

CIO Viewpoint

Hydrogen's premature promise of Big Bang power

Investment Solutions

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The transition to a new and clean economic model demands novel solutions to our energy needs. Hydrogen-derived energy offers one potential path, with the promise to transform some of the most carbon-emitting industries. Still, in the near term it remains an embryonic and expensive technology lacking obvious winners in the race to scale up.

Created at the Big Bang, hydrogen accounts for an estimated three-quarters of the universe's matter, including 9.5% of the [human body's](#) mass. It is the fuel burned by most stars to generate energy, in a process known as fusion. Five billion years from now, our own closest star, the sun, will run out of hydrogen.

Colourless, odourless and highly flammable, the lightest and simplest chemical is also, unfortunately, not yet cheaply available in large quantities through clean technologies. Here on earth we have to derive the element from water and/or fossil fuels.

Produced from renewable resources, hydrogen has the advantage of zero CO₂ emissions when used. However, so-called green hydrogen also remains an expensive source of energy to produce, technical to [store](#) and has some awkward side effects, including being explosive and, for example, making some metals brittle.

It is 350 years since the scientist and alchemist Robert Boyle noticed a reaction between iron and acid that created hydrogen gas. Almost a century later, physicist Henry Cavendish showed that when burned, what he called 'inflammable air' produces water. The element takes its Greek name from 'hydro' and 'genes,' meaning 'water forming.'

Hydrogen technologies do not yet have the capacity to solve all our clean energy requirements, but they may contribute to cutting CO₂ emissions from heavy manufacturing such as iron, steel and concrete production, which together account for nearly half of industrial carbon pollution. It is also used in manufacturing ammonia for fertilisers and combined with liquid oxygen, liquid hydrogen stored at -252 degrees centigrade already [powers NASA's rockets](#).



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Key takeaways

- Clean hydrogen offers a partial solution to the sustainable energy transition with demand forecast to rise eight-fold by 2050
- From 'clean' or 'dirty' resources, hydrogen is not an energy source like solar, wind or oil, but an energy carrier, like electricity. Production, infrastructure, storage and cost challenges remain
- Government investments and commitments to clean hydrogen are high, especially in the EU, because it offers a route to decarbonising heavy industry and some forms of transport
- Green hydrogen presents an uncertain investment challenge but looks more viable over time thanks to subsidies and partnerships with existing energy firms.

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A production spectrum

Green hydrogen is the cleanest form but also expensive, as it is produced from water by electrolysis using renewable electricity. The clean energy industry colour codes other sources of hydrogen, according to how they are produced. Brown hydrogen uses coal, making it the dirtiest and cheapest, while grey hydrogen is the commonest form, made from natural gas. Blue hydrogen seeks to offset the environmental impact of grey hydrogen by storing the resulting carbon dioxide underground, known as 'carbon capture,' and is being explored as an alternative, or a complement, to green.

One factor holding back green hydrogen is cost. The hope is that as the technology improves and the scale increases, green hydrogen will achieve cost-parity with polluting grey hydrogen. We have already seen how solar energy has become the cheapest available source of electricity as developments have cut costs five-fold over the past decade, and green hydrogen could be poised to follow a similar transformation path.

The question is how quickly hydrogen will become a large-scale solution. Over the next three decades, demand is expected to rise [eight-fold](#), supported by regulation and government financing. Much of that transition will only be possible through government investment in building the massive infrastructure to compete with fossil fuels, including hydrogen distribution networks and transport systems.

Cost-effective hydrogen also depends on correctly pricing carbon emissions and public subsidies, as the wind and solar industries have already proven.

As the costs of producing green hydrogen energy fall, advocates argue that a tipping point is inevitable. The price of producing hydrogen from renewable sources of electricity may drop by 30% this decade, according to the [International Energy Agency](#) and a 50% cut would make it as cheap as grey hydrogen. This turns it into a necessary tool in the transition to more sustainable and inclusive economy, but not the answer to all of our energy issues. Clean hydrogen, according to the European Commission, could answer one quarter of the globe's energy needs by 2050, a ten-fold rise from today, adding up to energy sales worth EUR 630 billion annually.

The European Union is the clear leader in clean hydrogen with more renewable projects announced or already up and running than elsewhere. The bloc is committed to cutting its CO₂ emissions by more than half before 2030 and the European Commission estimates that hydrogen investment commitments of as much as EUR [470 billion](#) over the next three decades may generate as many as 5 million jobs.

Iberdrola, a Spanish utility, for example is scheduled to invest EUR 150 million in a green hydrogen [project](#) at Puertollano, Spain. The construction will create the largest industrial green hydrogen plant in Europe with the goal of decarbonising the highly polluting process of manufacturing fertiliser. Nevertheless, ramping up to full industrial scale will require public support for the nearly EUR 2 billion investment to 2027.

China is a potential rival, with many hydrogen projects, including solutions for transport as well as industrial applications including steel and power generation. North America accounts for 19 projects, or fewer than 10% of hydrogen projects globally. In the US, the Biden administration has committed to producing green hydrogen more cheaply than grey hydrogen from shale gas and energy firm SGH2 is building a [facility](#), promised to become the world's biggest, in Lancaster, California.

Early-stage investments

Investments into hydrogen technologies have proven volatile. While some fuel cell and electrolyser makers recorded large gains in their share prices last year, they have since slipped as part of the wider cyclical stock rotation. Many are yet to show a profit. Partnerships with existing energy providers should provide more robust business models.

Large oil companies have recognised that hydrogen offers the chance to make their business models more sustainable. Grey hydrogen also offers a future for fossil fuels that does not exist under other sustainable energy sources of electrification. Using natural gas in the production of hydrogen for passenger vehicles, for instance, already lowers CO₂ emissions by 30% compared with a diesel-fuelled car.

Globally, a successful transition to sustainable energy and a fundamental shift in energy supply depends on a range of alternative sources, including hydrogen. With the need to over-build sustainable energy infrastructure to compensate for the naturally irregular supplies from wind and solar power, hydrogen has to form part of the solution to our energy needs. As the technologies are still at an early stage, and the vast majority of production sourced from fossil fuels, we believe that hydrogen has not yet come of age.

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