COUNTRYWIDE
RENEWABLE HYDROGEN

Hydrogen, the ZEB option

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What is HYDROGEN?

- Hydrogen is the **most common chemical** in the universe
- Can be produced as a **gas or liquid**
- Has **many uses** such as fuel for transport or heating, storing electricity, a raw material for industry or for decarbonising natural gas
- Hydrogen is a way of **storing energy for use when it is needed**
- Can be **stored as a gas** and delivered through existing **natural gas pipelines**
- Hydrogen can be **transported to refuelling stations** as high-pressure gas
- When converted to a liquid or ammonia, hydrogen can be **transported on trucks and in ships** - exported as an energy commodity

The colours of HYDROGEN - how it's produced

BROWN – produced by using coal or oil where the carbon emissions are released to the air

GREY – produced from natural gas where the associated emissions are released to the air

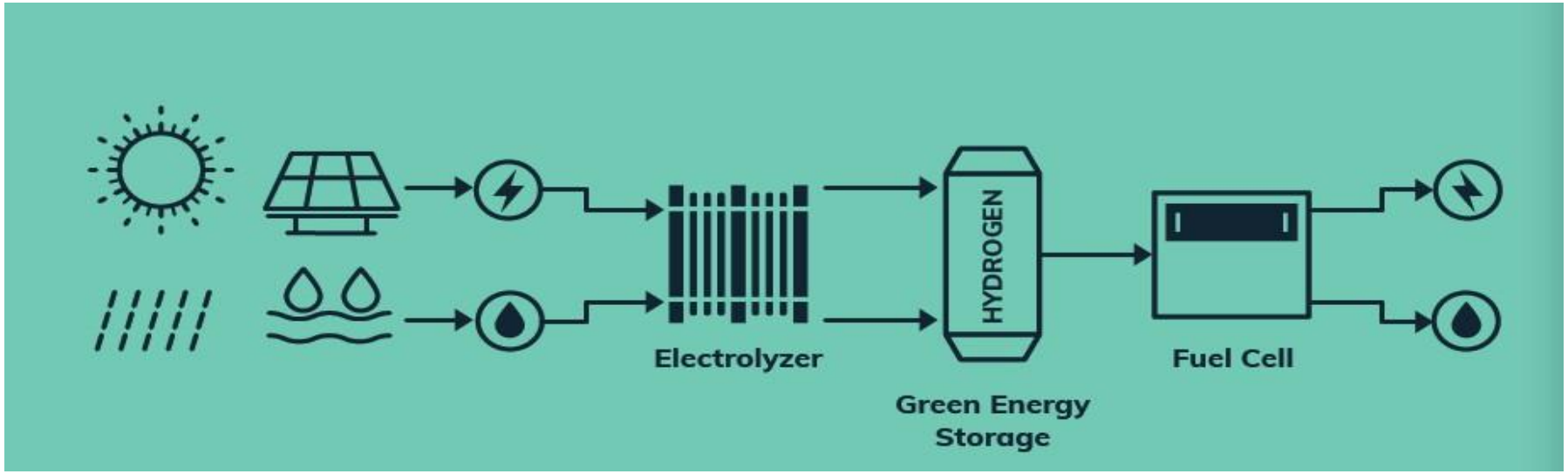
BLUE – produced from natural gas, where the emissions are captured using carbon capture and storage

AQUA – produced from municipal waste, where the emissions are captured as a solid for road construction – regarded as renewable hydrogen

GREEN – produced by electrolysis that is powered by electricity generated from renewables (solar, wind, hydro)

What is ELECTROLYSIS?

- **An electrolyser passes an electric current through clean water and splits the water (H_2O) into Hydrogen and Oxygen**
- **Both gases can be captured or the oxygen released to harmlessly into the atmosphere**
- **Electrolysers require 9 litres of water to produce 1kg hydrogen**
- **6kgs of hydrogen will drive a passenger car up to 800kms – Toyota Mirai recorded 1,003kms on one fill**



JUST ADD WATER

How does a HYDROGEN-powered bus work?

