

Carbon Recycling Technology (CRT): An Enabling Platform for Green Iron and Industrial Decarbonisation

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The global energy transition is often framed as a challenge of generating clean electricity. While this is essential, heavy industries such as steel, aluminium, magnesium, and silicon production operate on fundamentally different principles. These industries do not simply consume electricity; they rely on **high-temperature chemical energy carriers and reducing gases** to transform raw materials into useful products.

Steelmaking illustrates this challenge clearly. Modern **Direct Reduced Iron (DRI)** processes require hot reducing gases to convert iron oxide into metallic iron. Even in hydrogen-based DRI systems, electricity must first produce hydrogen through electrolysis, and then additional energy must heat that hydrogen to approximately **800–900 °C** before it can act as a reducing agent in the shaft furnace. For a typical **2 million-tonne-per-year green-iron plant**, hydrogen production alone may require **750–800 MW of electrolysis power**, with an additional **50–60 MW** required simply to heat the hydrogen to the required reaction temperature. In other words, the system must manufacture both the molecule and its thermal state before metallurgical reduction can begin.

Conventional MIDREX plants avoid this inefficiency by generating **hot reducing gas directly in the reformer**, where methane reforming simultaneously produces hydrogen, carbon monoxide, and the required process temperature. This architecture—where chemistry and heat are created in the same step—has made gas-based DRI one of the most efficient ironmaking routes available.

Carbon Recycling Technology (CRT) seeks to preserve this industrial architecture while eliminating the need for fresh fossil inputs. By integrating renewable hydrogen with recycled carbon in a closed-loop system, CRT produces **hydrogen-rich molecular energy carriers** that can deliver heat, reduction chemistry, and power generation within the same platform.

Rather than treating electricity generation, hydrogen production, and industrial heat as separate systems, CRT integrates them into a **single enabling energy infrastructure**. This platform can supply:

- firm renewable power
- hydrogen-rich reducing gases
- high-temperature industrial heat
- recyclable carbon-based fuels

Once such an energy platform exists, **green iron production becomes a natural extension**. A DRI shaft furnace can simply be integrated into the system, using the hydrogen-rich reducing gases already available to convert iron ore into metallic iron.

This approach highlights an important principle of industrial decarbonisation: while electricity powers machines, **molecules transform materials**. Heavy industry therefore, requires not only clean electricity but also scalable pathways to produce the high-temperature chemical energy carriers needed for metallurgical and industrial processes.

Carbon Recycling Technology provides a pathway toward such an integrated system—supporting green iron production while simultaneously enabling the broader decarbonisation of energy-intensive industries.