# Green Steel in the Frontline of Incoming CBAM

## CBAM當前，綠色鋼鐵進行式

For many years, steel has been one of the industries with the highest carbon emission, and it is also one of the first targets of EU's Carbon Boundary Adjustment Mechanism (CBAM). The production of steel requires using large quantities of coal. Iron ore is put into a steel furnace, resulting in iron oxide, and then hot air is blown into the high-temperature furnace, where coke will melt iron and produce carbon dioxide. **For every ton of steel produced, nearly two tons of carbon dioxide are emitted, making the steel industry responsible for 7-8% of the world's carbon emission.** Steel is the main material for fasteners. Although the research and development of green steel has already been explored before 2010, the development of green steel has gained more attention in recent years as the EU carbon tax is approaching.

The automobile industry is a major user of steel. Volvo Cars said that **steel is a major carbon emitting industry, accounting for 20% to 35% of the carbon footprint of each vehicle. The automotive industry is also concerned about the development of green steel in order to reduce carbon emission and minimize carbon taxes.** Volvo announced that it will use steel made with hydrogen to form automobiles' body structure, making it the first automaker in the world to use green steel. Mercedes-Benz announced that it will use green steel in its cars by 2025.

Consulting firm McKinsey estimates that in the next 30 years, **the global steel industry will need to invest an average of US$145 billion per year in order to "decarbonize" steel, which will increase the cost of steel production by 30%.** The most urgent task of decarbonization for the steel industry is to solve the problem of technical cost. Many steelmakers still use coal-fired blast furnaces, which is doubly carbon-intensive (coking coal is used to absorb oxygen from iron ore, and air polluting energy is used to heat up the blast furnace); instead, a more environmentally friendly approach is to use DRI (direct reduced iron) as the fuel for electric arc furnaces.

### Europe

Swedish steelmakers are now actively developing the use of hydrogen as a substitute for fossil fuels, and have succeeded in producing the world's first green steel, which will be the first to be launched globally. Hybrit—a joint venture between Swedish steelmaker SSAB, state-owned energy company Vattenfall, and state-owned mining company LKAB—aims to reduce the carbon footprint of steel production. **Hybrit uses solar and wind power equipment to generate electricity which is then used to electrolyze water to produce hydrogen, known as green hydrogen. The hydrogen reacts and only water vapor is produced, not carbon dioxide.**

**Instead of using coal, Hybrit uses hydrogen as a reducing agent in steel production. Hydrogen combines with the oxygen in iron ore to produce only iron and water vapor. The water vapor condenses during the process and can be recycled, thus eliminating the generation of carbon dioxide in the first place.** Hybrit plans to expand the production of green hydrogen steel to commercial scale by 2026, by which time it will be ready to supply the market. This will reduce Sweden's total $CO^2$ emission by 10% and help Finland to reduce them by about 7 percent.

In addition, another Swedish steel start-up, H2 Green Steel, expects to start producing green steel in 2024 and to have an annual production capacity of 5 million tons by 2030.

Besides Sweden, German steel group Salzgitter expects to provide the first batch of green steel by the end of 2022; major steel maker ArcelorMittal plans to build a zero-carbon plant in Spain which will produce 1.6 million tons of green steel in 2025; and major steel maker ThyssenKrupp will invest US$1.9 billion in hydrogen direct reduction. ThyssenKrupp, a major steelmaker, has invested US$1.9 billion in a

**hydrogen direct reduction system to produce green steel without the use of rare, high-grade iron,** and will produce 2.5 million tons of low-carbon steel by 2026.

In Italy, the Danieli Group, Leonardo and Saipem have announced a partnership to transform the steel industry into a green one. The three companies have signed a framework agreement to participate in a sustainable transformation project for the steel industry's energy-intensive 1st-level factories, and will jointly provide technologies and services to reduce carbon dioxide emissions from steel production.

GravitHy, a joint venture between many European and American companies, announced that it will build the country's first green steel plant in the Fos region of France in 2024, with an investment of €2.2 billion and an estimated capacity of 2 million tons of direct reduced iron (DRI) per year. The plant will be fully operational by 2027.

