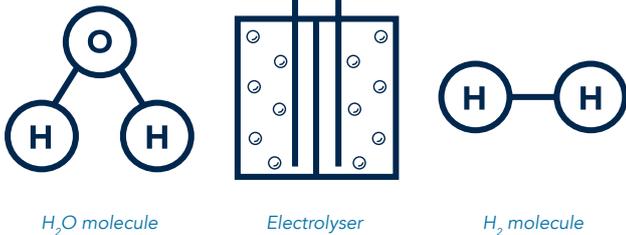


# Hydrogen Properties and Safety

## Where does hydrogen come from?



Hydrogen exists only in combination with other elements, such as oxygen to form water. To be used to create energy, hydrogen elements have to be extracted.

Because hydrogen readily reacts with other molecules, it is not naturally found in its pure form. Pure hydrogen can be produced by splitting the bond between hydrogen and other molecules using an energy source such as electricity – this is known as electrolysis.

The New Energies Service Station will use renewable electricity and an electrolyser to generate green hydrogen using recycled water and oxygen will also be produced as part of the process.

## Hydrogen Refuelling Service Stations worldwide

Hydrogen has been safely used by many different industrial sectors for more than 50 years. In the international transportation sector, hydrogen has already been used safely as fuel for cars, buses and forklifts.

There are over 500 hydrogen refuelling stations operating globally, some of which have been operational for over 10 years. This has allowed time for regulations and standardised industry practices, including safe refuelling protocols, to be developed.

The design of our service station draws on these international standards and the experience of global operators who are familiar with deploying and maintaining their equipment at similar sites.



## Experience and Commitment to Safety

Viva Energy's number one priority is safety. Our commitment to safety is supported by an extensive history of safe and responsible operations.

We have decades of experience with hydrogen production and use at both our former refinery in NSW and our Geelong Refinery.

The crude refining process at the Geelong Refinery produces around 70 tonnes of hydrogen per day. This experience in safely producing and handling hydrogen is applicable to the broader hydrogen sector.

### WHERE CAN HYDROGEN BE USED?

Hydrogen has a number of useful applications including to power vehicles and create heat and electricity in homes for cooking and heating.

The advantages of hydrogen powered fuel cell electric vehicles (FCEVs) compared to battery electric vehicles are faster refuelling times and the ability to travel longer distances, carrying larger loads before needing to refuel again.



## Six facts about hydrogen safety



### LOW RADIANT HEAT

Hydrogen flames have low radiant heat compared with hydrocarbons. Hydrogen combustion produces heat and water.



### REQUIRES AN OXIDISER TO COMBUST

Hydrogen storage systems in vehicles are specially designed to avoid any inadvertent intake of air.



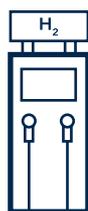
### CARBON FIBRE TANKS

Carbon-fibre hydrogen storage tanks are rigorously tested to withstand crash, drop test and fire.



### SAFETY SYSTEMS

Hydrogen tanks and vehicle systems are designed with multiple safety enhancements to prevent leaks in both routine use and extreme circumstances. In the very unlikely event of an issue, hydrogen systems are designed to safely release and ventilate the hydrogen.



### SAFE AND FAST HYDROGEN REFUELLING

The hydrogen fuelling protocol at service stations has been universally adopted around the world to ensure safe refuelling of fuel cell vehicles in three to five minutes for a range of ~483 – 644 kms on a tank of fuel.



### SAFETY, CODES AND STANDARDS

As a result of decades of international research into hydrogen, hydrogen systems are as safe, if not safer, than conventional fuelling systems.

## HYDROGEN FAST FACTS



– Acts as an energy carrier and is not itself a source of energy



– Has the greatest energy density per unit mass of any fuel



– When burned, hydrogen produces water vapour



– Hydrogen is a non-toxic, colourless and odourless gas at ambient conditions



– It is 14 times lighter than air and disperses very quickly in open spaces.



– Hydrogen has a wide flammability range, but it is this quick dispersion that helps avoid accumulation of gas to elevated levels where ignition is a risk.



– Hydrogen burns to produce heat and water, without emitting smoke, soot or CO<sub>2</sub>.



– Renewable hydrogen provides a low-carbon, emission-free alternative to conventional fuels including gasoline and diesel for transportation.



- 1kg of Hydrogen is the equivalent of:
  - 4 litres of gasoline
  - 14 litres of volume when liquefied at -253 oC
  - 120 MJ of energy, almost three times more than diesel or gasoline
  - 33.6 kWh of usable energy, versus diesel which only holds about 12–14 kWh per kg.

The project received a grant from the Australian Renewable Energy Agency (ARENA) as part of ARENA's Advancing Renewables Program and the Victorian Government also contributed to the project via the Renewable Hydrogen Commercialisation Pathways Fund.

*The views expressed here are not necessarily the views of the Australian Government, and the Australian Government does not accept responsibility for any information or advice contained here.*



## How to contact us?

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