

Green Direct Reduction of Iron (GDRI)

Grimes Carbon Tech (GCT)

A net negative green technology company changing the world

October 2024



CAPER (Caustic, Aqueous-Phase, Electrochemical Reforming)

Distributed CAPER systems using low-grade waste heat to produce hydrogen on-site & on-demand with a zero or negative carbon footprint

Steel demand to grow steadily through 2050

Steel produces about 3.6 billion tons of CO₂ or 10% of all global carbon emissions

Mining & steel production are difficult to decarbonize

- Blast furnace production hit 1.95 million tons in 2021 - 67% of total steel output
- Blast furnace production generates 2 tons of CO₂ per ton of crude steel
- Direct iron reduction using natural gas reduces this to 0.5 tons of CO₂ per ton of raw steel
- Average CO₂ emissions are 1.91 tons CO₂ per ton of raw steel
- Direct reduction & Electric Arc Furnace emissions depend on the carbon emitted by the related electrical generation
- Green Electrons are intermittent & scarce, while Green Hydrogen is prohibitively expensive

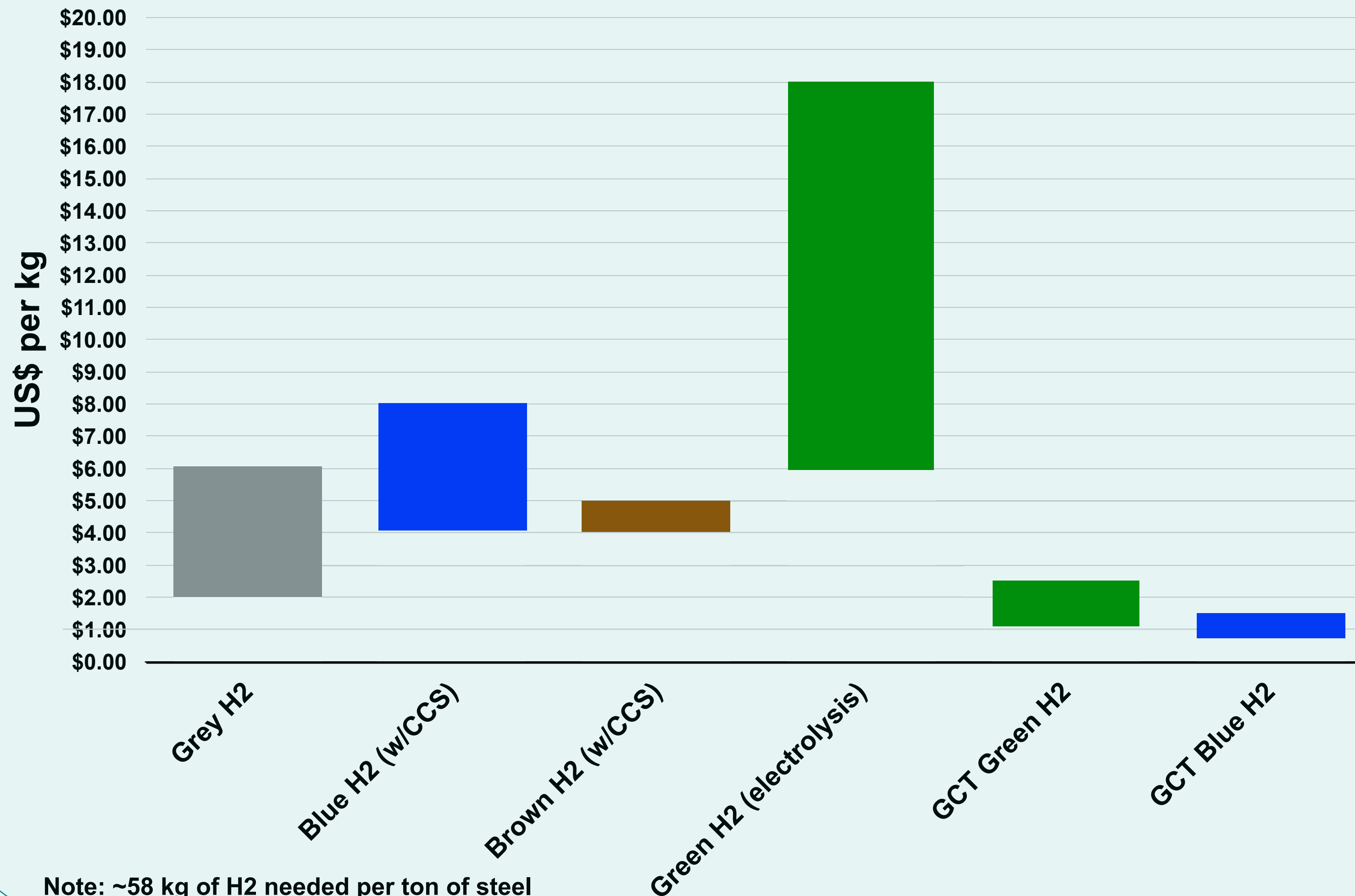




GCT can make affordable green H2 and/or electricity without subsidies

Makes onsite, on-demand hydrogen from benign, logistically compatible feedstocks

Comparison of Production Costs for Hydrogen



GCT CAPER process:

- Can use sugar juice directly & all waste by converting it to methanol & then Green H2 & electricity .
- Can operate on low-cost, raw ethanol.
- Long-term feedstock contracts offer price stability.
- Create blue electricity from natural gas or coal. When coupled with the CCR, this fossil carbon can be recycled as cost-competitive syngas or liquid fuels
- Onsite, modular systems can be added as needed & offers unparalleled system reliability.
- GCT,s hydrogen costs will make Green Steel economically viable without the need for subsidy.

CAPER increases overall system efficiency using multiple benign fuels

Can reduce hydrogen cost by 50% to 75% - make green steel cost competitive

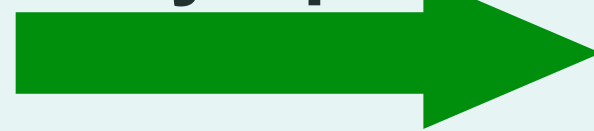
Inputs



Ethanol or
Methanol



Syrup



Carbon
Slurry

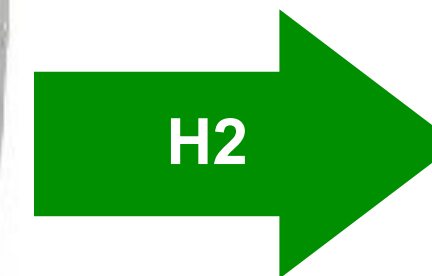


CNG, LNG or
Pipeline
Natural Gas



Modular, flexible and distributed

GCT's CAPER converts coal slurry in modular, factory-built shipping containers that eliminate the need for H₂ pipelines. The CAPER can be operated alone or integrated with a CCR system to produce fuels



Low energy, liquid-phase

GCT's CAPER operates on waste heat (< 200°C) and in liquid-phase, eliminating the need for gas-phase compression, a major cost. The system only produces H₂, eliminating the need for gas separation as well.

Users



Rotary Kilns



Vertical Kilns