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Decarbonization of Steel: Challenges and Opportunities for Modern Steelmakers and Carmakers

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The steel industry contributes approximately 7-8% of global CO_2 emissions. To reduce its environmental impact, technologies for producing "green steel"are being developed, including the use of the Electric Arc Furnace (EAF). This technology uses scrap, Direct Reduced Iron (DRI), and Hot Briquetted Iron (HBI) as raw materials, managing to reduce energy consumption
(-30%) and greenhouse gas emissions (-77%) compared to the traditional blast furnace method. Additionally, EAF allows the production of various steel types and in different quantities, adapting to market demands.
However, decarbonizing the steel sector presents significant challenges. The cost of converting blast furnaces to EAF is high, making investment difficult for medium-sized companies. Furthermore, the low price of traditionally produced steel ($580-640/ton in 2025) makes it uncompetitive to increase the selling price to recover the investment.
Another issue concerns raw materials. The use of scrap requires strict control of its chemical composition to prevent the presence of residual elements (Cu, Ni, As, Sn, Mo, Cr, Zn, Pb, V, Nb), which can compromise mechanical properties. Additionally, as green steel production increases, a shortage of scrap could occur, leading to rising costs.
To address this problem, DRI and HBI are used as feedstock, replacing fossil-based reducing agents with hydrogen to eliminate CO_2 emissions. However, hydrogen is expensive and not readily available on a large scale, increasing overall production costs. Moreover, it must be produced using renewable energy sources to ensure a real reduction in emissions.
Projects such as HYBRIT® and "Safe&Clean"aim to develop steel that is competitive in both cost and performance compared to traditionally produced steel.
HYBRIT® wants to create the first zero-emissions steel using DRI/HBI and EAF and put it on the market next year. Meanwhile, the EU project aims to investigate the number of elements that decrease the material's properties through various mechanical-computational tests.

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