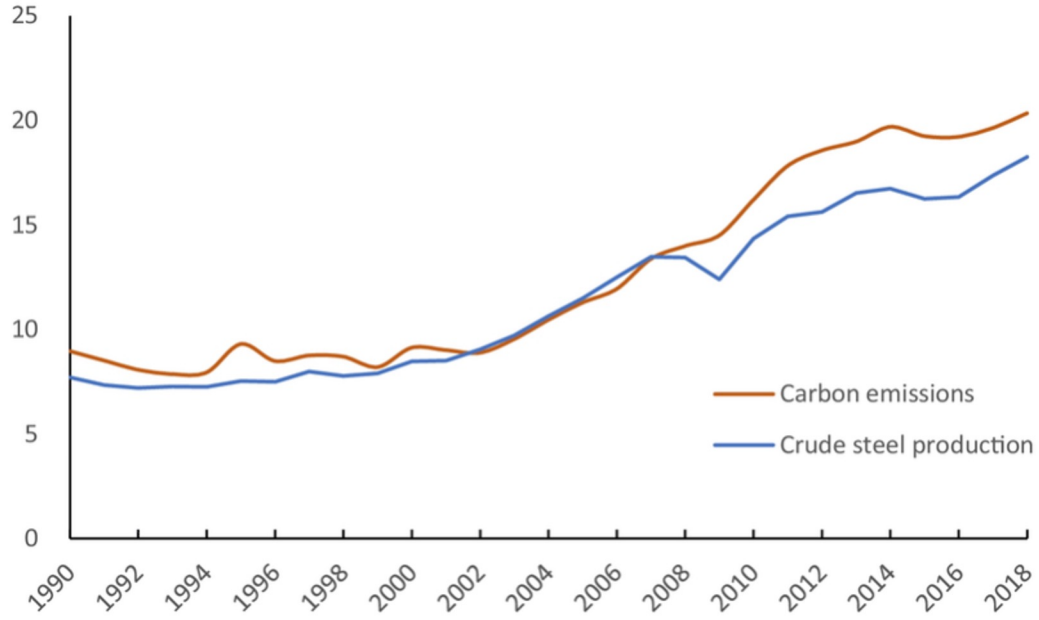
The steelmaking industry is a significant contributor to climate change



- 11% global CO_2 emissions (8% global GHG emissions)
- Peak emissions likely not yet reached
- Rapid pace of decarbonisation required to meet net zero commitments and align with Paris agreement

Source: Shao, Li & Zhang (2022). The impact of financial development on CO2 emissions of global iron and steel industry, *Environmental science and pollution research*, 29 (29).

Steel production: Business as usual

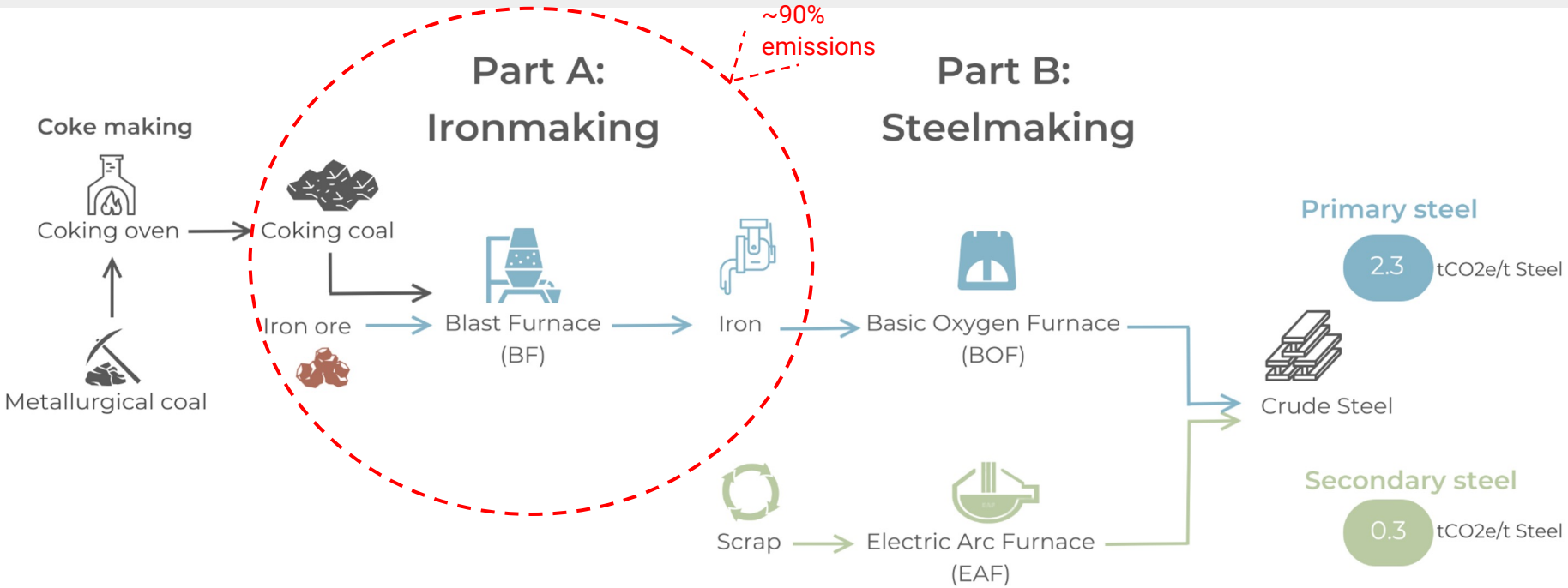


Figure: ACCR; Carbon intensities from World Steel Association, 2022.

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Ironmaking dominates emissions, accounting for 90% of the steel value chain’s total emissions

Chart: Waterfall chart of emissions in steel life cycle

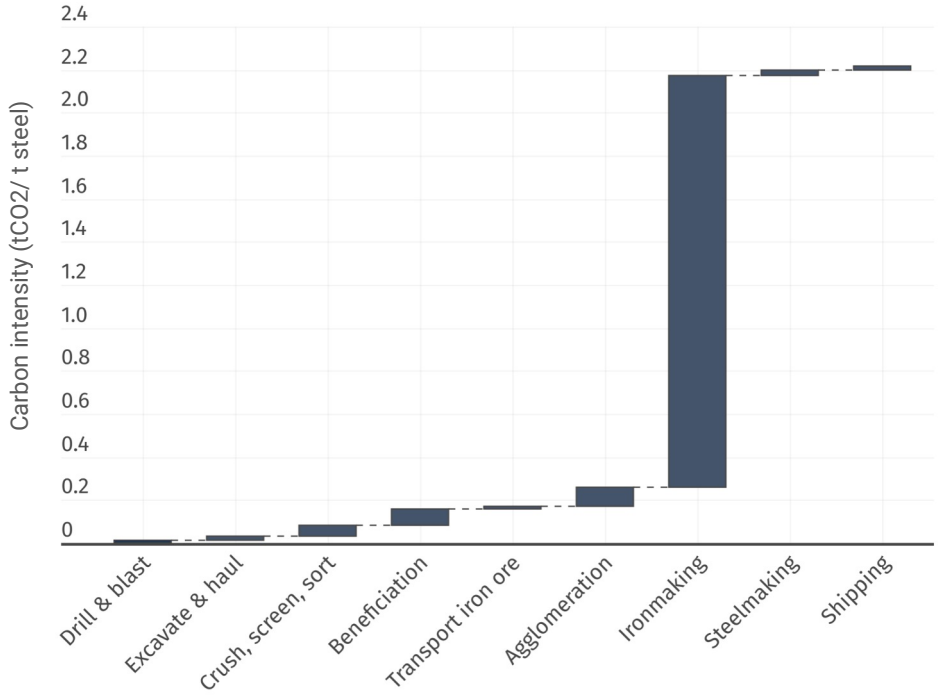

Chart: ACCR, Sources: GHD Analysis, Government of Western Australia

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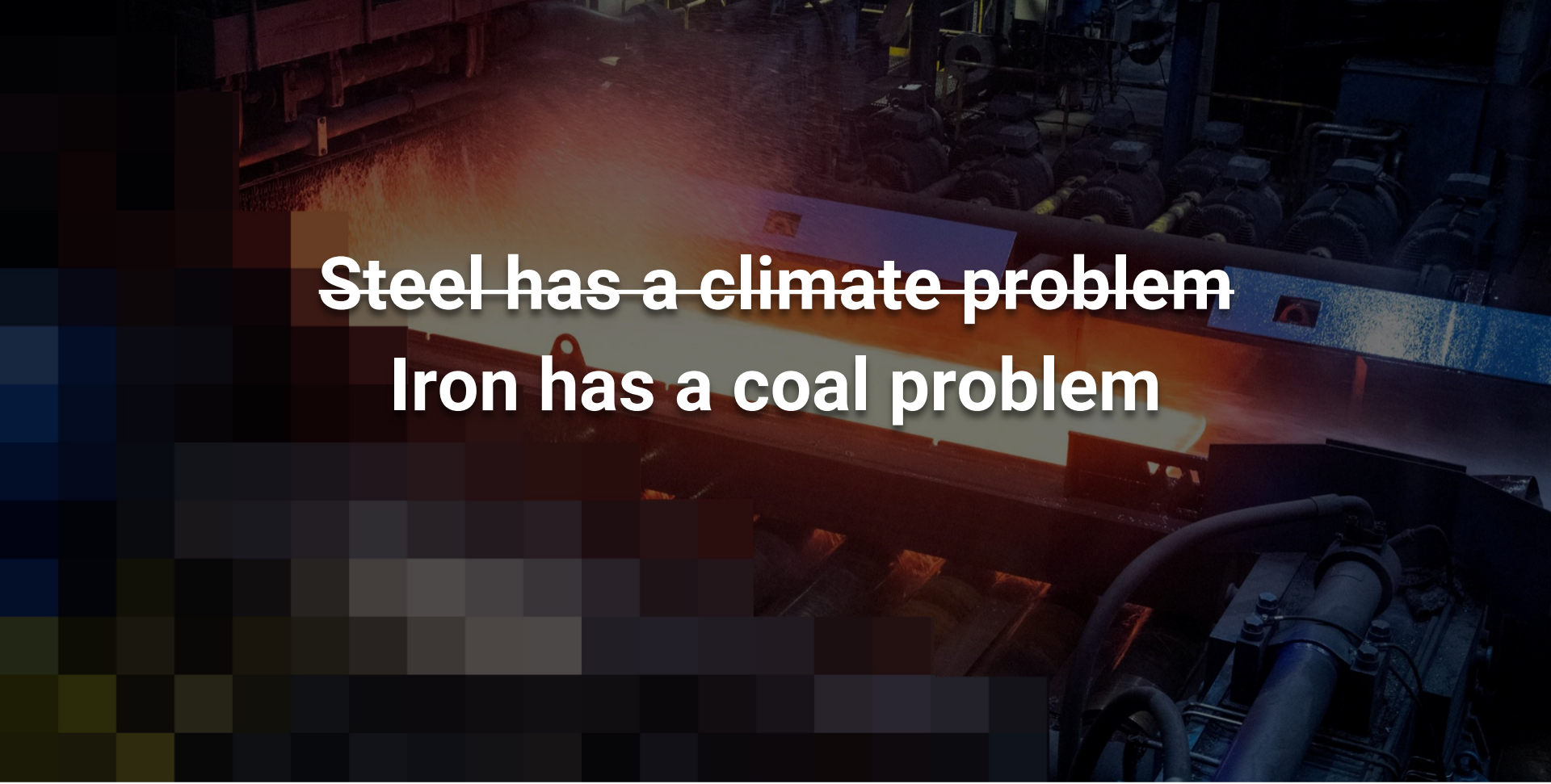

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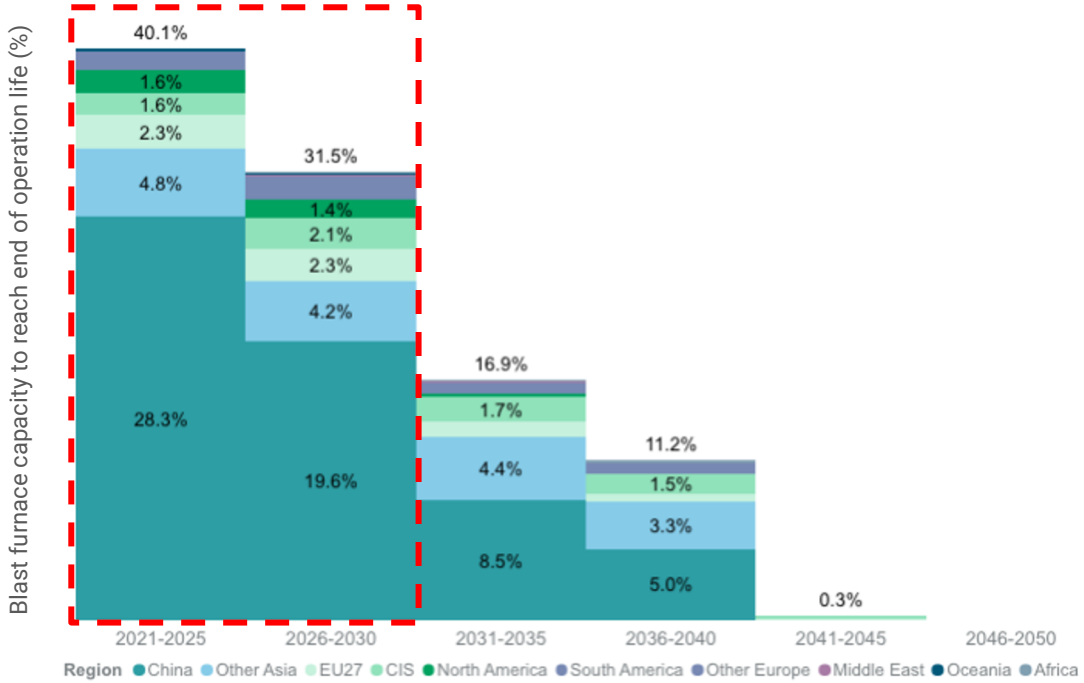
Decisive moment for steel's future: the next six years are crucial
Decisions to reline ageing blast furnaces could lock in high carbon emissions
Capital could pivot the industry towards significant decarbonisation instead



- Between now and 2030, 71% of the world's steelmaking assets will reach the end of their operating lives.
- Relining blast furnaces risks a 20-year lock-in of metallurgical coal use due to their operational lifespans, heightening the risk of stranded assets amid the industry's shift towards decarbonisation.

Quote on previous slide: Valentin Vogl, ARIA;
Chart: Agora Industry, REI (Japan), Next Group (South Korea), Wuppertal Institute and Lund University

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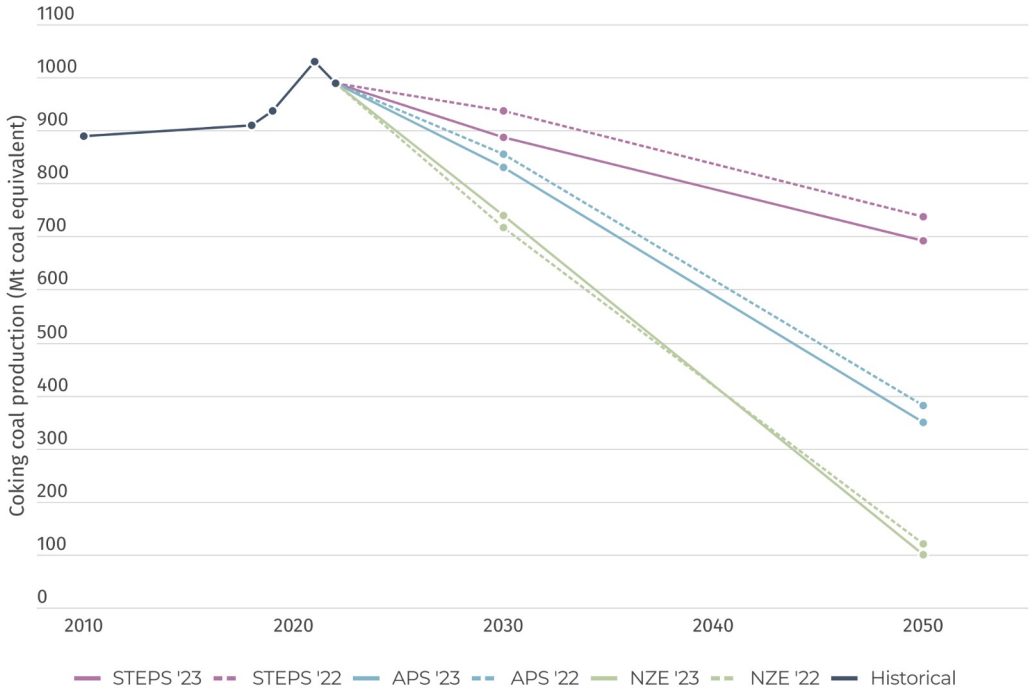
Recent projections from the IEA and Australian government suggest there will be a global downturn in metallurgical coal production and trade, signaling a definitive shift away from coal reliance by 2050



While Australia is the world's largest met coal exporter, **Australian exports are forecast to peak in two years time and then decline through to the end of the decade**.

