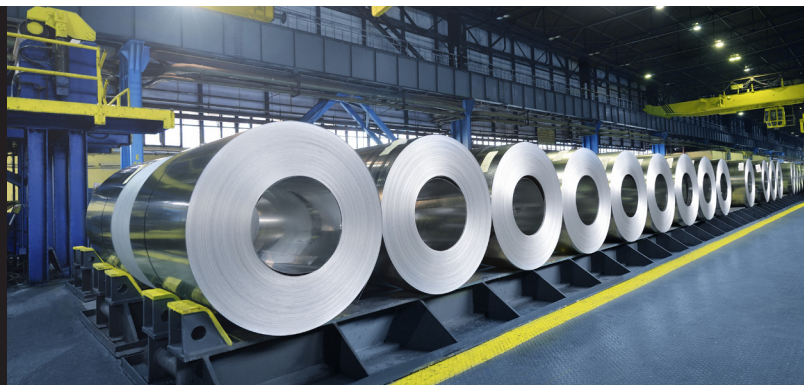
argusmedia.com

July
2021

Argus White Paper:

Decarbonisation of steel is the future



The global ferrous sector's transition towards decarbonisation will not be an overnight switch but a journey, riddled with stumbling blocks. The push from the world's largest steel producer and major iron ore producers to lower emissions underline the structural changes that are already under way for the steel and steel-producing raw materials industry.

China's carbon neutrality goals received another thrust last week when the country launched the world's largest carbon emissions trading scheme, with sectors like steel to be added as soon as 2025.

The country's carbon neutrality goals will be a third factor that affects steel demand this year and onwards, the China Iron and Steel Association Cisa said last month.

Beijing's policies to hold crude steel output flat to 2020 levels and keep individual mills' steel exports flat from a year earlier are having a ripple effect across seaborne markets by cutting supplies.

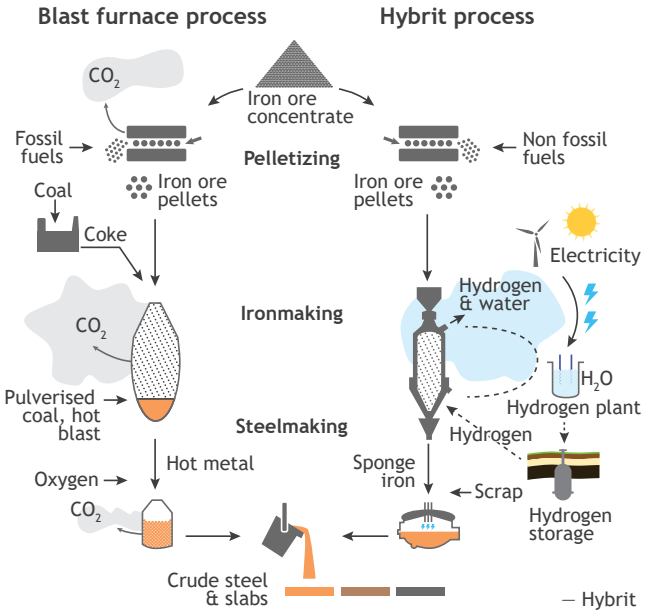
Iron ore, steel's largest input at 1.8bn t/yr of seaborne supplies, will play a key role in reducing the sector's carbon footprint.

The four major global iron ore producers – Rio Tinto, Vale, FMG and BHP – have all set targets to become carbon neutral over the next decade and later. But the change has major implications for iron ore. It finds use in both blast furnace-basic oxygen furnaces and the direct reduced iron (DRI) route. Iron ore is a major reason why steel is one of the "hard-to-abate" sectors, or simply areas where the transition to a lower carbon scenario will be harder to achieve.

Iron ore took a major step toward carbon neutrality last month when Hybrit — an initiative by steel producer SSAB, iron ore producer LKAB and energy company Vattenfall — announced the production of the first hydrogen-reduced sponge iron at a pilot scale. Sponge iron, or DRI, traditionally involves the reduction of high-quality iron ore using a gas or using a carbon source such as coal.

"The Hybrit pilot plant in Lulea, Sweden has completed test production of sponge iron and demonstrates that it is possible to use fossil-free hydrogen gas to reduce iron ore instead of using coal and coke to remove the oxygen," Hybrit said. Around 100t have been made so far, it said.

