



Addressing the energy transition challenge: Hydrogen

CSIRO actively researches the challenges associated with the transition of energy, industrial, manufacturing, agricultural and transport sectors to meet Australia's net zero emissions ambitions.

As Australia's national science agency, CSIRO is well positioned to support governments, industries and communities through the energy transition.

Science and innovation will be critical in supporting Australia's transition, which is being driven by new technologies, changing consumer preferences, and efforts to reduce greenhouse gas emissions.

As we move towards a net-zero emissions future the four key components of the energy sector – electricity, industry, transport and exports – are evolving rapidly. In this dynamic landscape, CSIRO provides reliable, actionable, evidence-based research.

Here we look at the role of hydrogen.

The challenge: Clean hydrogen under \$2 per kilogram

As we move towards a net-zero emissions future, the four key components of the energy sector – electricity, industry, transport and exports – are evolving rapidly.

This leads to the complex question of how to make the transition to a low carbon economy while also maintaining or increasing productivity, competitiveness and economic growth.

In order to meet Australia's net zero ambitions, we must focus on the assessment, development, and demonstration of priority low emission technologies.

One of these is clean hydrogen.

Clean hydrogen is a key component of the Australian Government's technology-led emissions reduction policy, and is listed as one of five priority low emissions technologies.

It has the potential to transform the energy sector – powering vehicles, generating heat and electricity, energy storage, and serving as a feedstock in industrial applications (for example fertiliser). It will also allow for the export of renewable and low emissions energy.

In order to build Australia's clean hydrogen industry and deliver a secure, resilient and sustainable energy system, there are a number of obstacles that must be overcome. These include cost challenges relating to production, storage, distribution and using hydrogen, as well as issues around safety and environmental impacts.

Blue and green hydrogen

Since Hydrogen does not exist in its pure form in huge abundance, it needs to be extracted from other sources such as water, fossil fuels or biomass. The different extraction processes have different emissions profiles – often described as the 'colours' of hydrogen.

The two most common colours are green and blue hydrogen.

Blue hydrogen is produced by reacting steam with fossil fuels. These processes result in the production of greenhouse gases, which must be captured and sequestered using carbon capture use and storage (CCUS) technologies. In the short term, this is likely to remain the lowest-cost method for producing clean hydrogen.

Green hydrogen is extracted by using an electrolyser to split water into hydrogen and oxygen – a method that does not produce greenhouse gas emissions if the electrolyser is powered using renewable energy. The cost of green hydrogen production is likely to fall as clean hydrogen demand grows.

What is the goal?

Australia's vision for a clean, innovative, safe and competitive hydrogen industry is guided by a number of key documents.

These include the National Hydrogen Strategy, which was adopted by all federal, state and territory governments in 2019; and CSIRO's 2018 National Hydrogen Roadmap, which considers the commercial readiness of different industrial applications for hydrogen and is designed to help inform the next series of investments among stakeholder groups.

Most recently, the Australian Government published the 2020 Low Emissions Technology Statement (LETS), which stated a goal of clean hydrogen under \$2 per kilogram. At this price, clean hydrogen becomes cost competitive with fossil fuels in industrial applications such as producing ammonia, as a transport fuel and for firming electricity.

It's estimated that a domestic hydrogen industry could generate over 8,000 jobs and \$11 billion a year in GDP by 2050, and would result in avoided greenhouse gas emissions equivalent to a third of Australia's current fossil fuel emissions by 2050.

One critical element to the success of the Australian hydrogen industry is fostering innovation and creating hydrogen hubs – clusters of large-scale supply and demand that will provide the industry with enough scale to decrease production costs and encourage infrastructure investment.

What is CSIRO doing to help?

CSIRO led the development of the National Hydrogen Roadmap, which represented a major turning point in the development of Australia's hydrogen industry.

Now, CSIRO is supporting Australia's National Hydrogen Strategy through the Hydrogen Industry Mission: a five-year, \$68 million initiative.

Missions are large-scale, major scientific and collaborative research initiatives aimed at solving some of Australia's biggest challenges.

Our focus is on research, development and demonstration that de-risks and fast-tracks emerging hydrogen technologies. We have a portfolio of projects, developed in close consultation with industry and government, each of which helps us get closer to the goal of clean hydrogen under \$2 per kilogram. Our activities include:

- A Hydrogen Knowledge Centre, to capture and promote hydrogen projects and industry developments across Australia. The first module, HyResource, was launched in September in collaboration with National Energy Resources Australia (NERA), the Future Fuels Collaborative Research Centre and The Australian Hydrogen Council.

- Feasibility and strategy studies to deliver trusted advice to government, industry and the community. This builds on recent hydrogen cost modelling and barrier analysis provided as part of developing the National Hydrogen Strategy.
- Demonstration projects that validate hydrogen value chains and de-risk enabling technologies, through initiatives such as a new refuelling and technology demonstration facility in Clayton, Victoria, with Swinburne University and the Victorian Government.
- Enabling science and technology through investment in breakthrough science, including through CSIRO's Hydrogen Energy Systems Future Science Platform, and a \$20 m partnership with Fortescue Future Industries that focuses on the development and commercialisation of new hydrogen technologies.

CSIRO is also leading the Hydrogen Research, Development and Demonstration (RD&D) International Collaboration Program, funded by the Australian Government, which aims to build domestic hydrogen RD&D capability by stimulating international research connectivity and knowledge sharing in support of Australia's hydrogen industry development.

Further reading

CSIRO links

[Partner with us to tackle Australia's greatest challenges – CSIRO](#)

[National hydrogen roadmap](#)

[Hydrogen RD&D report](#)

[HyResource \(csiro.au\)](#)

More information on the international collaboration program see [CSIRO's media release](#)

[csiro.au/hydrogen](#)

Other Australian links

Australian Hydrogen Council. The AHC is the peak body for the hydrogen industry, representing members across the entire hydrogen value chain. <https://h2council.com.au>

Australian government
<https://www.industry.gov.au/policies-and-initiatives/growing-australias-hydrogen-industry>

Australian Association for Hydrogen Energy (AAHE)
<https://hydrogenaustralia.org>

ARENA
[Hydrogen energy – Australian Renewable Energy Agency](#)

International

IEA
<https://www.ieahydrogen.org>
[Mission Innovation Clean Hydrogen Mission](#)

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