"...there are **risks to navigate**. Higher electric arc furnace (EAF) and **green steel production may harm the demand for metallurgical coal** from steel mills using blast furnaces."

- Australian Government, March 2024, Resources and Energy Quarterly, p.53.

Sources: IEA World Energy Outlook (WEO) 2022, Australian Government, IEEFA.

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Several green steel solutions have been proposed
There are clear distinctions in the decarbonisation potential of each technology

Category	Description	Technology Examples
Green potential	Steel production methods that have the potential to eliminate the use of fossil fuels entirely	• Renewable-powered EAF • Green hydrogen-based DRI • Electrolysis
Low carbon potential	Processes that significantly reduce emissions but may still utilise fossil fuels or emit carbon to some extent	• Gas-based DRI • Hydrogen injection in BFs • Biomass use
Limited potential	Technology solutions that offer minimal decarbonisation capabilities on their own	• Mass balance • Blast furnace optimisation • CCS/CCUS • Offsetting

Source: ACCR, adapted from Forging Pathways report, 2024

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Findings: Steelmakers

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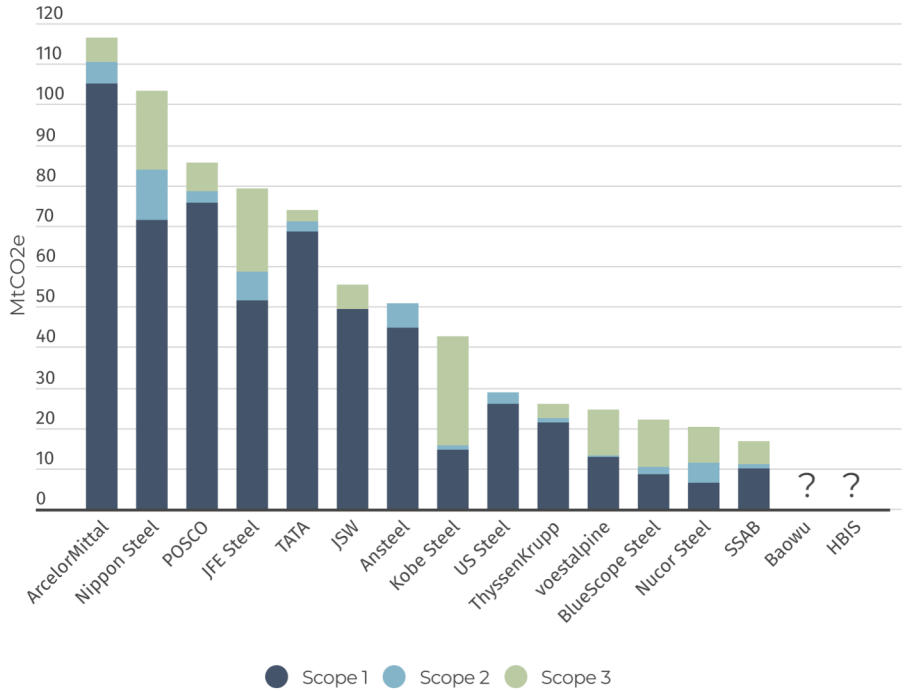
Steelmaker emissions hit 2% of global emissions in 2022, despite disclosure gaps

Chart: Absolute emissions for steelmaking companies by Scope ($MtCO_2e$) were 0.74Gt CO2e. Latest reported emissions were used.



Best practice emissions disclosure

- Includes all Scopes (Scope 1, 2 and 3) absolute emissions
- Breakdown of emissions by steelmaking method
- Comprehensive, including overseas assets and/or joint ventures

Chart: ACCR, Sources: Company data. NB: HBIS and Baowu absolute emissions were not disclosed.

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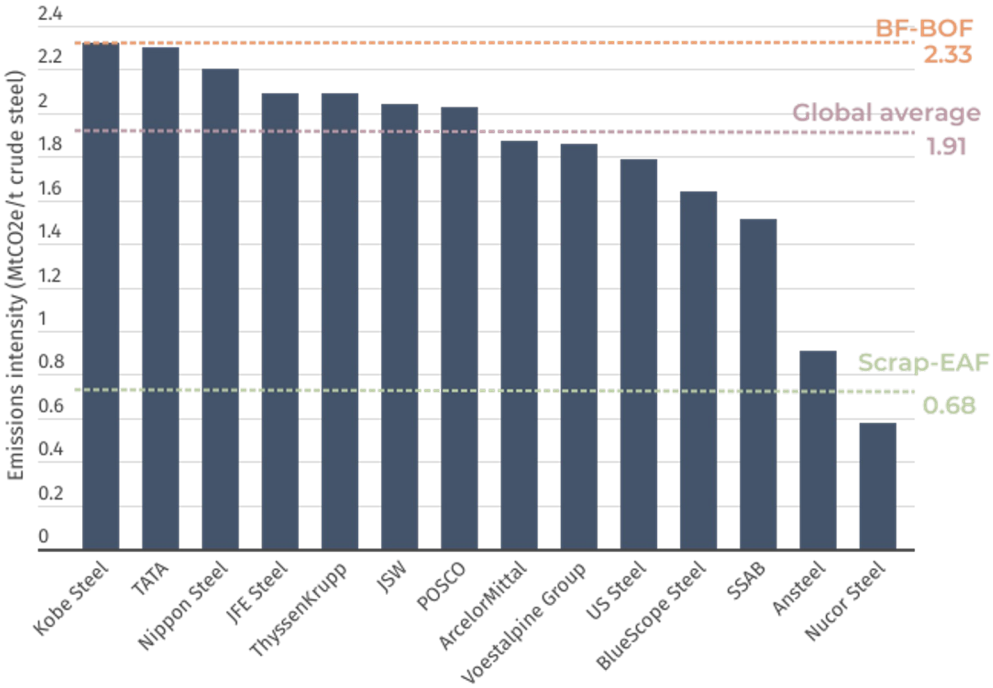
The carbon intensities of half of the surveyed steelmakers are above global averages

Chart: Carbon intensities for steelmaking companies



- Seven of 14 companies disclosed carbon intensities above the global average (1.9t CO2/ t steel)
- The average steelmaking intensity of the companies examined in this report was 1.8 tonnes CO2e/ tonnes steel (or 1.9t CO2e/ t steel when excluding Nucor), which is consistent with global averages.

Chart: ACCR, Sources: Company data, World Steel Association (2022). NB: HBIS and Baowu are excluded as emissions intensities were not disclosed. Horizontal lines indicate 2021 global average emissions intensities (WSA, 2022) for scrap steelmaking (green), BF-BOF steelmaking (orange), and overall (blue).

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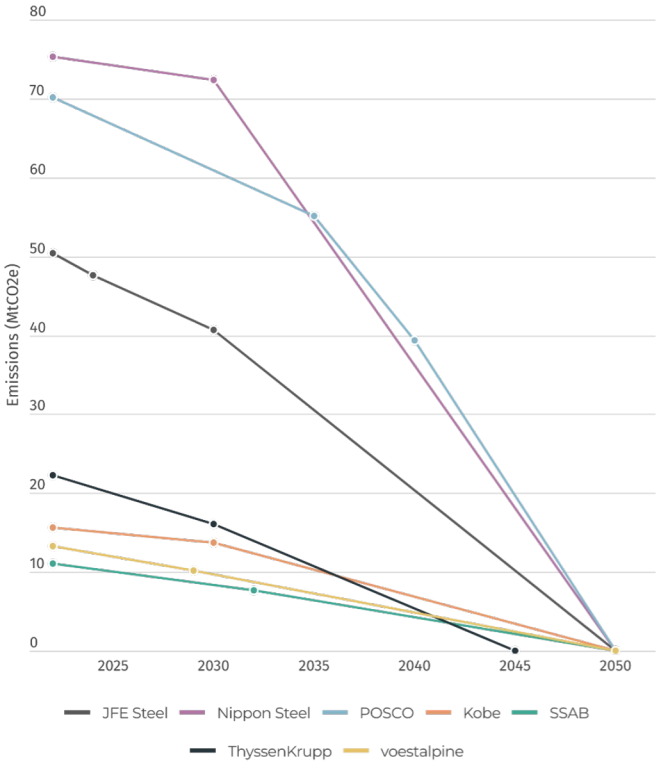
All steelmakers exhibit a pattern of substantial backloaded ambition, with planned steep declines in emissions primarily occurring post-2030

Chart: Comparative analysis of steelmakers' absolute emissions targets from a 2022 baseline



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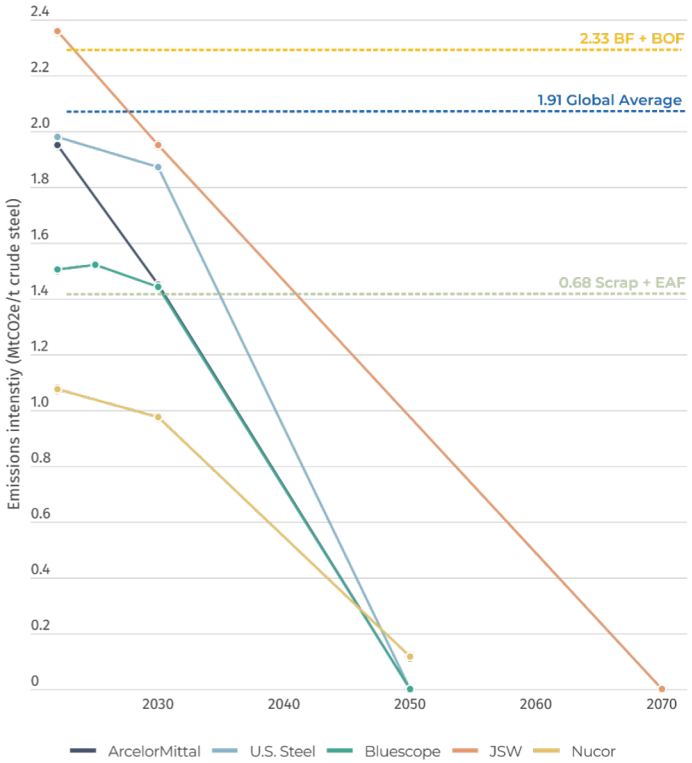

Best practice target setting

- Emission-intensity based
- Split by primary and secondary steelmaking
- Includes overseas assets and/or joint ventures
- Aligned and verified with a rigorous and holistic framework, such as SBTi

Not all of the companies assessed have carbon intensity targets. These charts show targets using the company's chosen metric.

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Table: Overview of steelmakers' climate commitments: Targets, NZE/SBTi alignment and net zero aspirations

Company	Base year	Short-term target (up to 2026)	Medium-term target (2027-2035)	Long-term (2036-2050)	SBTi-aligned	Scope(s) covered by targets	Target type	Scope 3 targets
Ansteel	2025	NA	30% in 2035	Net zero 2060	No	Not disclosed	Peak, absolute	No
ArcelorMittal	2018	NA	25% by 2030	Net zero 2050	No	1 & 2	Intensity	No
BlueScope Steel	2018	7% by 2025	12% by 2030	Net zero 2050	No	1 & 2	Intensity	No
China Baowu	2023	NA	30% by 2035	Net zero 2050	No	Not disclosed	Peak, absolute	No
HBIS	2022	NA	30% by 2030	Net zero 2050	No	Not disclosed	Peak, absolute	No
JFE Steel	2013	18% by 2024	30% by 2030	Net zero 2050	No	1 & 2	Absolute	No
JSW Steel	2005	NA	42% by 2030	NA	No	1 & 2	Intensity	No
Kobe Steel	2013	NA	30-40% by 2030	Net zero 2050	No	1 & 2	Absolute	No
Nippon Steel	2013	NA	30% by 2030	Net zero 2050	No	1 & 2	Absolute	No
Nucor Steel	2015	NA	0.975t CO_2/ t steel	Net zero 2050	No	1, 2 & 3	Intensity	Net zero by 2050
POSCO	2017-19 average	NA	30% by 2035	50% by 2040 Net zero 2050	No	1 & 2	Absolute	No
SSAB	2018	NA	35% by 2032	Net zero 2050	Yes, Scope 3 not included	1 & 2	Absolute	No
TATA Steel	2018	NA	UK: 30% by 2030 EU: 30-40% by 2030 Group-wide: NA	Net zero 2045	No	1, 2 & 3	Absolute	No
ThyssenKrupp Steel	2018	NA	30% by 2030	Net zero 2045	No	1, 2 & 3	Absolute	Net zero by 2045
US Steel	2018	NA	20% by 2030	Net zero 2050	No	1 & 2	Intensity	No
Voestalpine	2019	NA	30% by 2029	Net zero 2050	Yes, medium-term target only	1& 2	Absolute	25% reduction by 2030

Green: Leader - Company target ahead of the NZE pathway/ SBTi aligned

Orange: Neutral - Company target in line with the NZE pathway

Red: Laggard - Company target behind the NZE pathway/ not SBTi aligned

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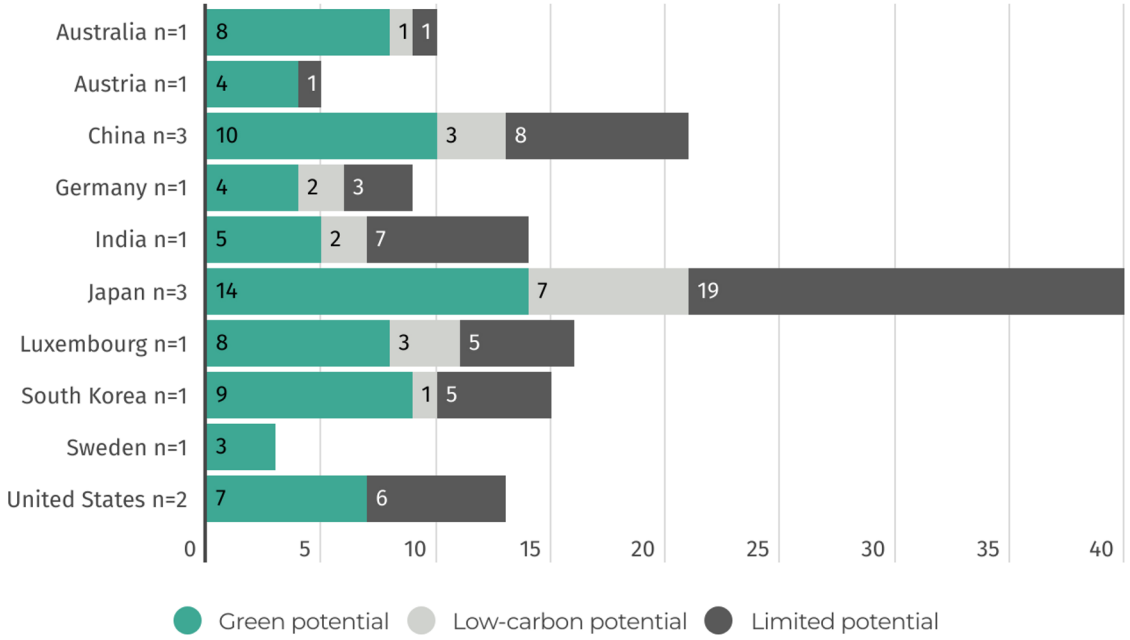
Global investments are propelling the steel industry towards greener horizons, despite mixed approaches and the need for decisive action on green solutions

Chart: Steelmakers decarbonisation projects, by country and green potential



- Global investment trends show a shift towards decarbonisation, with **half of all projects aiming for green potential**, signalling a sector-wide momentum.
- European companies lead in strategic investments in green technologies, supported by early industrialisation benefits, access to renewables, carbon pricing (CBAM), and public subsidies.
- The US and Asian steelmakers show a varied commitment, mixing high- and limited-potential projects.
- More than **a third of the projects pursue technologies with limited emissions reduction** capability, including CCU/CCS.

