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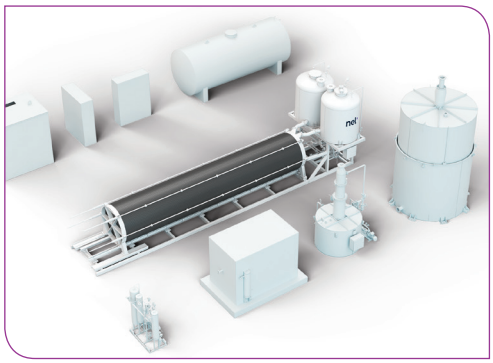
Unlocking the potential of renewables

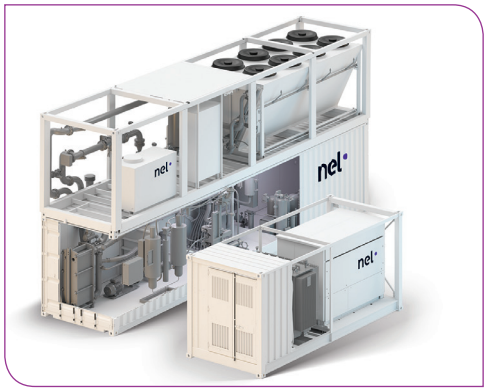
Green hydrogen steelmaking will grow with suporting infrastructure

For anyone who follows industry news, there has been a buzz about hydrogen-enhanced EAF (electric arc furnace) steelmaking that can reduce CO_2 emissions by a total of up to 90% compared with traditional blast furnace and BOF (basic oxygen furnace) steelmaking. Hydrogen can provide both thermal energy and reducing reactant conditions, in place of coal and natural gas in steelmaking while releasing only water vapour rather than climate-damaging CO_2. The benefits and technology to use hydrogen in place of coal and coke for steelmaking are generally understood now, and there are challenges and emerging solutions for producing hydrogen so that it's truly impactful for the steelmaking industry. Among the remaining challenges include making enough hydrogen and making it in a way that is environmentally superior – ideally from renewables. Further, the hydrogen must be made at a price that the market will buy. And, of course, there needs to be enough customers wishing to invest in green hydrogen and green steel.

Addressing all these concerns, our company, Nel Hydrogen, has launched a target to reach a $1.50 per kilogram cost of hydrogen by 2025. That target will enable the industry to compete with fossil-derived hydrogen and advance towards cost parity with natural gas for direct reduced iron (DRI) production. It is believed that DRI process customisation for the use of hydrogen, may bring the process the rest of the way to full parity with natural gas reducing.

Electricity is the most important determinant of hydrogen cost when using water electrolysis on a large scale. Water electrolysis runs on electricity. Therefore, investments in increasing electrolyser efficiency, and reducing electrolyser capital expense (CAPEX) are important, especially considering intermittent renewable supplies. Nel is investing to reduce CAPEX in both its alkaline and proton exchange membrane (PEM) electrolysers. While some CAPEX cost reduction techniques are common for both, such as larger volume manufacturing and advancements in automation, PEM is earlier in its technology life cycle and has multiple opportunities for technology innovation around optimised materials, more efficient use of precious platinum group metal catalysts, and advanced component design.





Nel builds alkaline electrolysers in Norway and builds PEM electrolysers in the United States. In Norway, Nel is dramatically increasing its production capacity. Currently, it's at 40 megawatts per year (input electrical power to electrolysis) and will increase shortly to 500 megawatts per year with the completion of our new plant, progressing to 2000 megawatts per year with subsequent expansions. In the US, the company is increasing its production for PEM systems to 50 megawatts per year, with additional expansion planned as demand increases.

In another development, we are vastly increasing the size and capacity of our PEM electrolyser cell stacks by a factor of 20, boosting the energy capability of a single stack to generate hydrogen reliably and efficiently. The company is also reducing the CAPEX of its PEM electrolysis equipment by transitioning from largely handmade membrane electrode assemblies containing platinum group metals, to volume production roll to roll manufacturing of membrane electrode assemblies.

Operational considerations will drive costs and create opportunities. The lingering questions are: When will hydrogen storage become more cost effective? What role will be played by alternative hydrogen outlets such as vehicle fuel, chemical intermediates, natural gas pipeline injection and more? One thing is certain, as the coming years unfold, these issues will be resolved. When the steel industry is ready, hydrogen generation will be ready, and in fact it's not all theoretical and wishful thinking. Pilot hydrogen steel plants are coming online in northern Europe now. Nel is providing the hydrogen electrolysers for these pioneering plants, and much will be learned and gained by this experience.

David Wolff
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Nel Hydrogen