## The U.S.

Boston Metal in the U.S. is revolutionizing the steel industry by commercializing a patented molten oxide electrolysis (MOE) process to produce green steel, with a goal of producing 1 billion tons. The company's MOE process uses renewable electricity to convert all grades of iron ore into steel in an energy-efficient, single-step process. **MOE produces no carbon dioxide and does not require the treatment of wastewater, hazardous chemicals or precious metal catalysts.**

## Asia

India's Tata Steel has begun its efforts to switch to green hydrogen-based steelmaking in order to massively reduce carbon emission from steel. The company aims to reduce carbon emission by 30% by 2030, 75% by 2035 and achieve net zero by 2050. The company has also launched a direct reduced iron (DRI) manufacturing facility, which will begin production in 2030 and will supply at least 200,000 tons of carbon-neutral-equivalent steel per year in the future. The company has also launched the **Zeremis Carbon Lite series of low-carbon green steels, which reduce carbon emission by 30%.** For customers with higher carbon reduction targets, Tata Steel said it can be allocated additional carbon reduction certificates and that these low-carbon green steels are suitable for use in industries such as automotive, packaging and white goods.

In Japan, the Liberal Democratic Party (LDP) has been discussing with automotive and steel industry groups to promote green steel manufacturing processes and carbon reduction. Initial estimates suggest that the overall investment in the steel industry will be about JPY 10 trillion. Nippon Steel has formed an alliance of hydrogen-based reduced iron in collaboration with JFE Steel and Kobe Steel, and is working to achieve **Hydrogen Direct Reduction (H-DR), with trials to be launched in 2024-2025. This technology uses only hydrogen to extract iron from low-grade iron ore which contains less iron, and then melts it in an electric furnace.**

South Korean steel companies are also actively developing new furnaces. Dongkuk Steel has initiated research on ultra electric furnace, and plans to complete the research by 2028, focusing on the development of energy-cycling ultra processing technology to improve the efficiency of electric furnaces. The key to an ultra electric furnace is speed of operation and energy efficiency. By speeding up operation, electricity consumption can be reduced, thereby the reduction of carbon emission. **Dongkuk Steel plans to improve the way it preheats and loads scrap steel, and to utilize the Eco-Arc electric furnaces, an environmentally friendly steelmaking facility, to improve power and energy efficiency, leading to the development of ultra electric furnaces, which can reduce power consumption by 30%.**

Hyundai Steel has the largest electric arc furnace production capacity in Korea, at more than 10 million tons annually. The company is working on a carbon-neutral manufacturing system called Hy-Cube and introducing a hydrogen-based steel manufacturing system, a unique integrated manufacturing system based on hydrogen-based manufacturing process. **Hy-Cube is an advanced process that improves on the existing electric arc furnace,** providing greater flexibility in terms of raw materials, manufacturing process, and products, and is **capable of producing a full range of products, including rods and bars, that were originally produced in electric arc furnaces.**

POSCO plans to invest US$462.9 million to build a new electric arc furnace with an annual capacity of 2.5 million tons at its Gwangyang plant in January 2024, which will be launched in 2026. The company will push on carbon reduction by introducing electric furnaces until hydrogen reduction refining becomes commercially viable to replace the current blast furnaces. Unlike Europe's direct reduced iron manufacturing that uses high-grade pellets as feedstock, **POSCO's HyREX hydrogen reduced steelmaking technology produces reduced iron directly from iron ore fines.** POSCO's green hydrogen technology will be combined with HyREX to produce steel when it is ripe.

**Taiwan CSC has collaborated with Jinn Her Enterprise, a major manufacturer in the fastener industry, and succeeded in developing and producing 150 tons of carbon-neutral steel,** which is now actively going through various international certifications and is expected to pass by yearend, thereby relieving pressure on fastener export for Taiwan which has an annual output value of hundreds of billions of Taiwanese dollars.

In China, **Baosteel and Schaeffler Group signed a tactical agreement on the sustainable development of green steel.** The two companies will work together to create a green steel supply chain in the area of steel decarbonization based on a shared concept of sustainable development.

## Green Steel May Help Downstream Business Owners Take Actions for CBAM

CBAM will impose a carbon tariff on steel and fasteners sold from other countries to the EU. In many countries fastener suppliers are small and medium-sized enterprises (SMEs) which are relatively weak in terms of their ability to reduce carbon emission. If upstream steel manufacturers can provide green steel, it will help downstream suppliers calculate their carbon fees and reduce carbon emission.