Chart: ACCR, Sources: Company data

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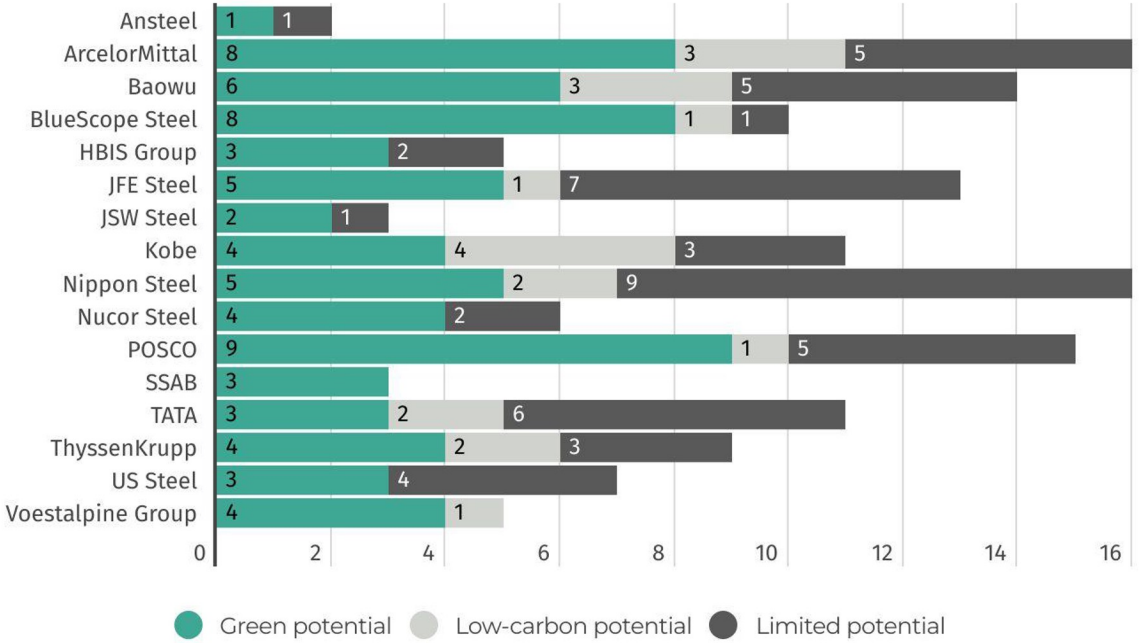
Strategic variations reveal global steelmakers' diverse pathways through the green transition, highlighting leaders, operational challenges, and opportunities for impactful change

Chart: Steelmakers decarbonisation projects, by company and green potential



- **SSAB** and **voestalpine** focus investments on high-impact green steel projects, leading the charge for industry-wide decarbonisation with targeted green strategies.
- **ArcelorMittal** explores a wide range of decarbonisation technologies, presenting a diverse yet unclear path forward, highlighting the need for strategic focus and investment efficiency.
- **BlueScope Steel** invests in green potential while also spending 1 billion AUD on blast furnace relining, illustrating the challenges of marrying green ambitions with existing infrastructure.
- **JFE Steel** and **Nippon Steel's** focus on limited-impact projects mirrors Japan's renewable energy and steel industry hurdles, yet these companies are uniquely positioned to lead change by pushing for policy improvements and green technology collaborations.

Chart: ACCR, Sources: Company data

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Steel sector's embrace of green iron and DRI/HBI signals industry-wide consensus on technology pathway, despite some continued interest in CCS/CCU

- Steel industry investments are diversified across technologies with varying emissions reduction potentials, with 55% of projects focused on ironmaking, the most carbon intensive stage of steelmaking.
- There's a preference for green iron production using green hydrogen and DRI/HBI advances in 28 projects, signalling a shift towards fossil-free methods and the potential industry consensus on DRI-EAF as the future of green steel.
- CCU/CCS technology, despite its challenges and unproven scalability, continues to attract interest with 21 projects exploring its viability.

Best practice

- In instances where CCU/CCS technology is being trialled, **full performance data should be disclosed, including actual vs intended capture rates**, and their proportion relative to total plant emissions

Chart: Steelmakers decarbonisation projects, by technology

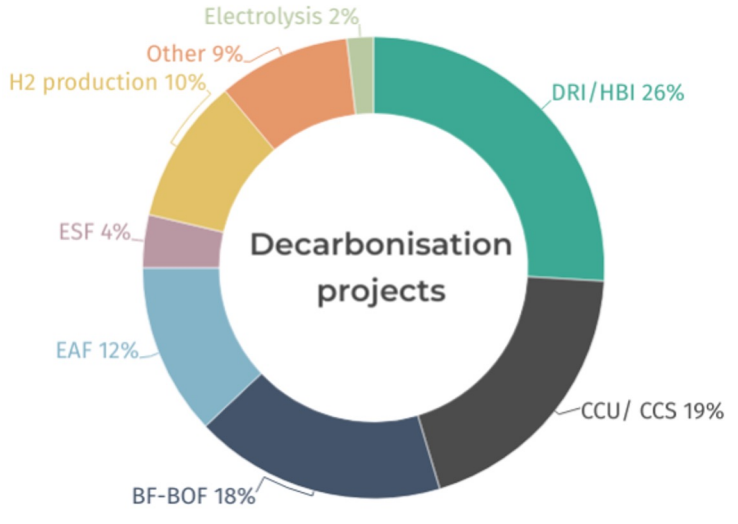

Chart: ACCR, Sources: Company data

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Capital allocation transparency and progress in decarbonisation investments vary across the leading steel producers

- Leading steel producers vary in their decarbonisation commitments, with significant differences in reporting, fund allocation and/or spend, as well as their forward-looking investment timelines.
- ACCR's analysis of the steelmakers' projects assesses each project's objective clarity, green potential, pilot stage progression, and disclosed investment/spend, revealing a transparency gap that complicates evaluation.

Best practice

- Each company should have **clear transition pathway**, which details the **estimated contribution of each technology to emissions reduction** and the likely associated **timeline with development and operation** of each technology
- Clear, costed transition plan for forward 3-5 years including:
  - Total spend per year of implementation
  - Approximate proportion of capex being allocated to each technology in transition plan
  - Details on how the company expects to fund transition plan

Table: Analysis of the quality and transparency of steelmakers decarbonisation projects

Company	HQ Region	Total projects with clear research areas and objectives	% projects with clear objectives and green potential	% projects with spend or investment disclosed
JFE Steel	Asia	11/13	15.4%	15.4%
Nippon Steel	Asia	8/16	6.3%	0.0%
POSCO	Asia	6/15	26.7%	46.7%
China Baowu	Asia	11/15	26.7%	33.3%
TATA Steel	Asia	6/15	20.0%	13.3%
JSW Steel	Asia	2/5	20.0%	20.0%
Kobe	Asia	9/11	18.2%	9.1%
Ansteel	Asia	1/2	50.0%	50.0%
HBIS Group	Asia	5/7	28.6%	42.9%
ArcelorMittal	EU	15/15	46.7%	53.3%
SSAB	EU	3/3	100.0%	66.7%
ThyssenKrupp	EU	6/10	20.0%	30.0%
Voestalpine	EU	5/5	60.0%	40.0%
BlueScope Steel	Oceania	6/10	40.0%	30.0%
Nucor Steel	US	6/6	66.7%	33.3%
US Steel	US	3/8	25.0%	12.5%

Emerging green steel ventures are rapidly materialising, backed by substantial investments and ambitious production forecasts

The rise of disruptive green steel ventures signifies a rapid industry transition and set to ignite a competitive race towards decarbonisation.

Traditional players will need to expedite their efforts to secure a competitive share in the evolving green steel market.

Green steel ventures	Plant/facility location/s	Production forecast	Technology	Raw material and quality required	Money raised/invested	Expected time operation commences
H2 Green Steel	Boden, Sweden	5Mt/yr by 2030	Green H2-based DRI-EAF	High grade iron ore in pellet/lump form	EU 2.1bn in equity since launch in 2021	2025
Hybrit	Gällivare, Sweden Oxelösund, Sweden	1.2Mt/yr	Green H2-based DRI-EAF	High grade iron ore in pellet form	EU143M from EU under Innovation Fund, EU30M from SSAB and EU5M from LKAB	2026
Blastr	Inkoo, Finland	2.5Mt/yr steel 6Mt/yr pellets	Green H2-based DRI-EAF	High grade iron ore	- US$10M from Cargill in ongoing series A funding round - Inkoo is expected to be EU4bn investment total	2027-2028
Boston Metal	Woburn, Massachusetts Minas Gerais, Brazil	A plant will make 1-2Mt/yr	Molten Oxide Electrolysis	All iron ore grades	Over US$350M as of Sep 2023	Commercial deployment 2026; Industrial production 2028
Electra	Bolder, Colorado Boston, Massachusetts	A plant will make ~300,000t/yr	Low Temperature Electrolysis	Low iron ore grades (<55% Fe)	US$85M as of Oct 2022	Demonstration plant expected by the second half of this decade.
Element Zero	Port Headland, Western Australia	2.7 Mt/yr iron	Low Temperature Electrolysis	All iron ore grades	US$10M in seed funding	Not yet disclosed

Findings:
Iron ore miners

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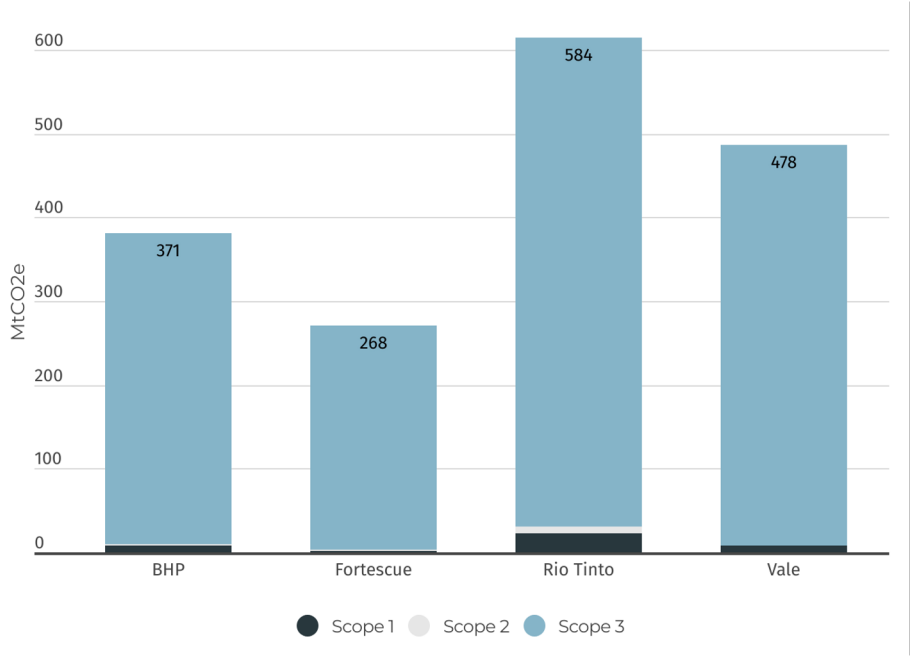
Scope 3 emissions dominate the total emissions portfolio of iron ore miners, accounting for over 95% of emissions and posing a substantial risk if not adequately addressed

Chart: Iron ore miners' emissions by Scope ($MtCO_2e$) according to latest available disclosures



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Iron ore miners show uncertainty in steel sector decarbonisation, lacking ambitious targets despite making strategic investments to reduce Scope 3 emissions

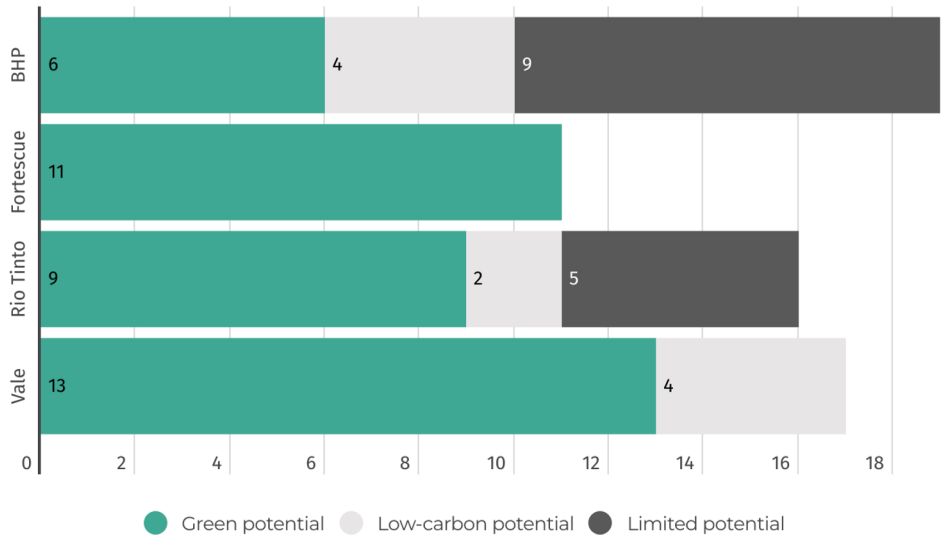
Table: Iron ore miners' quantifiable Scope 3 emissions reduction targets and goals related to steelmaking

Company	Mid-term (2025-2035)	Long-term (2036-2050)
BHP	**Goal**: to support technologies capable of 30% emissions reduction in steelmaking by 2030 (FY20 baseline)	Net zero **goal** by 2050
Fortescue	**Target:** 7.5% emissions intensity reduction in steelmaking by 2030 (FY21 baseline)	Net zero **target** by 2040
Rio Tinto	**Targets:** - support customers to reduce emissions from blast furnaces by 20-30% by 2035 - 50% reduction in Scope 3 emissions from Iron Ore Canada by 2030 (7Mt CO_2), subject to technical feasibility and funding approval.	None
Vale	**Target**: 15% reduction for all scope 3 emissions by 2035 (FY18 baseline)	None

- Iron ore miners are already making strategic investments and forming partnerships aimed at reducing Scope 3 emissions.
- Despite this, there is a **substantial lack of concrete ambition in the miners' target setting.**

Vale and Fortescue are leading in the commitment to decarbonise, developing several green potential projects, whereas BHP and Rio Tinto's broader, less focused approaches reveal a pressing need for strategic refinement to enhance the impact of their decarbonisation efforts

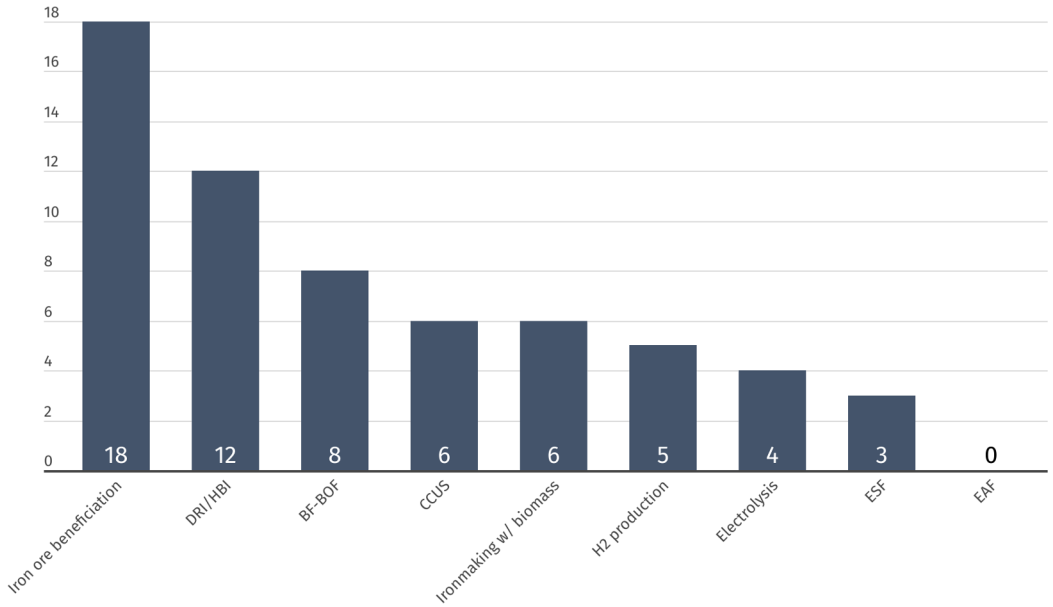
Chart: Iron ore miners steel decarbonisation projects, by green potential



- **Vale** demonstrates a strong commitment with 13 green projects, particularly in high-grade iron ore and pelletisation, alongside strategic partnerships in the Middle East for cleaner production methods.
- **Rio Tinto** shows a mixed approach with a balance of green and limited potential projects, highlighting a need for reassessment to maximise their decarbonisation impact.
- **Fortescue** stands out for its clear decarbonisation strategy, underscored by its investment in green hydrogen and magnetite ore projects.
- **BHP**'s focus includes a notable number of limited potential projects, mainly in CCU/CCS, and uniquely it continues in metallurgical coal mining, presenting a dichotomy in its environmental strategy.