Hybrit ironmaking

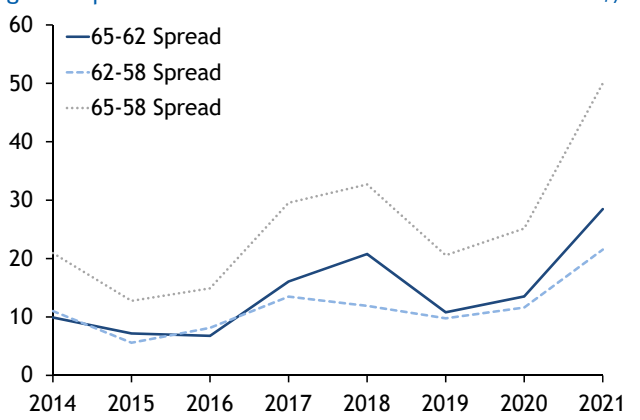


Metals
illuminating the markets

Before green steel

The steel industry's journey towards low emissions is well on its way, pushed even before China announced its carbon neutrality goals. The world's top steel producer made environmental protection a key part of its 13th five-year economic plan rolled out in 2016. The move, along with the steel supply reforms during the period, has pushed China's steel-producing industry to a more profitable permanent state while promoting use of higher grade iron ores. This is reflected in the 65-62 grade spread that has moved structurally higher (see chart).

China's flight to quality has widened iron ore grade spreads



"By 2025, China expects to raise the proportion of its electric arc furnace-based steel capacity, which uses ferrous scrap as the principle raw material, from the current 10pc to over 15pc," the China Metallurgical Industry Planning and Research Institute's chief engineer Li Xinchuang said at the Singapore Exchange's Iron Ore Forum on 13 July. Li conceded that while EAF production may still be small relative to China's output through the blast furnace route, in absolute terms the shift would be sizeable. China produced 1.06bnt of steel last year and is to post higher growth this year compared with a year earlier if it continues to produce crude steel at the rate it did in January-June 2021. China for its part is looking to reach peak steel emissions by 2025 and is pushing greater use of ferrous scrap towards this goal. The push towards lower emissions has come significantly from iron ore producers as well. Rio Tinto and BHP are increasing the proportion of lump ore in the product portfolio, in line with efforts to lower emissions both from their and their customers' operations. Fortescue Metals' Iron Bridge project in Western Australia will increase the quality profile of its product mix. Brazil's Vale already boasts of a high Fe, low impurity iron ore product mix and has benefited substantially from China's pivot towards cleaner steel, perfectly encouraged by high steel-producing margins since the 2018 steel supply reforms.

Inflection point reached

With seaborne iron ore prices and mills' margins at near record levels, one would wonder what is the incentive for mining firms and their customers to tread the unexplored path of chasing green steel? "Where we are with green hydrogen is not dissimilar to where we were with renewables 20 years ago," Fortescue's director of energy Rob Grant said at the SGX forum. "We've had experience now in seeing the co-relations between increasing carbon dioxide concentrations and rising temperatures and the impact on humanity and call to chase lower emissions will come from humanity. It does not matter what the hierarchy of control will be — governments or customers."

Global demand for steel is arguably insatiable. So in theory even when China's steel production, and in turn its iron ore demand, peak, new demand centres will emerge that should be able to offset the loss of demand from China. But the push towards lowering emissions would vary based on where steel-producing capacity is situated, the regulations in place and customers' eventual ability to accept higher costs for more environmentally-friendly products. China faces the challenge of having a blast furnace fleet that is relatively young and built at high capital expenditure, but it is likely to be driven by policy requirements. The push in Europe and US is coming from the old age of the steel-producing capacity, which lends it easier to upgrade, policy and from commitments of steel consumers like auto producers to lower their carbon footprint. Swedish steel producer SSAB is teaming up with Volvo to develop fossil-free steel for use in the automotive industry. Ford aims to become carbon neutral by 2050 by focusing on three areas that account for about 95pc of its CO2 emissions — vehicle use, supply base and company's facilities.

"The further up a value chain a product is taken, the lower the cost of raw material, and as such, customers are expected to be able to absorb the higher cost of low-carbon steel production," the director of the Centre for Energy Technology and deputy director of the Institute for Mineral and Energy Resources at the University of Adelaide Gus Nathan said at the SGX forum.

Hydrogen the way forward

The problem to solve for the steel industry in terms of lowering carbon emissions is seemingly a simple one. To convert iron oxides into purer iron, an agent is required to react with the oxides. This agent is currently carbon-rich metallurgical coke that reacts with the oxide to release carbon oxides. If carbon is replaced with hydrogen, the by-product would be water instead, so problem solved. Efforts are already being made to promote the development of green hydrogen using renewable energy to reduce emissions across sectors. Examples include an integrated green fuels project in Western Australia that is being explored by a group of Hong Kong- and Australia-based companies. The project could produce up to 3.5mn t/yr of green hydrogen, equivalent to over 5pc of current global supplies. China's Hebei Iron and Steel (HBIS) is investigating a number of approaches that will bring down its carbon emissions, with peak carbon emissions by 2022 reduced by 10pc by 2025, by another 30pc by 2030 and to net zero by 2050, its chairman Yu Yong said on a blog for the World Steel Association last month. A second phase would add another 600,000 t/yr by producing iron through the electrolysis of water, the electricity for which will be produced from 100pc renewable sources.

