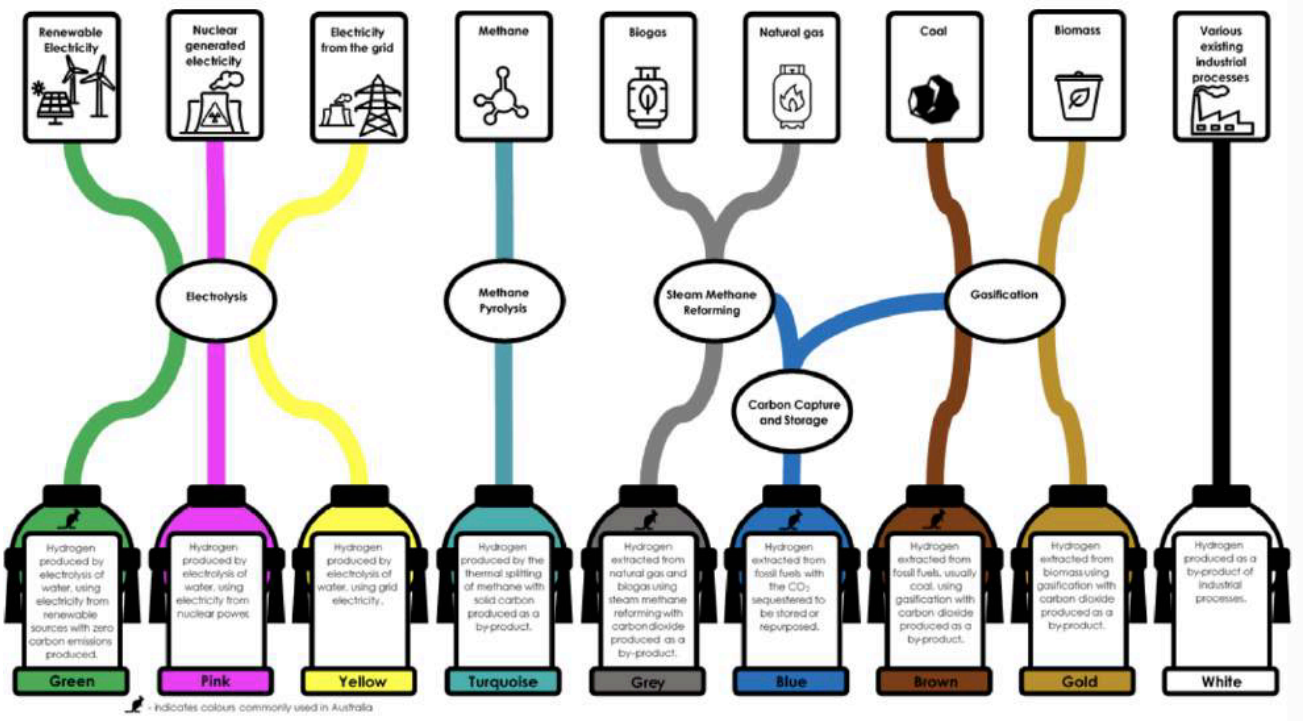
Hydrogen Production

Background

Hydrogen might be the most abundant element on Earth, but it is rarely found in its pure form. As hydrogen produces zero harmful emissions when it is used, it is an important commercial gas and needs to be extracted from another compound. There are many ways to extract or produce hydrogen and all of them are endothermic processes, meaning they all require a primary source of energy to produce the hydrogen gas. Fossil fuels, such as natural gas and coal, biomass, nuclear energy and renewable energy sources such as wind, solar, geothermal and hydroelectric power can all be used to produce hydrogen.

However, not all the production processes are equal when it comes to being emission free. As hydrogen can be produced from different sources, by different processes, industry has proposed the use of colours to reflect the environmental friendliness of the different production methods. Green, pink, yellow, turquoise, grey, blue, brown, gold and, white, used around the world, however only green, grey, blue and brown are commonly used in Australia.

The image below shows the raw materials, production processes classified into their associated colours.



Colours as described in The Alchemist, Issue 39 - Hydrogen: Applications in Mining and Metals.