Iron ore miners are broadening their technological horizons to mitigate steel production emissions, with a significant focus on processes to increase ore quality and pave the way for more sustainable and efficient steelmaking. However, the varied approach in technology adoption indicates both an aspiration for green transformation and a strategic hedging against the uncertainties some decarbonisation pathways contain

Chart: Iron ore miners steel decarbonisation projects counts



- There is a clear interest in continuing to use low-grade ores in green processes, such as DRI/HBI, iron ore beneficiation and electrolysis, which is positive
- However, blast furnace optimisation and CCUS projects also indicate the ongoing use of blast furnaces
- Biomass and hydrogen production projects reveal a strong interest in alternatives to coal, with varied decarbonisation potentials.

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Analysis of decarbonisation project transparency reveals a stark gap: numerous projects lack clear objectives and detailed information on investment, highlighting an industry-wide need for enhanced clarity and accountability on emissions reduction efforts

Table: Analysis of the quality and transparency of iron ore miners' decarbonisation projects

Company	Total projects with clear research areas and objectives	% projects with clear objectives and green potential	% projects with spend/ investment disclosed
BHP	7/19	15.8%	52.6%
Rio Tinto	8/17	35.3%	11.8%
Fortescue	10/11	90.9%	54.5%
Vale	7/18	35.3%	29.4%

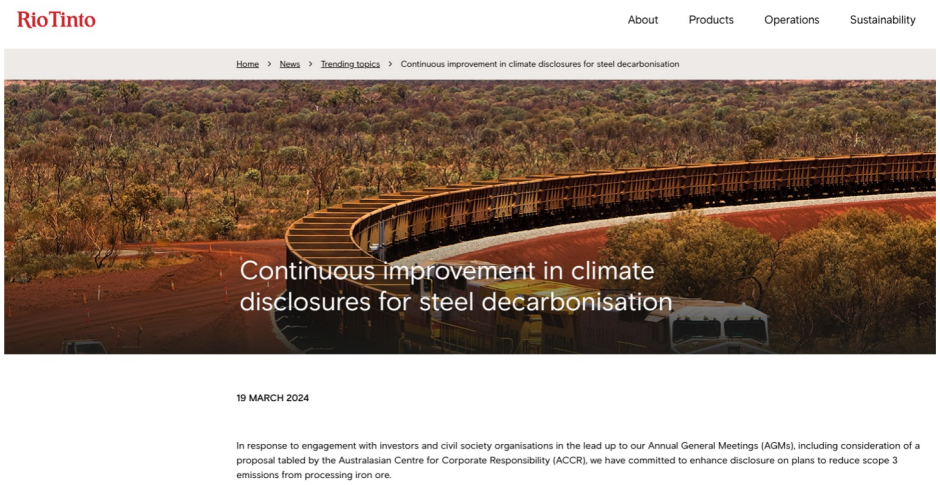
- Fortescue stands out for efficiency, dedicating itself to fewer projects but with 90% showcasing well-defined objectives and green potential.
- BHP leads in project quantity but lags significantly in clarity and potential, with only 16% of its projects having well-defined goals and none detailing future steps.
- Rio Tinto provides the most information on next steps for its projects, though it discloses the least about project funding.
- Vale avoids projects with limited reduction potential, but falls short on providing sufficient detail and objectives for most of its projects.

Rio Tinto's commitment to "continuous improvement in climate disclosures for steel decarbonisation"

19 March 2024: Rio Tinto commits "To provide more information and transparency for investors and interested stakeholders on our approach to this challenge, **we [Rio Tinto] will enhance disclosures prior to the 2025 AGM and thereafter** by providing:

- **Actual expenditure on steel decarbonisation**, and **forecast spend**, as a range, over a 3-year period
- Capital expenditure on Rio Tinto-led steel decarbonisation projects and financial contributions to steel decarbonisation partnerships (subject to commercial agreements)
- **Known milestones and timelines, anticipated expenditure and potential abatement opportunities** of announced projects and partnerships (subject to joint venture partner approvals)
- Potential abatement opportunities of announced projects and partnerships aligned to industry abatement curves and net zero decarbonisation scenarios

We will engage with ACCR on the development of these disclosures, in particular, on industry appropriate frameworks and enabling policy settings."



Source: https://www.riotinto.com/en/news/trending-topics/accr-commitment

Policy

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Policy initiatives are crucial for fast-tracking the steel industry's decarbonisation and reduces both environmental impact and investment risks

Effective policies should aim to:

- Increase access and use of renewable energy in steel production
- Reduce the cost of capital for emerging green steel technologies that will meaningfully reduce emissions
- Implement taxation or penalties on fossil fuel-based production methods

Key areas for policy support	Examples	Gaps
Carbon pricing	**CBAM** in the EU for carbon-intensive imports; **ETS in South Korea and China**, though with limited impact on steel so far	Absence of comprehensive carbon pricing mechanisms outside of advanced economies, leading to carbon leakage
Increasing renewable capacity	**IRA** in the USA with financial incentives; the **Green Energy Act** in Germany, etc.	Emerging economies lack financial incentives and infrastructure for renewables; some Asian countries have transmission and capacity bottlenecks
Growing green steel technology	**Govt subsidies**, recipients include: ArcelorMittal, HYRBIT, Thyssenkrupp, Tata Steel, Nippon Steel, U.S. Steel, etc.	High capital expenditure requirements, insufficient support for green technology in many steel-producing countries; steel technology investments target limited-potential reduction technologies

Best practice disclosures in policy and lobbying by companies across all operational regions are crucial for aligning the global steel sector with decarbonisation goals and the Paris Agreement

Best practice company policy disclosures:

The company should have clear and publicly available policy positions that cover all regions in which it operates, addressing key areas of strategic importance for the steel sector, including:

- Renewable energy and green hydrogen production
- Carbon markets and border adjustment mechanisms
- Financial incentives for green technologies
- Regional considerations (as relevant)
    - EU and US steelmakers should be focused on increasing circularity for scrap-based production, and collaborating/sharing technologies with Asia
    - Asian steelmakers and Australian iron ore miners should focus on securing access to renewables and high-quality green iron.

Best practice company lobbying disclosures:

The company should have clear and publicly available policy positions that cover all regions in which it operates, addressing key areas of strategic importance for the steel sector, including:

- Global policy positions
- Commitments to align lobbying with its decarbonisation strategy and the Paris Agreement
- The review of direct and indirect lobbying alignment on (at least) an annual basis, with actions to address misalignment and to enhance the impact of its advocacy on a clear timeline.

Leveraging positive advocacy: Investors can play a key role in ensuring policies work to the geographical strengths of different jurisdictions across the steel value chain

Investors and companies wield substantial influence in shaping policy directions.

Key actions investors can take to encourage positive policy settings include:

- **Push for geographically smart policies that address disparities;** use influence to promote policies that capitalise on regional strengths and support efforts to close the gap between developed and developing countries in the steel industry
- **Underwrite renewable energy**, solidifying the demand outlook for power generators and governments
- **Advocate for consistent, industry-wide policies**, including global carbon pricing and emission standards
- **Promote green procurement** policies that increase demand for green steel
- **Foster international collaboration** by participating in global forums and partnerships, including with industry association groups and civil society organisations
- **Support policies that facilitate technological advancements** and financial support for green steel.

Recommendations

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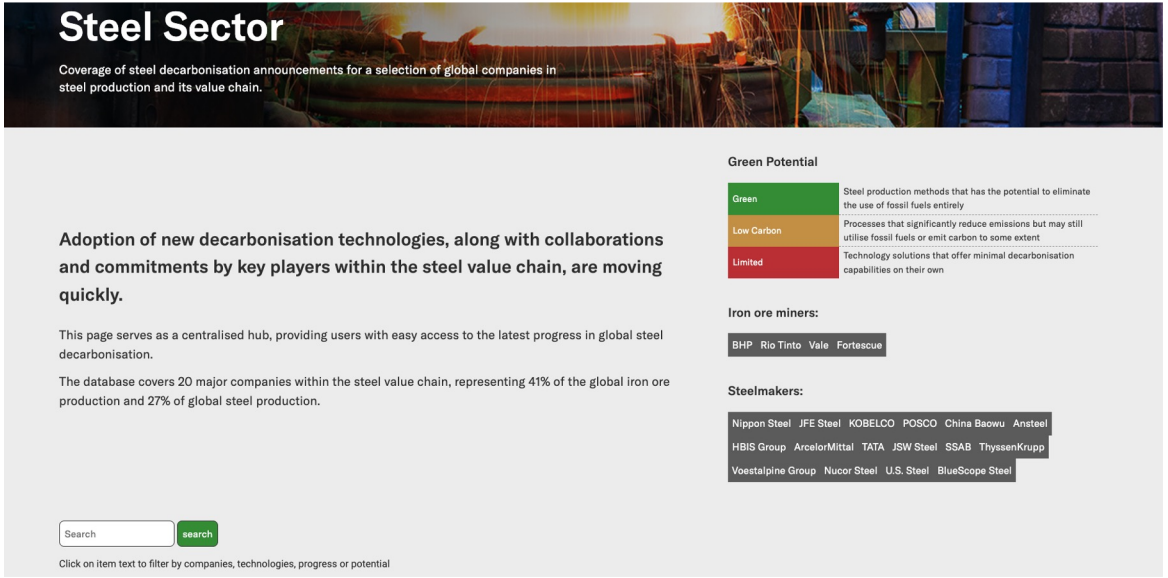
Summary of recommendations

There are five crucial steps that can help accelerate the transition to green iron and steelmaking:

1. Reallocate capital away from coal-dependent blast furnaces and towards processes with high decarbonisation potential.
2. Increase renewable energy capacity to enable the green electricity and green hydrogen required for green steelmaking.
3. Work towards standardised, comprehensive and robust emissions disclosure across the industry.
4. Catalyse immediate action towards decarbonisation with short/medium-term climate commitments that are ambitious and science-based.
5. Ensure that the transition from traditional iron and steelmaking to green processes is just and equitable, supporting communities and workers.

Additional resources: Steel Decarbonisation Tracker & Investor Handbook



Report – [Forging pathways: insights for the green steel transformation]

Database of [steel decarbonisation announcements]

[Investor handbook: Engaging with the steel sector]

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Steel Decarbonisation & Investor Sentiment

April 2024

Jasmine Fowler-Morrow, Analyst, ACCR
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Fiona Deutsch, Lead Analyst, ACCR
fiona@accr.org.au

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Contents

Objectives

- What are the prevailing narratives around steel and decarbonisation for investors? Is it seen as too hard? Within reach? What are the perceived challenges and opportunities?
- What are investors' perceptions of metallurgical coal and its role in the steelmaking process?

Methodology

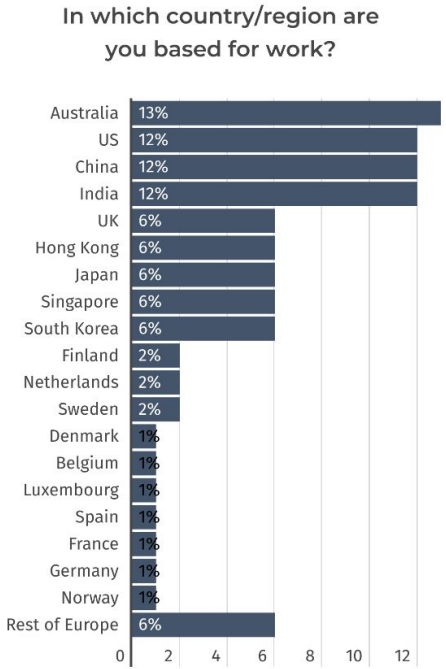
- We engaged the services of a consulting firm, which conducted a comprehensive survey of 500 global investors with investments in steelmaking, iron ore and/or metallurgical coal mining.
- Respondents answered a series of multiple-choice questions relating to the decarbonisation of the steel sector and its value chain.

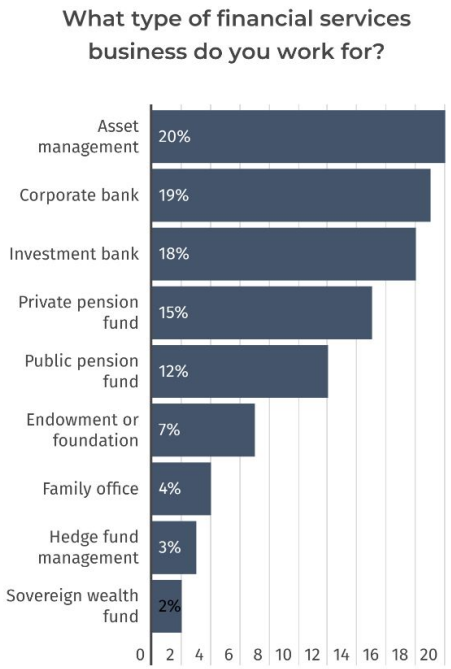
Respondents worked for a range of financial services and based themselves across the World (n=500)

Survey respondents:

- based themselves all over the globe
- worked for a wide range of financial services
- held investments in:
    - steel manufacturing
    - metallurgical coal and/or iron ore mining
    - a combination of the two.

38% of respondents managed assets valued over US$10 billion.





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Key findings

- The vast majority (81%) of investors agree green steel is made without fossil fuels.
- Nearly all (98%) investors see metallurgical coal as a risky investment by 2040, with half receiving strong signals from their customers to divest.
- Almost half (46%) of investors say their institutions have not vetted their portfolios for climate-related risks or assets at risk of becoming stranded.
- 59% of investors believe robust climate policies are key to speeding up the shift to green steel, with half also pushing for government incentives to foster renewable energy development.

