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Ammonia as a Cost-Effective Energy Carrier for Decarbonization in the European Steelmaking Industry

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This paper analyses the potential of ammonia in the decarbonization race within the steel industry and gives an outlook in presenting realistic, cost competitive decarbonization solutions such as the Paul Wurth EASyMelt. Ammonia, with its high hydrogen content and established infrastructure, presents a viable alternative to pure hydrogen. The European Union's commitment to carbon neutrality by 2050 has driven the exploration of low-carbon technologies. Traditional steelmaking processes, which rely heavily on coking coal, produce approximately 1.8 tonnes of CO2 per tonne of steel. Transitioning to hydrogen-based Direct Reduction of Iron (H-DRI) can reduce these emissions significantly. However, the high costs associated with hydrogen production and storage pose economic challenges.

Ammonia offers a cost-effective solution due to its lower production and storage costs compared to hydrogen. The production of ammonia via renewable energy sources, such as wind or solar power, can achieve near-zero carbon emissions. In Europe, the cost of renewable electricity can be €100/MWh or more due to the high demand. Fortunately, ammonia enables large energy consumers to use imported and stored energy efficiently from regions with significantly lower renewable electricity prices below 30€/MWh. Ammonia can therefore significantly lower OPEX for large industrial hydrogen consumers, whilst leveraging existing infrastructure to minimize CAPEX.

Additionally, ammonia's efficient integration in CO2 lean steelmaking process can further enhance its economic viability. For instance, the cost of producing hydrogen through electrolysis is estimated at €4-8/kgH2, whereas ammonia production costs are lower, at approximately €2-4/kgH2. These cost advantages are further amplified by efficient usage in the Paul Wurth EASyMelt process, positioning ammonia as a key enabler for the decarbonization of the steelmaking industry in Europe.

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