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Hydrogen as an energy source

What is hydrogen?

Hydrogen is a colourless, odourless, and highly flammable gas. It is the lightest element in the periodic table and is the chemical element with the symbol H and atomic number 1. It is a potential clean and sustainable energy source that can be produced without generating emissions into the atmosphere.[1]

What can it be used for?

As an energy carrier, hydrogen can replace some fossil fuels and can support renewable power production through the storage of surplus renewable energy. It can also be used as a raw material (termed 'feedstock') to fuel machinery and in chemical production.[2]

Hydrogen is used for home heating and cooking, travel and transport, business and industry, and the export industry (supplying global markets).[3] In Australia, potential low-emissions hydrogen exports could reach a value of $2.2 billion by 2030 and $5.7 billion by 2040.[4]

What are the main challenges in using hydrogen?

- **Safe network for distribution:** Hydrogen must be transported over long distances and pumped as a gas from its place of production to its places of use: in homes, factories and refuelling stations.
- **Transportation of hydrogen:** Options include (i) using gas pipelines 'similar to natural gas'; (ii) as a compressed gas transported by truck, trains, and boats; OR (iii) liquid hydrogen that stores more energy in a smaller space. Note: the cooling process for liquid hydrogen is expensive and energy intensive.
- **Sustainable production and low to zero carbon emission**.[5]

What are the types of hydrogen?

There are four types of hydrogen. A colour-code system is used to distinguish between the different types of hydrogen production. Each colour refers to the level of the environmentally friendly processes used in that production.[6]

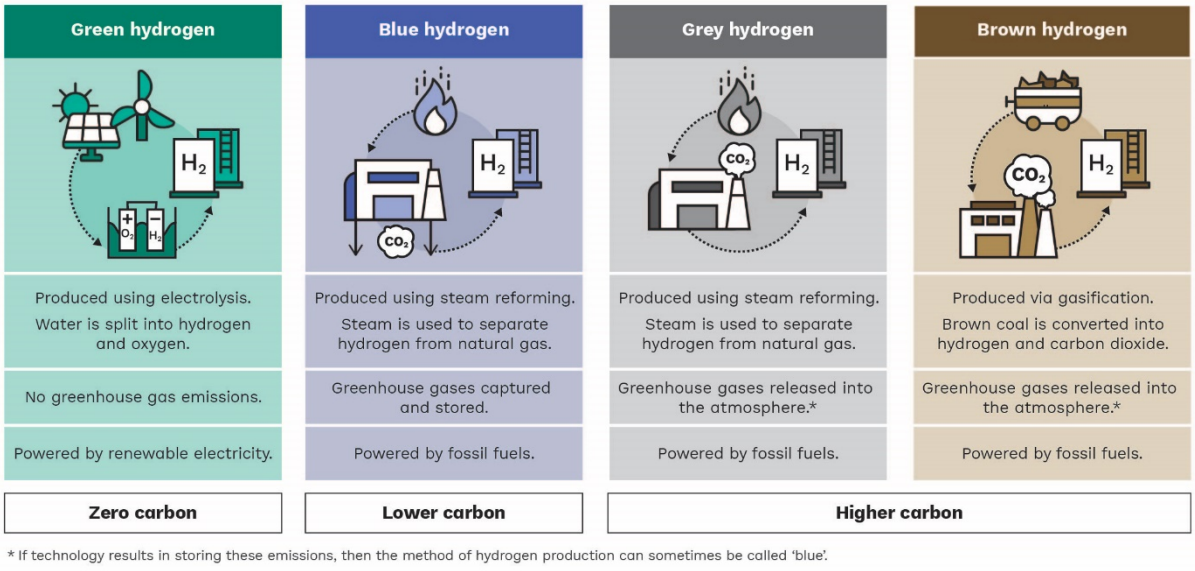
Green hydrogen is made from water, using renewable electricity, and there are no CO_2 emissions.

Blue hydrogen is made from natural gas, using fossil fuels, and the CO_2 emissions are then captured and stored. Storage is known as carbon capture utilisation and storage (CCUS). Blue hydrogen is the cheapest to produce. It is estimated that, over the next three decades, green hydrogen has the potential to become the dominant form of production as costs drop.[7]

Grey hydrogen is made from natural gas, using fossil fuels, and the CO_2 produced is emitted into the atmosphere.

Brown hydrogen is made from coal, using fossil fuels, and the CO_2 produced is emitted into the atmosphere.[8]