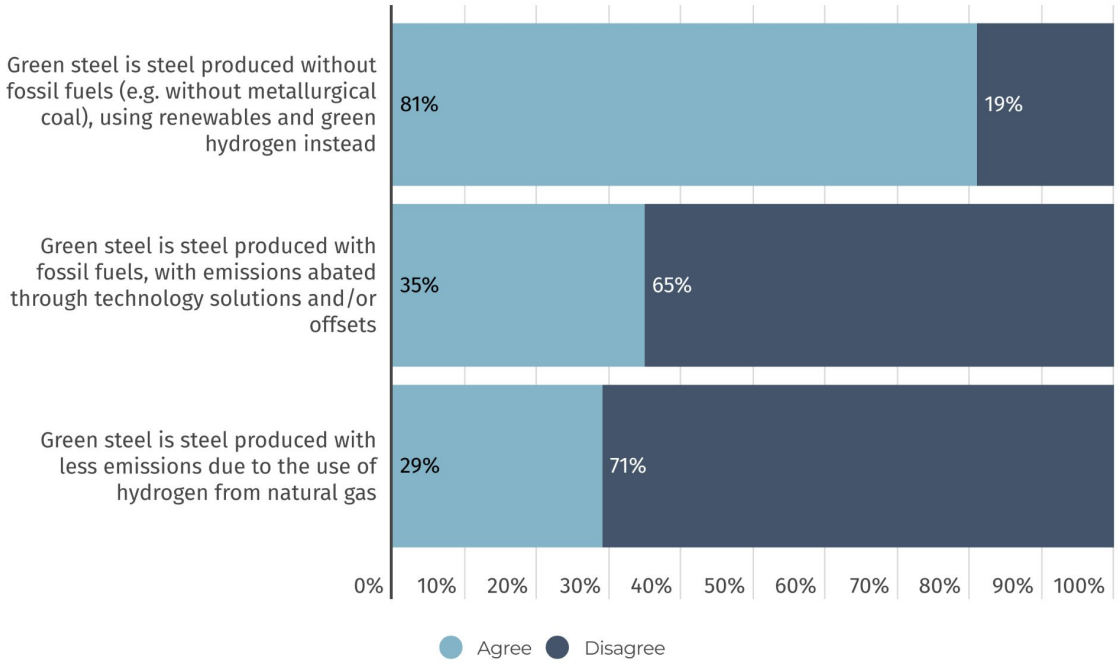
Section one: Green steel

Sentiment, opportunities and challenges

81% of investors agree green steel is produced without fossil fuels

Most investors agree that green steel:

- is produced without fossil fuels
- is not simply steel abated with CCS/offsets
- is not made with hydrogen from natural gas.



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Challenges and opportunities for Green steel

Investors see technology maturity & high capex as the greatest challenges, but they also see opportunities to improve their reputation & align their portfolio with ESG benchmarks

Challenges 

1. Technology maturity - concerns about technologically viable alternatives
2. High capex - concerns about commercially viable alternatives

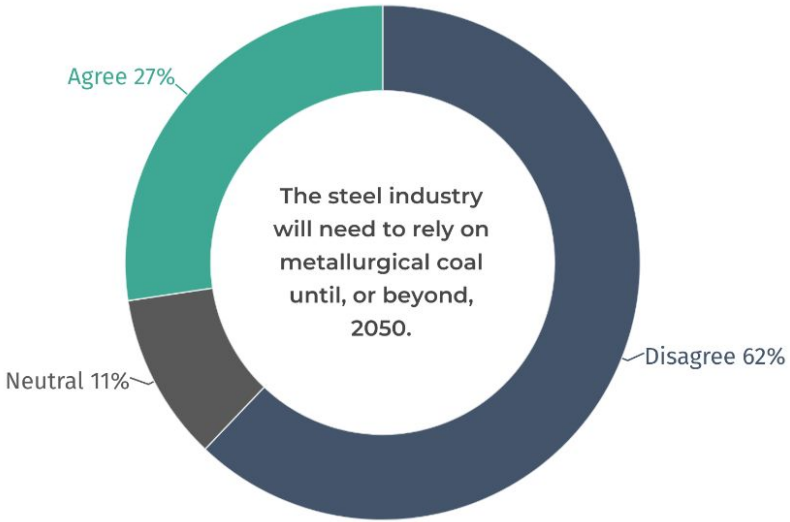
Opportunities 

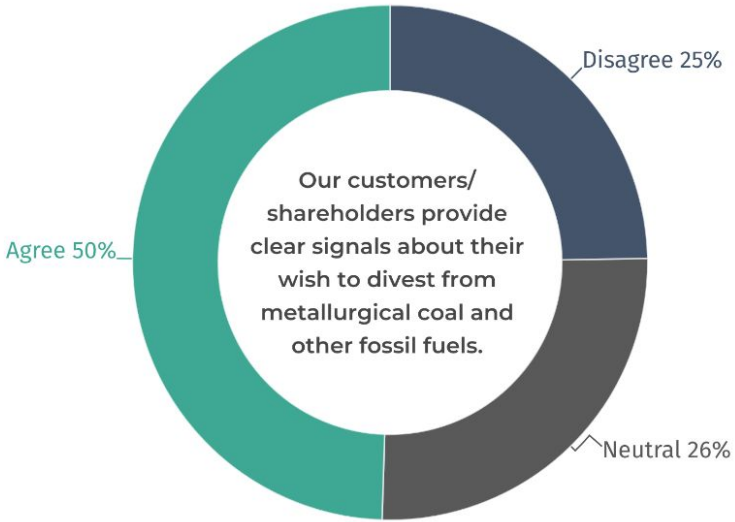
1. Improved reputation
2. Align portfolio with ESG benchmarks

Metallurgical coal

A risky asset in the eyes of investors

Investors foresee a transition away from metallurgical coal in steel





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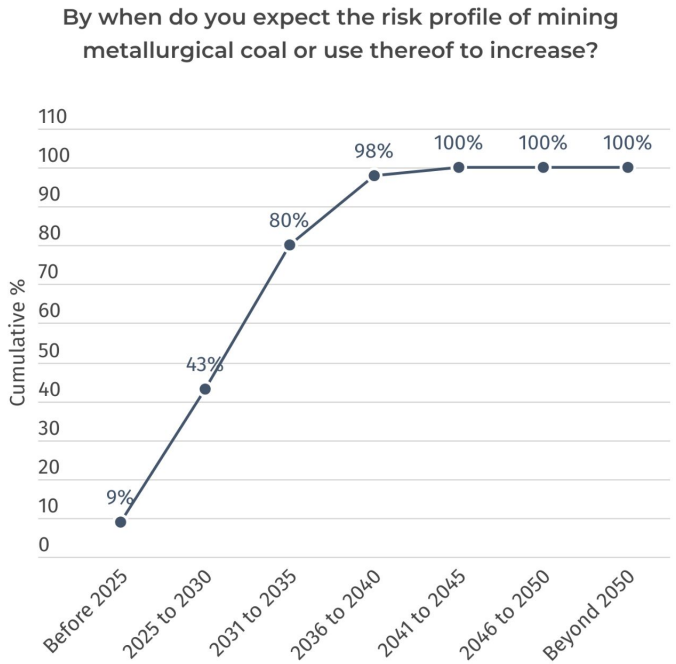
80% of investors expect the risk profile of met coal to increase by 2035 or earlier



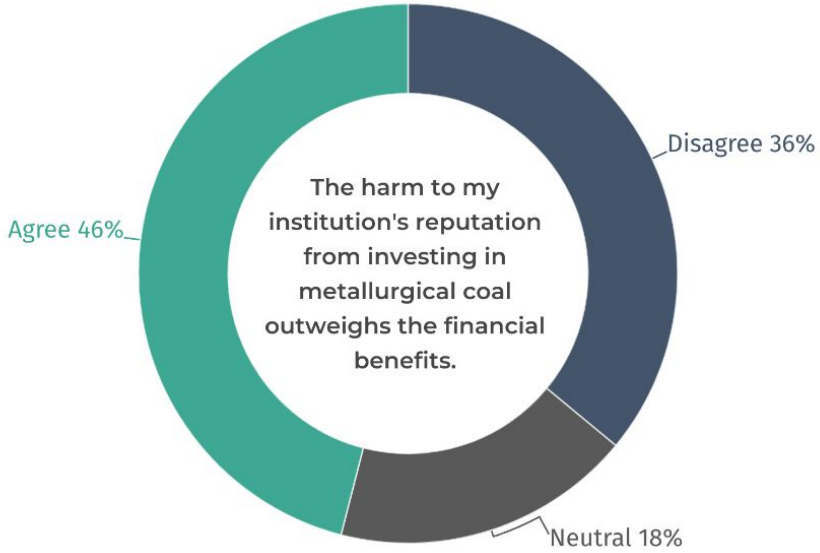
When do investors expect the risk profile of met coal to increase?

- 43% expect this to happen within the next 6 years
- 80% expect this to happen no later than 2035
- All respondents expect this to happen by 2045

Stranded assets and reputational harm are seen as the greatest risks of mining metallurgical coal

Two greatest risks associated with metallurgical coal:

1. Reputational risk/pressure from civil society or NGOs
2. High risk sector/fear of stranded assets



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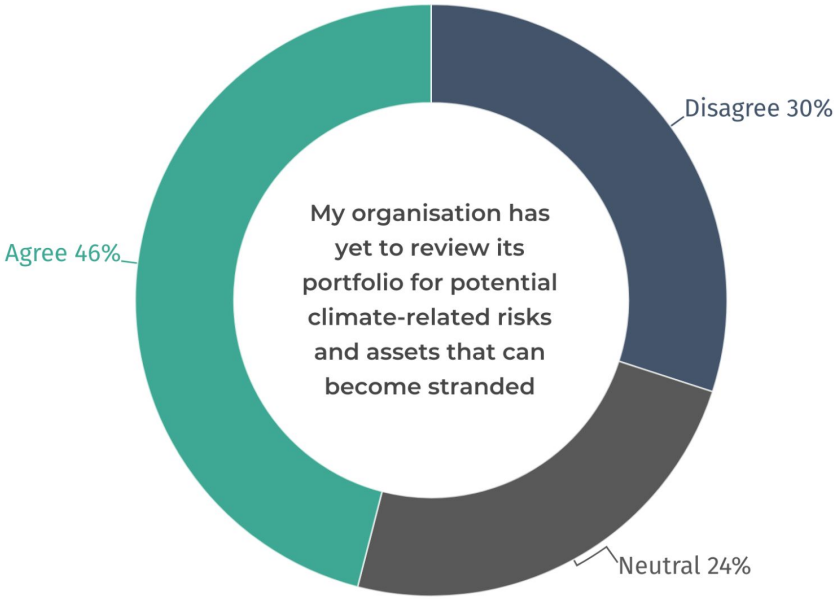
Around half of investors acknowledged their institutions had not yet reviewed its portfolio for potential stranded assets



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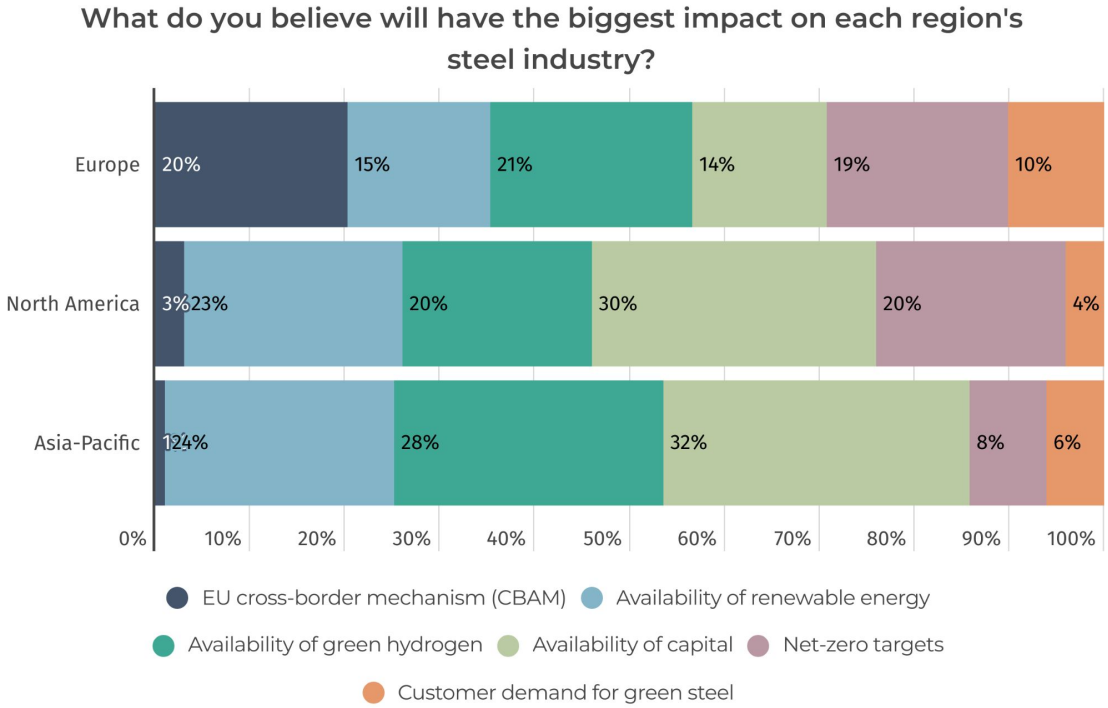
Accelerating the green steel transition

Investor perceptions on opportunities to speed up the decarbonisation of the steel industry

Investors expect numerous factors to impact the steel industry, however expect these to vary by region



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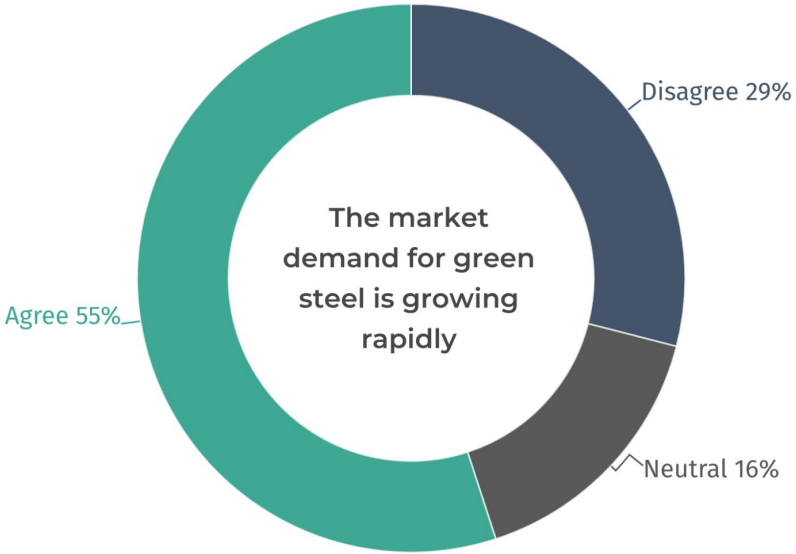
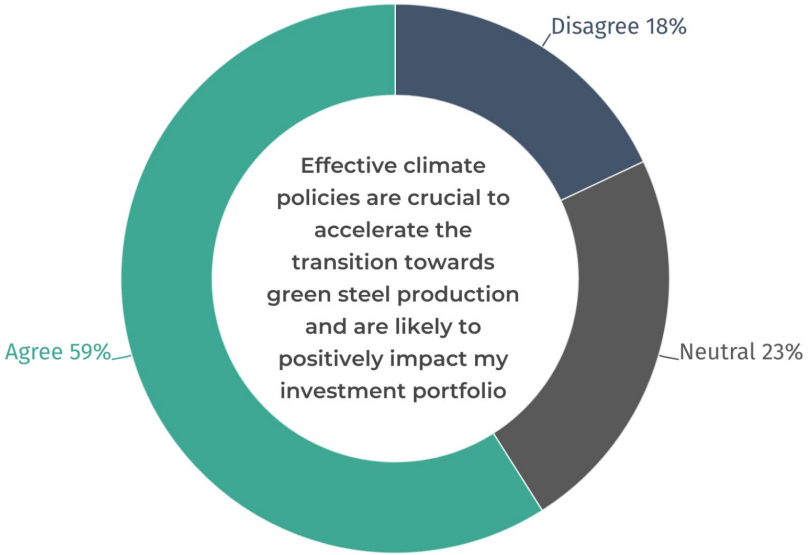
Green steel market demand is increasing and policy is expected to support this growth