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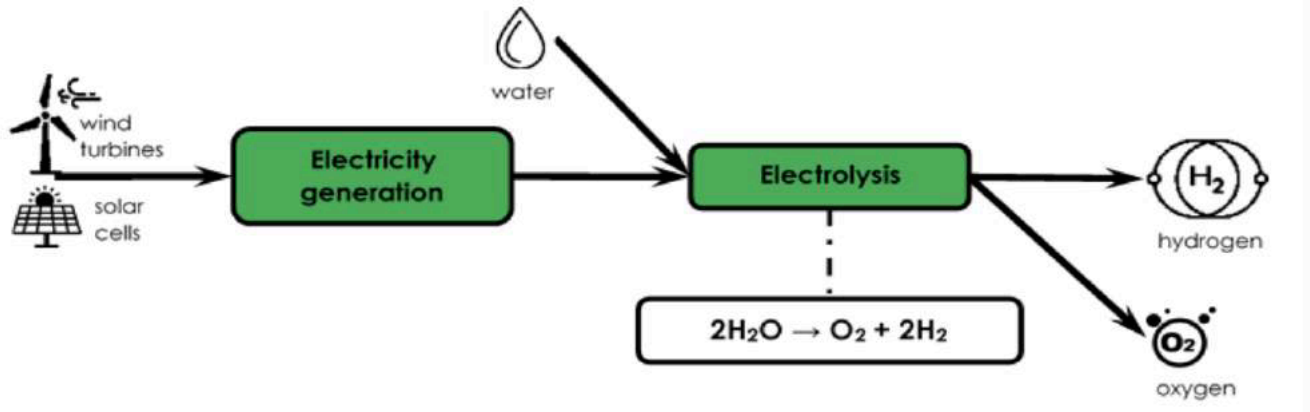
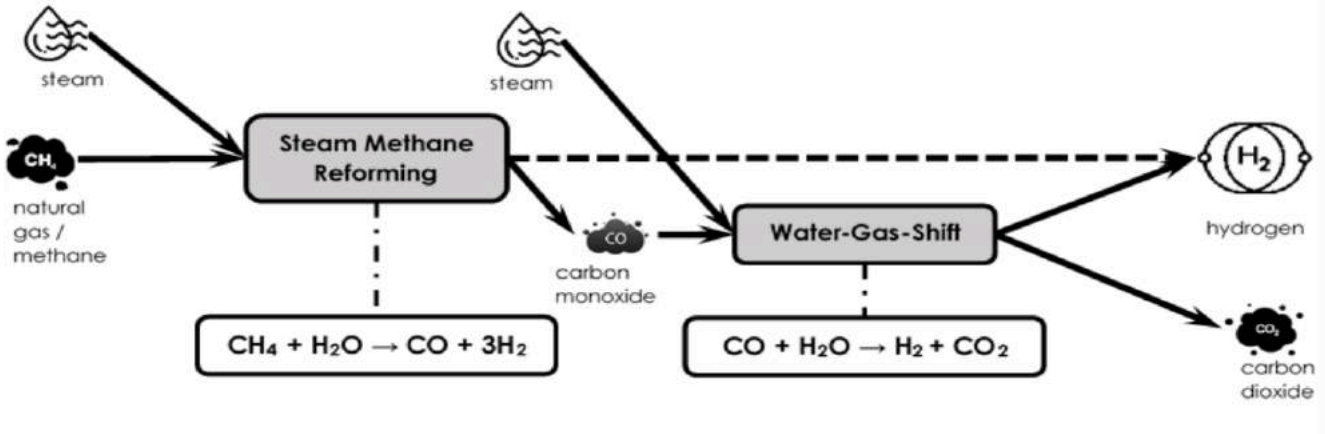
Hydrogen production technologies are in various stages of development, from conceptual to commercially viable. The three most established methods of hydrogen production are electrolysis, steam methane reforming and coal gasification.

Electrolysis is a process that uses an electrical current to split water into hydrogen and oxygen. Requires the use of low or zero emissions electricity to produce clean hydrogen. Established electrolyser technologies include polymer electrolyte membrane (PEM) and alkaline electrolysis (AE)



Steam Methane Reforming is the process that involves reacting natural gas with high-temperature steam to produce syn-gas. This is then reacted with additional steam to produce a higher hydrogen content gas stream. The hydrogen can then be separated and purified.



Coal Gasification is the process where coal is initially, partially oxidised to produce some heat and some carbon dioxide. The carbon dioxide is a gasification agent and when it is hot it reacts with the rest of the carbon in the coal to form carbon monoxide. This carbon monoxide is then mixed with steam to generate a mixture of hydrogen and carbon dioxide gases. The hydrogen gas is then separated from the carbon dioxide and purified.