The push from HBIS may well be the indicator for the role that hydrogen plays in the future of China's steel industry.

Fortescue is approaching carbon-neutral goals by aiming for the production of the "cheapest green hydrogen in the world and has set an industry leading target of being net zero by 2030 that will make us the first green iron ore producer globally and that will have competitive opportunities for the business", Grant said.

"Our customers' emissions are our Scope 3 emissions and our ability to offer the customers the cheapest green hydrogen in the world, in the same way we do iron ore, will be a pathway for customers to make their choices on production routes targeting lower emissions," he said. The availability of large-scale, low-cost reliable source of green hydrogen will be a critical path towards decarbonisation for the steel industry. "Our aim is to make the product as green as possible before it leaves Australia, whatever that product is," Grant said.

"Hydrogen is seen as the vector that is closest to commercial reality in the reduction step for steelmaking," Nathan said, pointing to research that if hydrogen can be produced at around $2/kg, then it will breakeven with the conventional route of coal-based steel production in China. "If producing green hydrogen was done by the green electricity route, it would favour countries with availability of renewable electricity, and Pilbara area in Australia has coincidence of low-cost renewable energy that can feed low-cost hydrogen production," he added. This will also save shipping costs of not just hydrogen but also of the impurities contained in iron ore and the water, he said.

Producing clean hydrogen under $2/kg is a priority stretch goal under the Australian government's 2020 Low Emissions Technology Statement.

An uneven world

It is a given that the path of the steel industry towards lower emissions will be uneven, and cost will be a key hurdle to achieving commercial viability. It could take until 2050 for hydrogen-based steel production, carbon capture and storage, as well as carbon capture use, to become competitive options for steel producers, according to consultancy McKinsey.

"Actual funds directed at hydrogen remain very small relative to total energy transition investments," BHP noted earlier this year. It was $1.5bn out of around $500bn in 2020, according to green think tank BNEF. BHP also pointed to the logistical, cost distribution and storage challenges with the use of hydrogen.

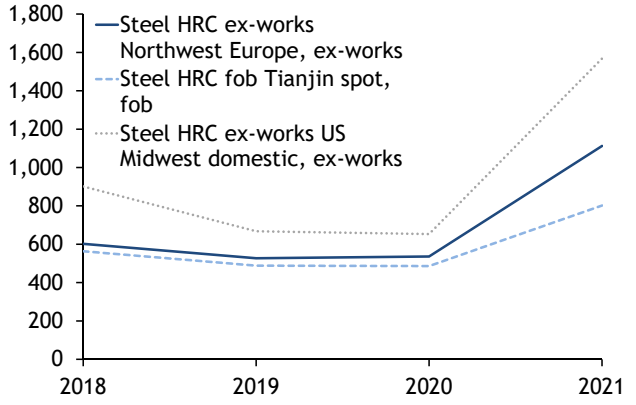
Even ahead of hydrogen's adoption, the steel industry faces challenges in transitioning to a low-carbon world because of inadequate supplies of high-quality iron ore and ferrous scrap. The transition towards low-carbon or green steel is likely to create variations in the price of the final product and arguably in those of raw materials. Low-carbon premiums are already seen in the metals market, with aluminium an example.

"There will be early adopters willing to pay a premium, perhaps, but with scale the costs to decarbonise will come down," Grant said. More specific to the steel industry, China's move to open its doors to ferrous scrap imports, or what they call recycled steel, in line with its green goals is already creating ripples across the ferrous markets on expectations that it could structurally lift the price of the steel-producing raw material and alter trade flows.

The EU is expected to come up with a carbon border mechanism imminently. The European Parliament in March confirmed its preference for the measure to cover energy-intensive sectors such as power, refineries, metals, petrochemicals and fertilizers. The EU Emissions Trading System is arguably the world's first major carbon market and aims to achieve carbon neutrality for the region by 2050, including the "intermediate target of an at least 55pc net reduction in greenhouse gas emissions by 2030".

The current record-high steel prices (see chart) are perhaps masking some of the effect that high carbon prices may bring to the steel market. An uneven path towards greener steel will also raise questions on maintaining the integrity of the value chain, or how do consumers ensure that their green DRI does not turn grey as it changes hands across trading firms. The answer may lie in standardised certifications, with work already under way across the value chain to develop these. Change will be unsettling but the steel industry is on a definitive path.

Surge in international steel prices has widened the spread between China, overseas steel prices *$/t*



For more information on prices and methodology, please contact:

Deepali Sharma - Deputy Editor, Argus Ferrous Markets, Argus

deepali.sharma@argusmedia.com

+65 96447012