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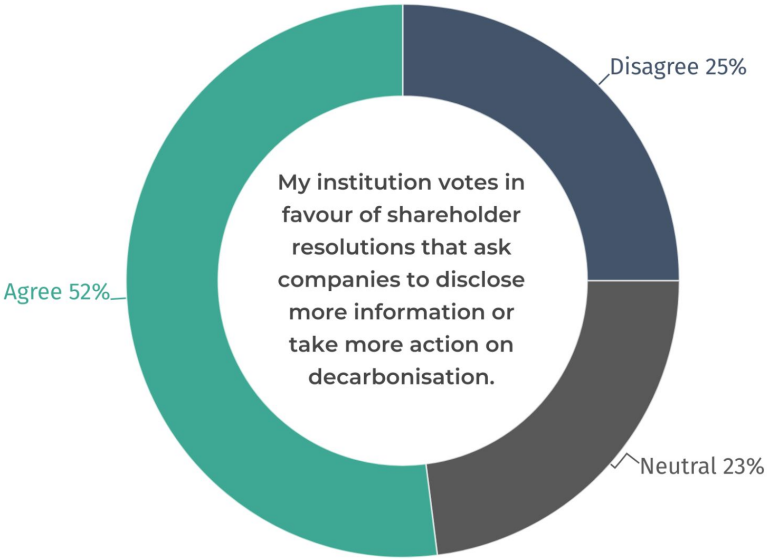
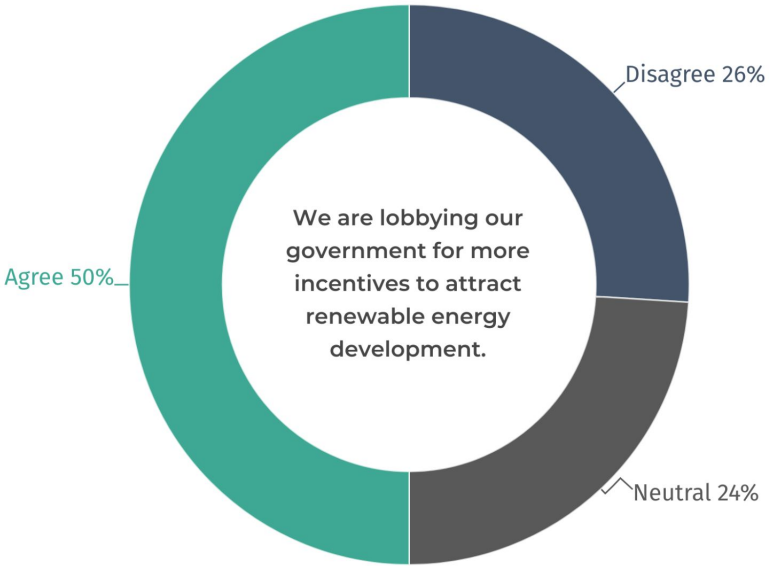
Investors are engaging with both companies and government to accelerate steel decarbonisation





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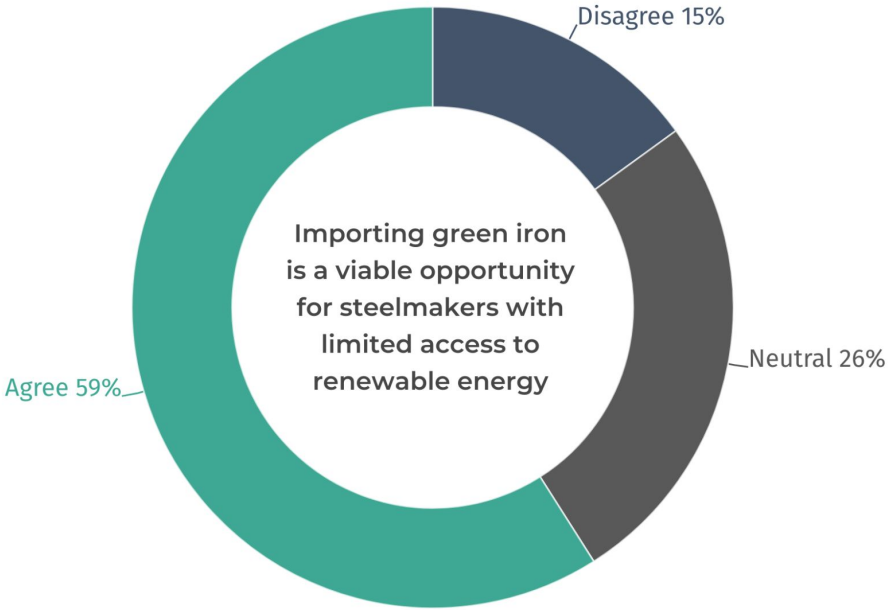
Investors see importing green iron as an opportunity in situations where low carbon energy is not available



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Decarbonising steel making in the Asia-Pacific

Jorrit Gosens

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Director, Strategic Research Spoke on Energy Transitions, Australian Centre on China in the World

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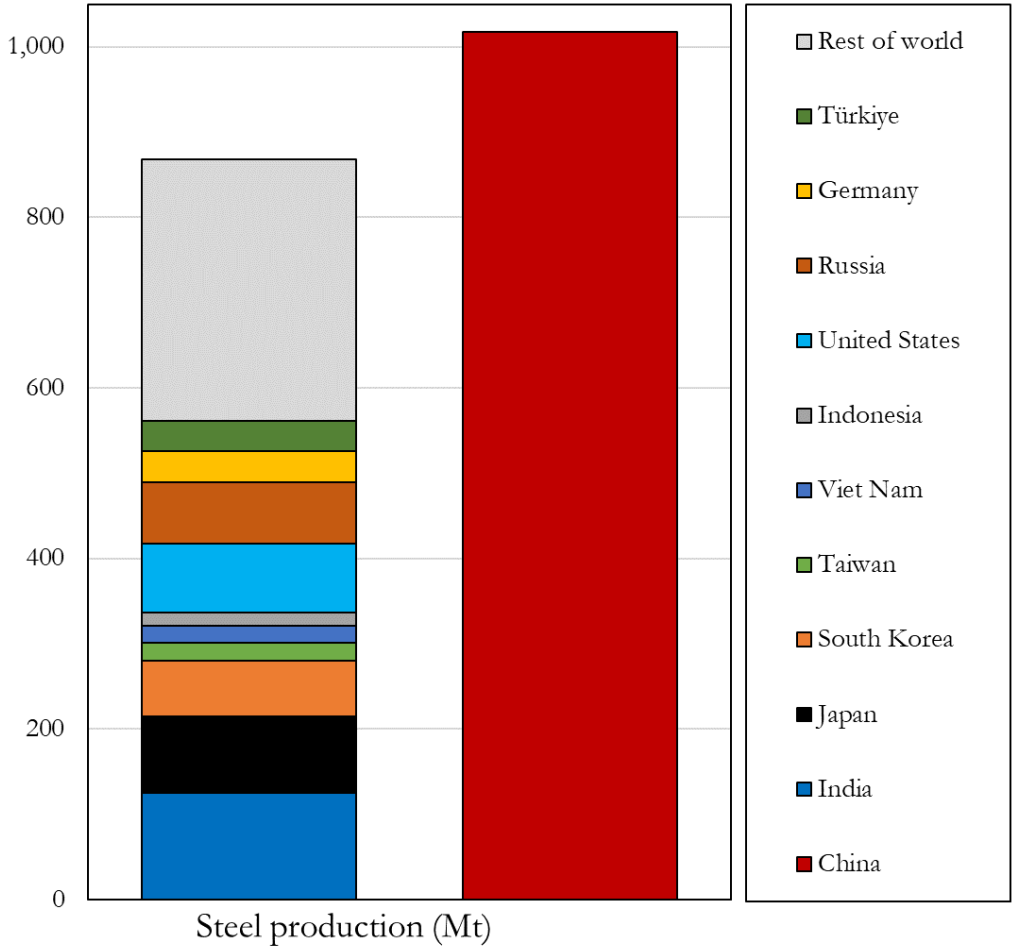
Australian National University

Relevance of China in global steel making



Global production of crude steel (Mt, 2022)

Data from World Steel in Figures, https://worldsteel.org/steel-topics/statistics/world-steel-in-figures/

Chinese plans to reduce steel sector emissions

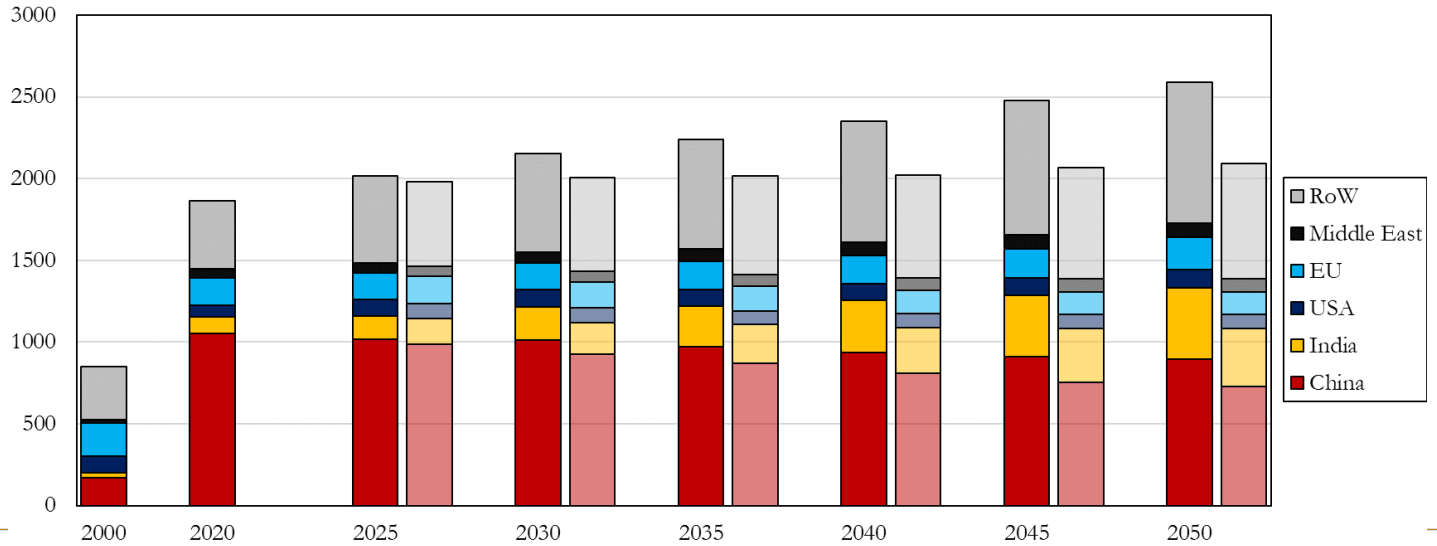
1. Use less steel
2. Recycle more scrap
3. Switch to green steel

Chinese plans to reduce steel sector emissions

Overall steel outlook

- Will depend on:
  - macro-economic policy incl infra construction stimulus
  - Housing market development
  - Industrial incl auto demand
- Uncertain, but down overall in almost all scenarios/forecasts

Global crude steel output (Mt)
In IEA's Stated Policies (dark) & Sustainable Development (light) scenarios



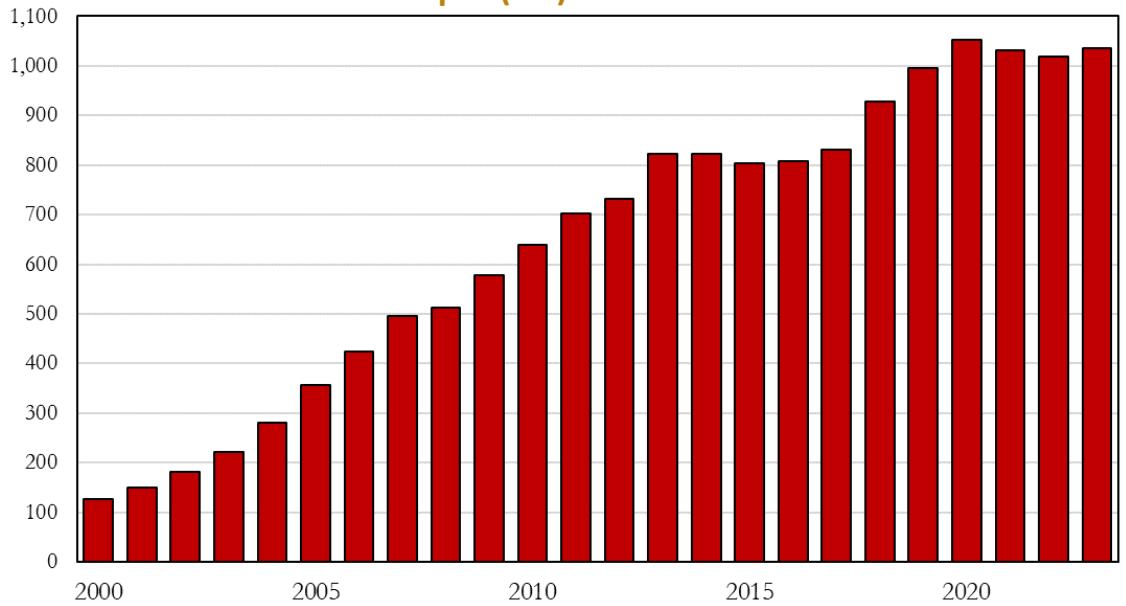
Data source: IEA Iron and steel roadmap 2022

Chinese plans to reduce steel sector emissions

Steel output targets for short term only

- 2021: NDRC & MIIT target an (undefined) reduction in steel output
- Repeated in 2022, but no such target in 2023 plans

Chinese crude steel output (Mt)



Source: NBS, forecast 2023 based on increase in output Jan-Sep

Chinese plans to reduce steel sector emissions

Steel output targets for short term only

- Annually determined reduction target (or max prod level)

Production capacity reduction policy

- Requirement to close 1.25x existing steel capacity before new capacity can be opened. 1.5x in key air pollution control areas
- New EAF capacity requires 1x existing capacity to be closed
- New hydrogen-based projects also need to comply with this

Chinese plans to reduce steel sector emissions

Steel output targets for short term only

- Annually determined reduction target (or max prod level)

Production capacity reduction policy

- Requirement to close existing steel capacity before new capacity can be opened, also for EAF or hydrogen-based projects

Increased scrap use targets

- In 2020: 220 Mt or ~20% crude steel output
- 2025 target: 320 Mt or 30-35% of steel production

Steel scrap cost curve for China

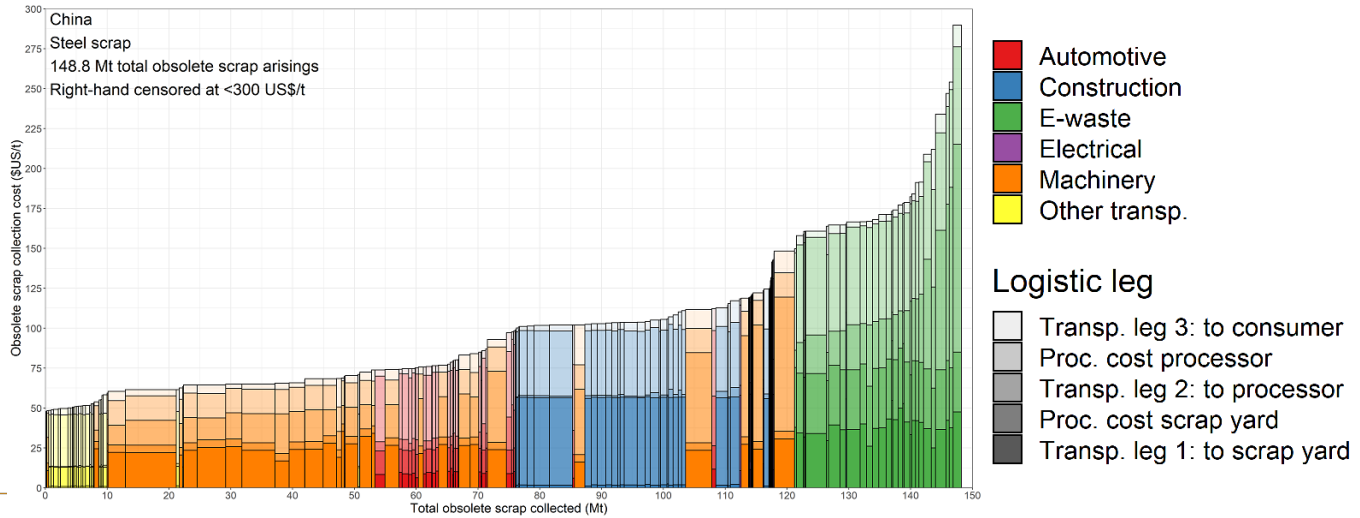


Image source: author's research (unpublished)

