# Green steelmaking industry

Green Steelmaking

Since the Industrial Revolution， the Earth's average annual temperature is rising. This is mainly due to the burning of fossil fuels which increases the carbon dioxide (CO2) emissions in the atmosphere. Before the industrial revolution， 280 ppm (0.028 %) of the atmosphere consisted of CO2， while at the beginning of 2019， this number has increased to approximately 413 ppm (0.0413 %). Figure 1 shows the increase in annual global temperature and the concentration of CO2 on Earth over the last 800，000 years. The atmospheric CO2 data were provided by the National Oceanic and Atmospheric Administration (NOAA). Since no direct measurements are available， the corresponding information was obtained from ice cores through the European Project on Ice Cores in Antarctica (EPICA).

Figure 1 The onset of global warming

Global warming is actually the result of "too much of a good thing". Without the atmosphere， the Earth's surface would be virtually frozen. When sunlight enters the atmosphere， it is absorbed by the oceans and continents， thus warming them. Most of that heat is then radiated back into space as energy-rich infrared light. This is where the "greenhouse gases" come into play. These gases， consisting mainly of water vapor， carbon dioxide and methane， interact with the infrared light so that it does not leave the atmosphere as it enters space. As a result， "good things" happen and the atmosphere retains its heat. It's just that too much of the warming effect has the negative effect of making the atmosphere too warm.

While promoting a clean energy transition， steel is also an important factor in the current challenge the world faces in meeting climate goals. With its heavy reliance on coal and coke as fuels and reducers， the industry's direct CO2 emissions are about 2.6 gigatons per year， or about a quarter of industrial CO2 emissions. In addition， a further 1.1 billion tons of CO2 emissions are caused by the use of its exhaust gases and other fuels to generate electricity and import heat.

The current high dependence on coal for primary steel production， long-term capital assets， and the sector's impact on international trade and competitiveness make the transition to near-zero CO2 emissions challenging. It is for these reasons that the sector is sometimes referred to as one of the "hard to abate" sectors.

Meeting the demand for steel products poses a challenge to the steel sector as it seeks a more sustainable path while remaining competitive. Steel producers therefore have a major responsibility to reduce energy consumption and greenhouse gas emissions， develop more sustainable products， and improve their competitiveness through innovation， low-carbon technology deployment and resource efficiency.

Recent studies estimate that the global steel industry can find that around 14% of its potential value is at risk if steel organizations fail to reduce their environmental impact. Therefore， decarbonization will be a top priority to maintain economic competitiveness and retain the industry's license to operate. In addition， the long investment cycle of 10 to 15 years， the need for billions in financing， and limited supplier capacity make this issue even more relevant and lock in a significant lead time to address the decarbonization challenge.

The steel industry has recognized that long-term solutions are needed to address CO2 emissions from steel production processes. As a result， the steel industry has been very proactive in improving energy consumption and reducing CO2 emissions. Since 1975， energy efficiency improvements have reduced the energy required to produce one ton of

crude steel by approximately 50% in most top steel producing countries. Further energy efficiency improvements are being made by expertly maximizing the use of state-of-the-art technology.

Figure 1 shows that since the industrial revolution， atmospheric carbon dioxide levels have risen from 280 ppm to 413 ppm. carbon measurements show that this increase is associated with the burning of fossil fuels (coal， oil and natural gas). Although 1 degree Celsius does not seem high， it is believed that any further increase will have serious consequences， such as the loss of sea ice and the receding of glaciers， leading to a rise in sea level， which is currently measured at an average of 3.3 mm per year. To avoid the adverse effects of climate chances， global warming needs to be kept below 2 degrees Celsius.

In terms of total global fossil and industrial emissions， the steel industry is a specialized single sector， accounting for 7% to 9% of greenhouse gas (GHG) emissions. It is a specialized industrial emission source， currently accounting for about 8% of global final energy demand. As such， it is a primary concern for governments. On the other hand， steel is critical to modern economies and， as such， global demand for steel is expected to grow to meet the growing demand for social and economic welfare. It is also a key input to the clean energy transition. The generation and use of electricity depends in part on the ferromagnetic properties of steel and its alloys. Steel is a key input material for wind turbines， transmission and distribution infrastructure， hydroelectric and nuclear power plants， and other key energy sector assets.

Green steelmaking includes the use of processes that reduce CO2 emissions. Green steelmaking processes are being developed in the EU， US， Canada， bar West， Japan， Korea， Australia and China. For the development of green steelmaking technologies， five key directions are being explored. These directions are (1) technologies involving coal use， (2) technologies involving hydrogen use， (3) technologies involving electrons， (4) technologies involving biomass use， and (5) technologies involving carbon capture， use，