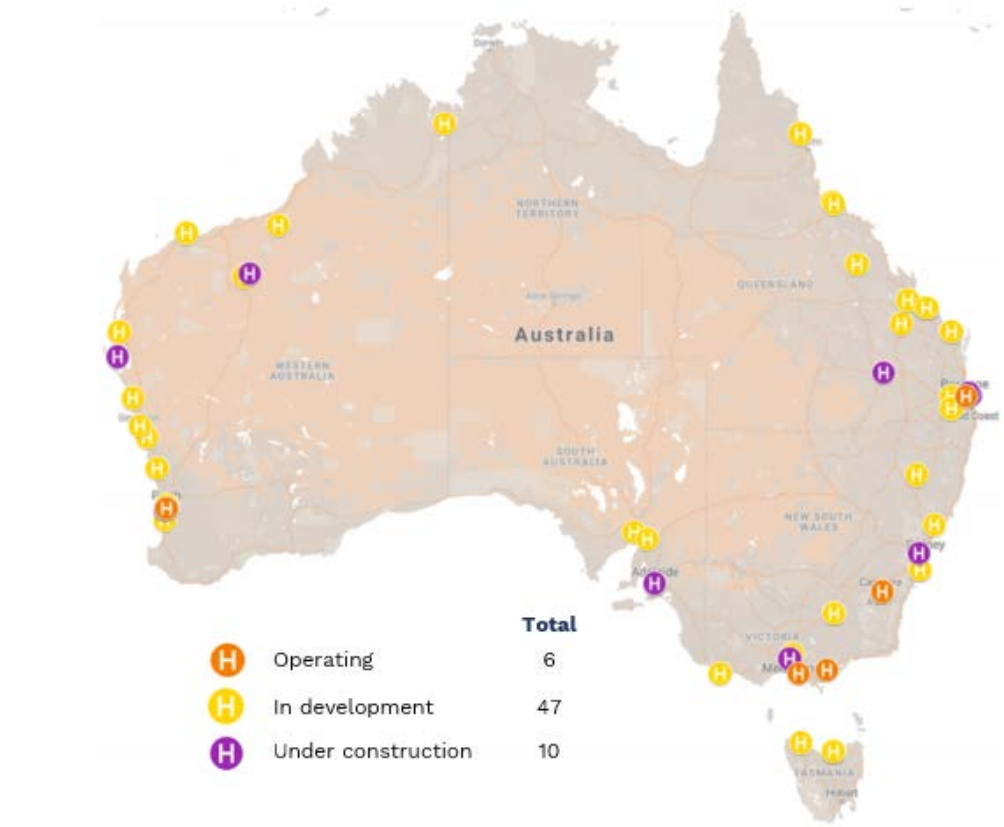
Figure 1: Methods of hydrogen production

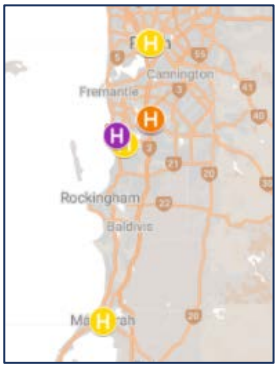


Hydrogen projects in Australia

In Australia, the main methods of hydrogen production are known as **renewable hydrogen** (made with electrolysis using renewable sources) and **CCS hydrogen** (made with a thermochemical reaction from coal or natural gas, where CO_2 emissions are captured and stored).[9]

Figure 2: Hydrogen projects in Australia





Perth

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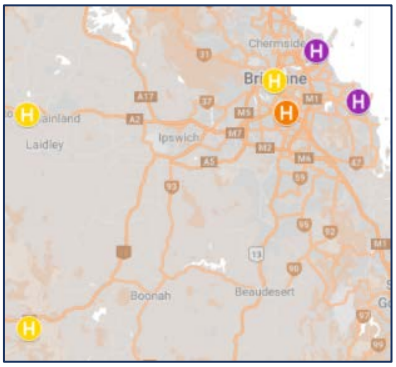

Brisbane

Please see the Geoscience Australia website for further information.

Further reading

- Victorian Hydrogen Hub / Swinburne University of Technology (launched in 2021)
- Victorian Renewable Hydrogen Industry Development Plan / Department of Environment, Land, Water and Planning (2021)
- ACT Sustainable Energy Policy 2020–25: Discussion Paper / Environment, Planning and Sustainable Development Directorate (2019)
- Australian Hydrogen Council / Home page (2021)
- Australia's National Hydrogen Strategy / COAG Energy Council (2019)
- Briefing Paper: Hydrogen Energy / L. Roth & T. Gotsis, NSW Parliamentary Research Service (2021)
- Green Paper: A vision for hydrogen in New Zealand / Ministry of Business, Innovation & Employment (2019)
- Hydrogen / International Energy Agency (2021)
- Hydrogen energy / Australian Renewable Energy Agency (ARENA) (2021)
- Hydrogen Strategy for Canada: Seizing the Opportunities for Hydrogen / Natural Resources Canada (2020)
- Hydrogen Strategy: Enabling a low-carbon economy / US Department of Energy (2020)
- New South Wales Hydrogen Strategy / Department of Planning, Industry and Environment (2021)
- Northern Territory Renewable Hydrogen Strategy / Department of Trade, Business and Innovation (2020)
- The Norwegian Government's hydrogen strategy / Ministry of Petroleum and Energy & Ministry of Climate and Environment (2020)
- Queensland Hydrogen Industry Strategy 2019–2024 / Department of State Development, Manufacturing, Infrastructure and Planning (2019)
- South Australia's Hydrogen Action Plan / Department for Energy and Mining (2019)
- Tasmanian Renewable Hydrogen Action Plan / Department of State Growth (2020)
- UK Hydrogen Strategy / Department for Business, Energy & Industrial Strategy (2021)
- Western Australian Renewable Hydrogen Strategy / Department of Jobs, Tourism, Science and Innovation (2021)

References

1 Energy Institute (2021) 'Energy Essentials: A Guide to Hydrogen', Energy Institute website.

2–3 ibid.

4 Department of Jobs, Tourism, Science and Innovation (2021) *Western Australian Renewable Hydrogen Strategy*, Perth, DJTSI, p. 12.

5–7 Energy Institute (2021) op. cit.

8 ibid. See also: F. Brown & D. Roberts (2021) 'Green, blue, brown: the colours of hydrogen explained', CSIROscope website.

9 Geoscience Australia (date unknown) 'Hydrogen', Geoscience Australia website.

Research & Inquiries Service

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All links are current and available as at the time of publication.

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