Chinese plans to reduce steel sector emissions

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Increased scrap use targets

- 2025 target: 320 Mt or 30-35% of steel production

Demand creation for green steel: absent

- Sector originally asked to plan emissions peak by 2025, delayed to 2030
- Not a single policy mention of a green steel demand target

Image source: author's research (unpublished)

Chinese plans to reduce steel sector emissions

Steel output targets for short term only

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Demand creation for green steel: absent

- Sector originally asked to plan emissions peak by 2025, delayed to 2030, no green steel demand target

Pilot projects for hydrogen steel making

- 2 ‘full-scale’ pilot projects, using hydrogen enriched natural gas

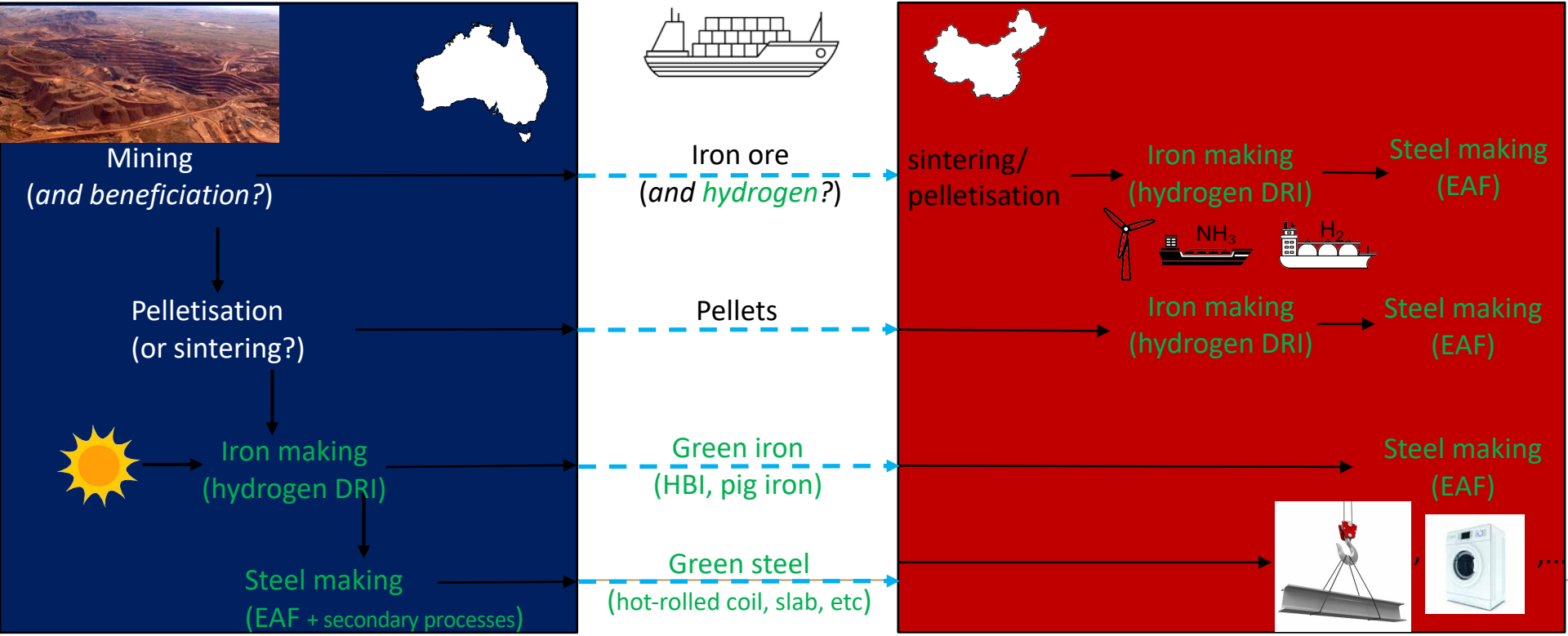
Hydrogen policy

- Strongly aimed at use in transport, even in key steelmaking areas
- Tangshan, Hebei, hydrogen plan: use hydrogen in steelmaking if/when local hydrogen sector picks up

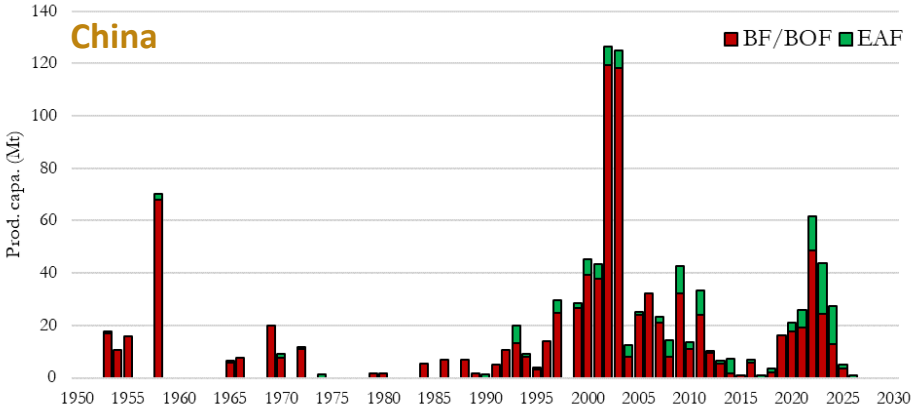
Image source: author’s research (unpublished)

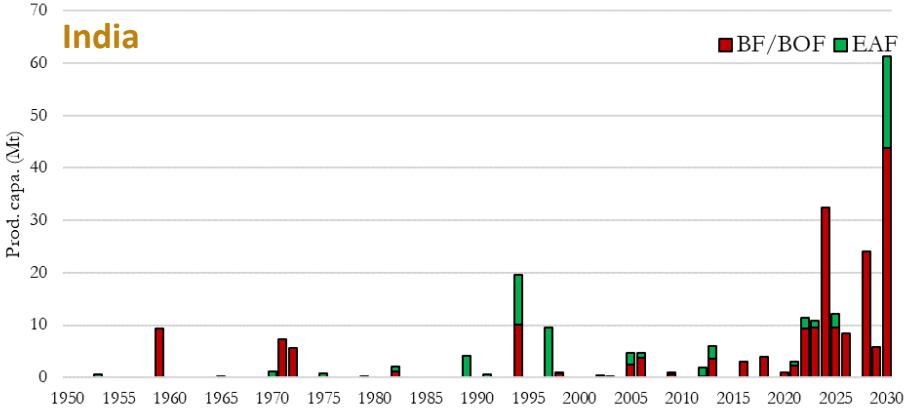
Reorganising value chains for green steel?

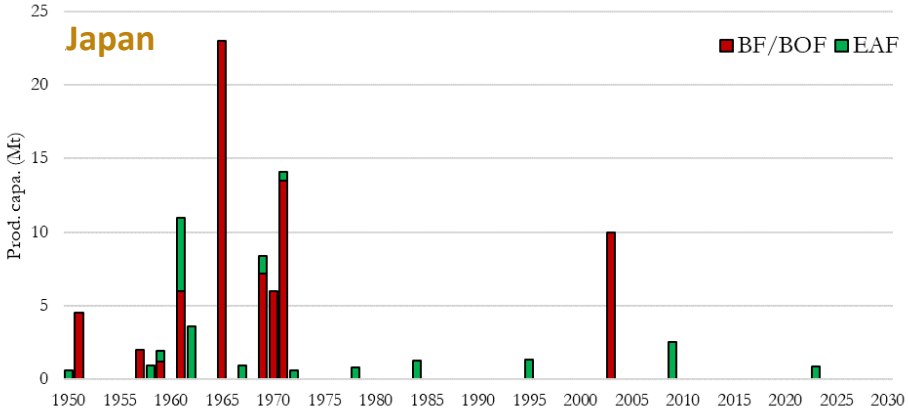
Could reduce the cost of green steel demand by benefitting from low-cost Australian renewables

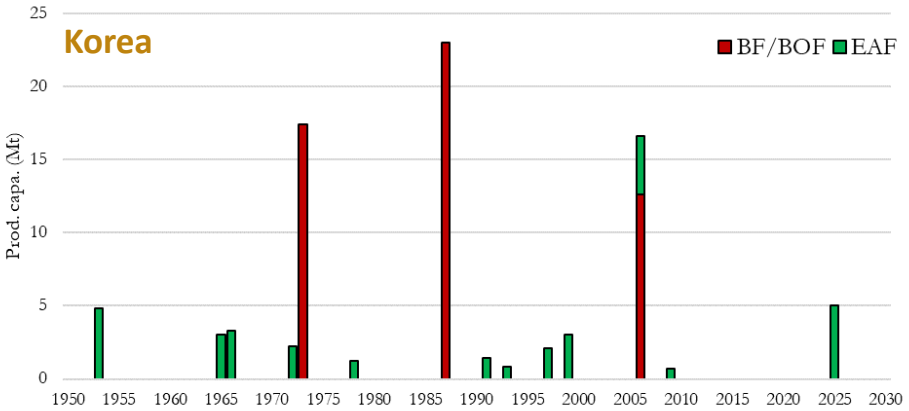


Steelmaking capacity (incl planned) across APAC





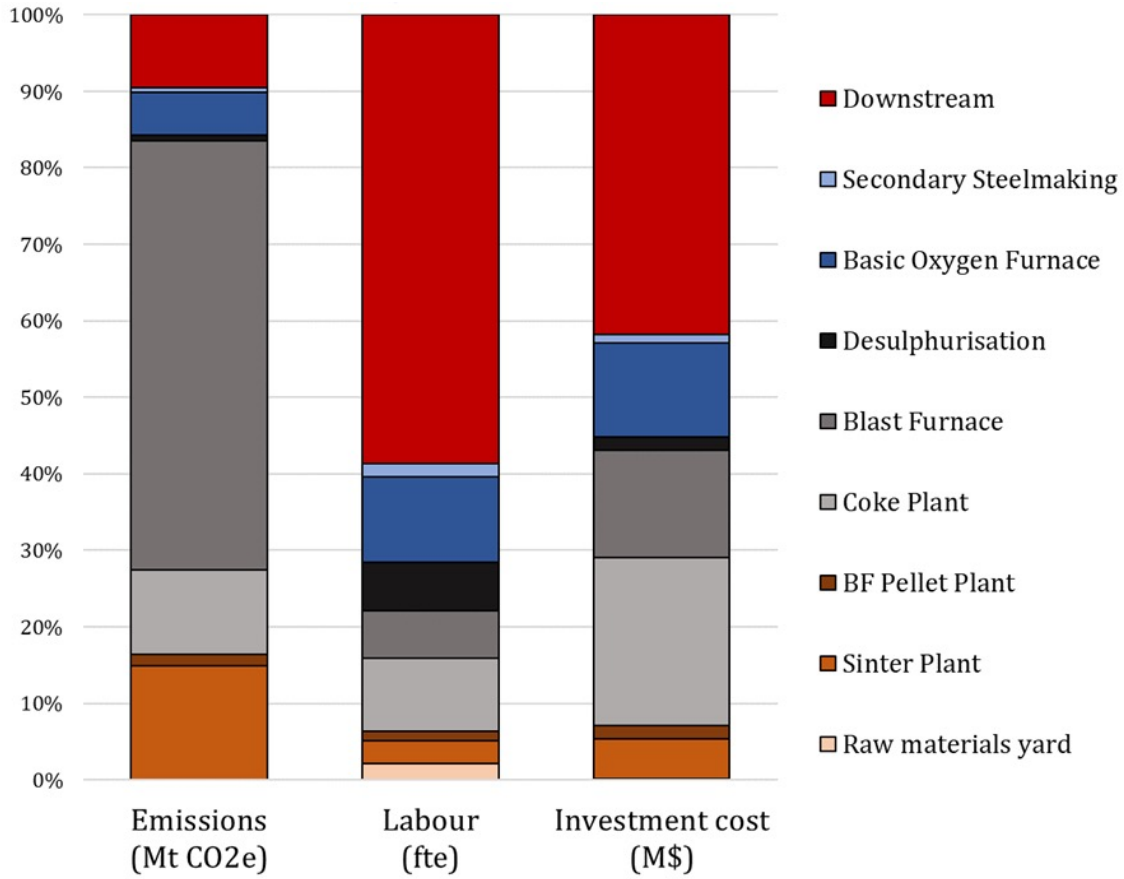




Data from the Global Steel Plant Tracker, https://globalenergymonitor.org/projects/global-steel-plant-tracker/

Chinese willingness to offshore value chains?

Offshoring emissions intensive, labour extensive processes?

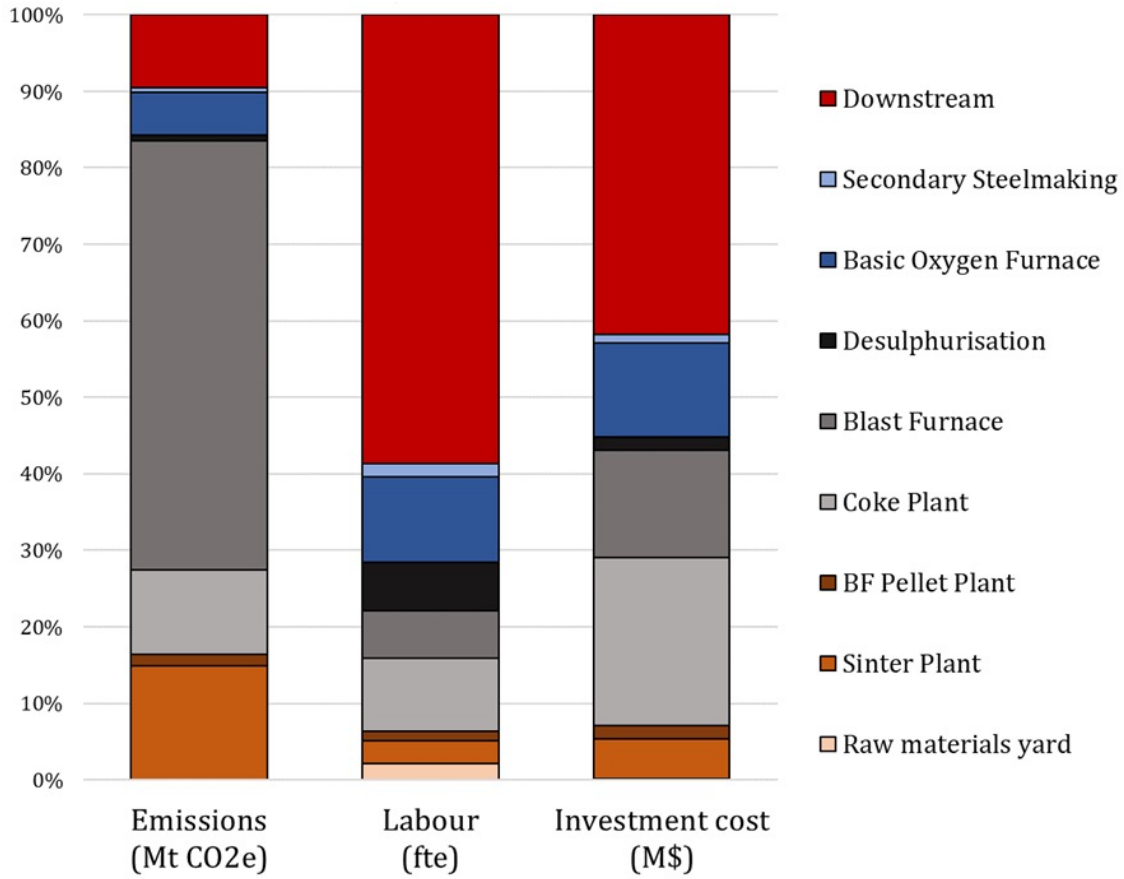


Source: CRU data for a BF/BOF steel plant in Tangshan, Hebei province, China

Chinese willingness to offshore value chains?

2022 “Guiding opinions on promoting the high-quality development of the iron and steel industry”

“Encourage imports of semi-manufactured products, incl. pig iron, direct reduced iron, recycled raw materials, steel billets, steel ingots and other resources”



Source: CRU data for a BF/BOF steel plant in Tangshan, Hebei province, China

Corporate push for green steel?

What sectors provide windows of opportunity for early demand creation?

- Technical feasibility of using green steel?
- Cost differential on final product
- Willingness to pay for customers
- Across auto, appliance, building, … uses

Guaranteed offtake contracts?

- Between consumers and producers of steel
- Between consumers and producers of iron

Investment in green iron manufacturing capacity in Australia?

- By Chinese/Japanese/Korean/Indian firms?
- Done in lithium processing, but what about steel sector SOE?

Encouraging the transition to green steel in China & rest of APAC

1. Push for Chinese gov't policy including demand creation
2. Encourage reorganisation of international value chains
3. Identify nursing market segments

Ongoing ANU research

Cost-competitiveness of Australian producers in value chains for green steel in China:

- Iron ore + green hydrogen
- Partially metallised ore
- Green iron (DRI or HBI)
- Green steel

Cost optimization model: considers costs of:

- Mining
- Transport
- Processing
- Emissions, when priced

Further considers

- Iron ore chemistry: effects on energy, flux cons, and suitability in conventional and green iron/steel manuf
- Installation-level technical detail (capacity, efficiency, location)

Scenarios analysed

- Various levels of Chinese policy stringency:
  - as Mt of green steel demand
  - as Mt/% of emission reduction
  - considering ranges of scrap recycling targets
- Ranges of cost developments for hydrogen, RE etc
- Ranges of carbon pricing levels

THANK YOU

ANU Research providing insight on decarbonisation in the Asia-Pacific

- Gosens, J., Turnbull, A. B., & Jotzo, F. (2022). China's decarbonization and energy security plans will reduce seaborne coal imports: Results from an installation-level model. *Joule*, *6*(4), 782-815.
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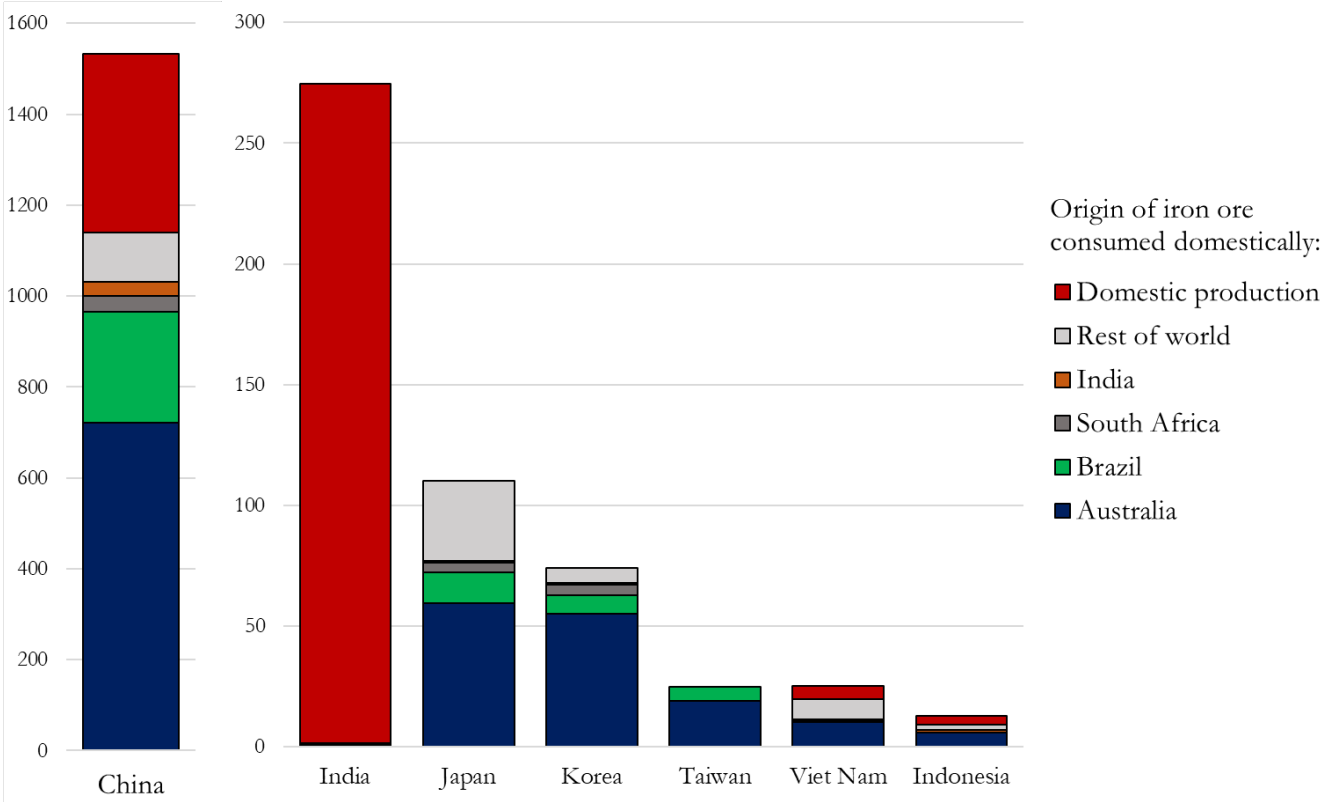
- Burke, P. J., Beck, F. J., Aisbett, E., Baldwin, K. G., Stocks, M., Pye, J., ... & Bai, X. (2022). Contributing to regional decarbonization: Australia's potential to supply zero-carbon commodities to the Asia-Pacific. Energy, 248, 123563.
- And many more: https://iceds.anu.edu.au/research/research-initiatives/zero-carbon-energy-asia-pacific-initiative/publications

Australian National University

ZERO CARBON ENERGY FOR THE ASIA-PACIFIC

APAC iron ore trade flows



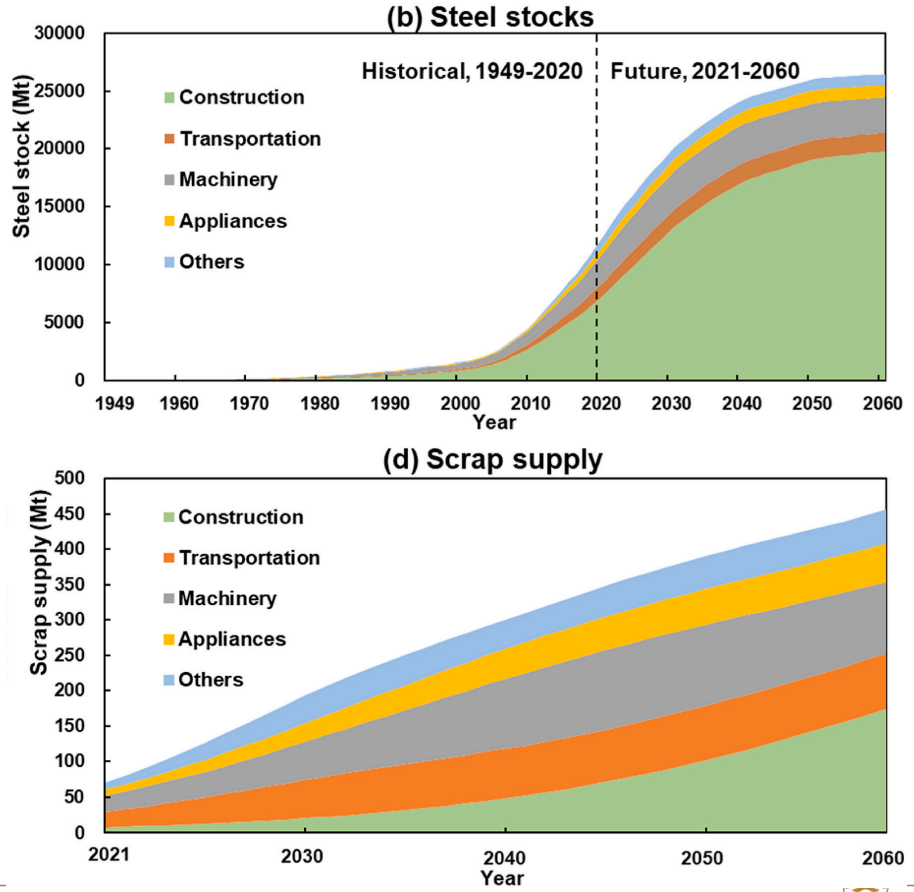
Origin of iron ore consumed domestically (Mt, 2022)

Data sources:
Domestic production: USGS Iron Ore Statistics and Information;
Imports: UN Comtrade;
Taiwan data: estimates based on https://news.metal.com/newscontent/100090034/Taiwan-iron-ore-imports-rebound-in-January

Increasing scrap consumption

Stock of steel in use grows with overall development level, which drives up scrap supply

Chinese steel stocks in use and scrap supply

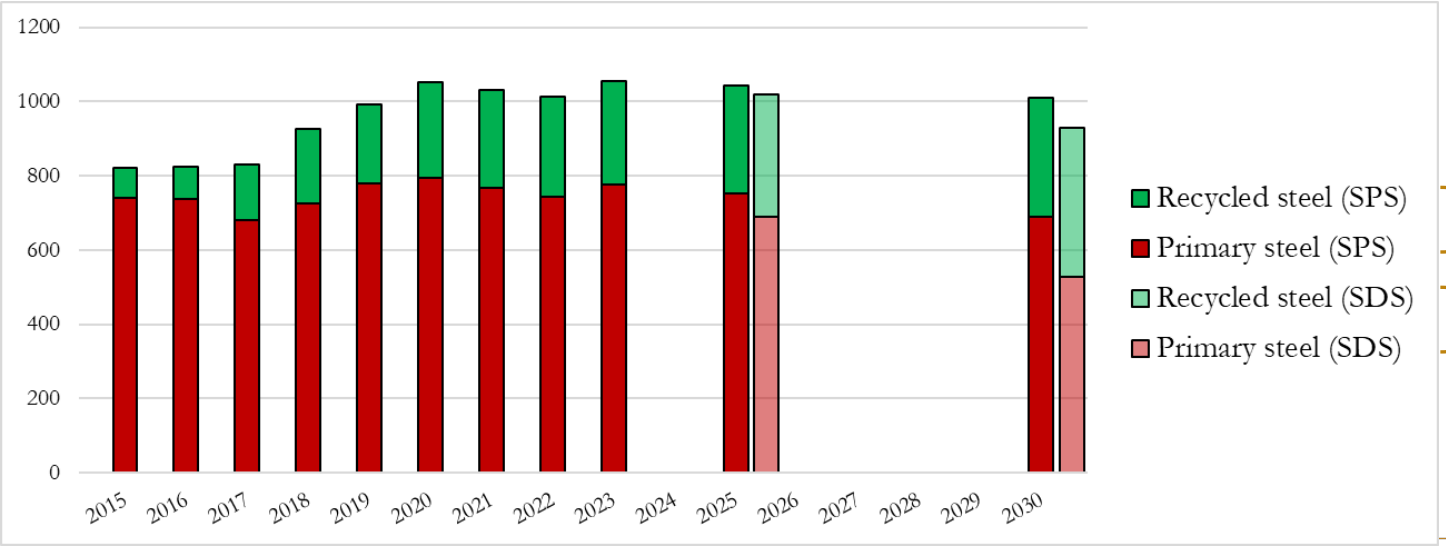


Source: Lin, Y., Ma, L., Li, Z., & Ni, W. (2023). Coordinating energy and material efficiency strategies for decarbonizing China's iron and steel sector. *Journal of Cleaner Production*, 139038.

Combined effects of less steel consumption, more scrap use

Reduced consumption and increased scrap use are roughly 50/50 drivers of emission reductions

- 3-11% reduction in iron ore consumption by 2025
- 11-32% reduction in iron ore consumption by 2030



Data source: NBS (historical); WoodMac (forecasts for scrap); IEA (crude steel forecasts)

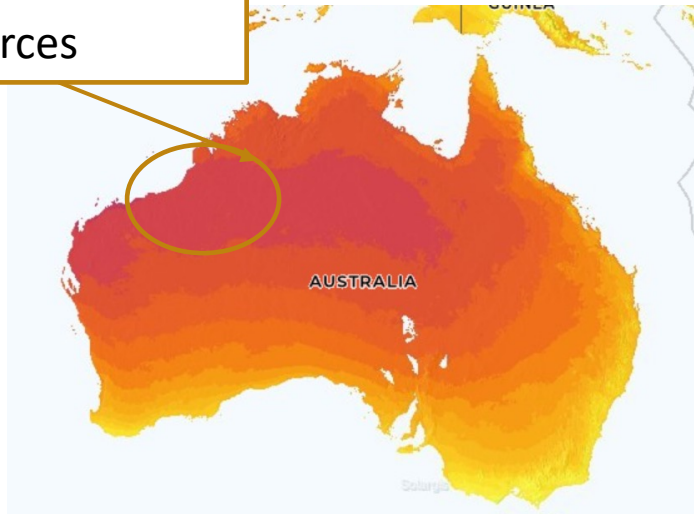
A switch to green steel

Could benefit from Australian renewables

- Co-located with good iron ore resources in the Pilbara

Abundant, low cost renewables

Iron ore + excellent solar resources



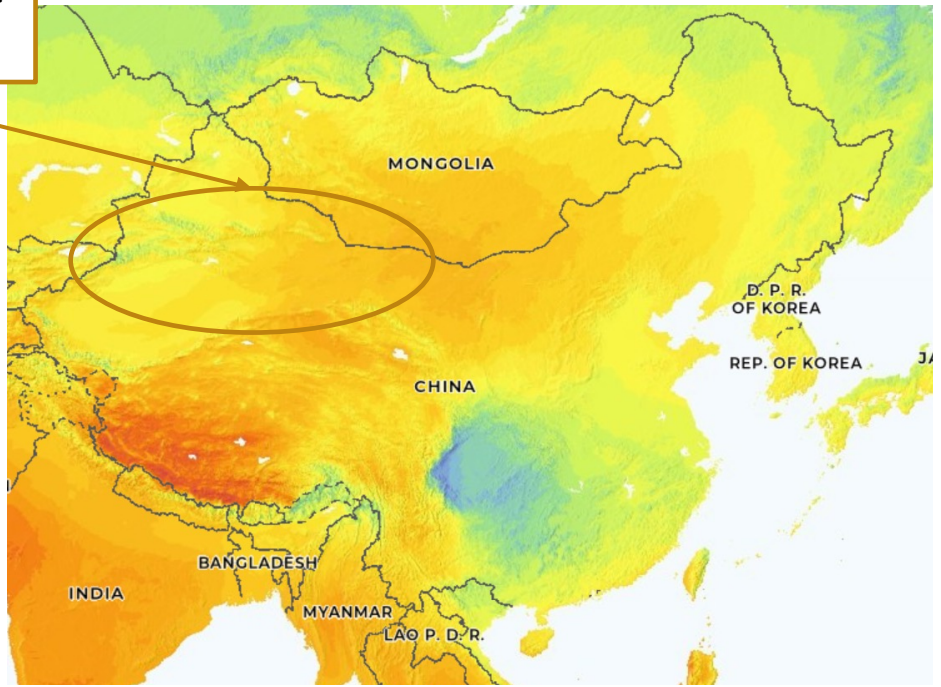


Image source: Global Solar Atlas https://globalsolaratlas.info/map