- **Hydrogen is stored as a gas in tanks within the body or on the bus rooftop**
- **When the hydrogen is released into a fuel cell (the engine) and it meets with air, the chemical reaction generates electricity**
- **It's an electric bus – like a battery electric bus, electricity drives the wheels and bus equipment**
- **Fuel cells are highly efficient, have no moving parts and can operate continuously**
- **Only tailpipe emission is water**
- **No noise, odour, vibration or harmful emissions**

BEB vs FCEB – pros and cons

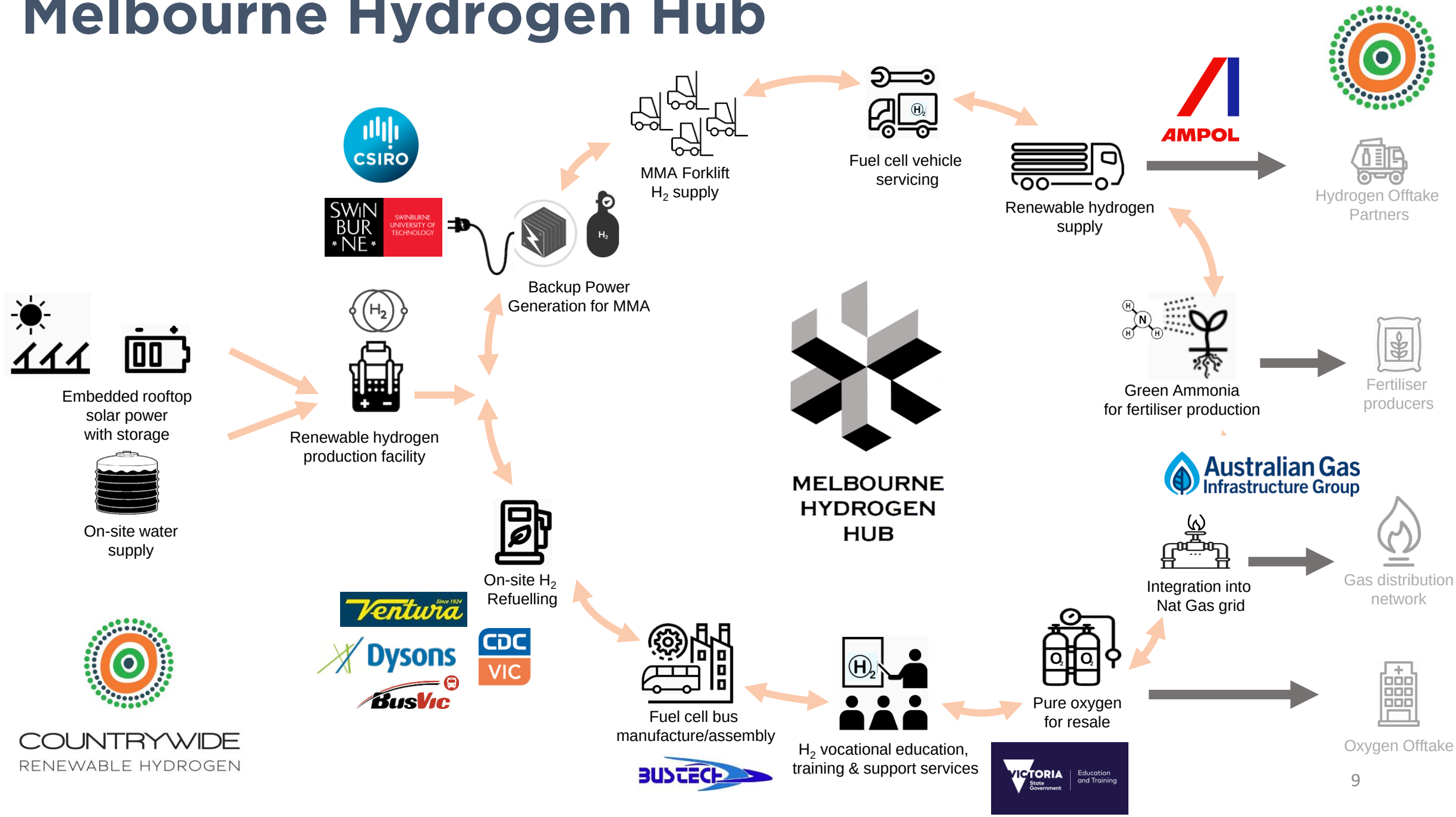
FCEB = fuel cell electric bus | BEB = battery electric bus

- **FCEB is more expensive to purchase – double a diesel bus but CAPEX is falling**
- **FCEB OPEX is less than a diesel bus**
- **BEB buses are ideal for short runs to allow recharging between routes e.g. school buses**
- **FCEBs can travel an 800km route on one fill**
- **Refuelling a FCEB bus takes around 15 mins – either depot or refuelling station**
- **FCEBs are not challenged by hot and cold weather or hilly routes**
- **Recharging a number of BEBs requires significant electrical infrastructure at the depot – can be $millions**
- **Both are noise, vibration and odour free**

Who is backing the HYDROGEN wave?

- Fuel cells – Cummins, Toyota, Hyundai, Ballard, Air Liquide, ITM (Linde)
- Fuel Cell production forecast 1mill units by 2028, CAGR 70%
- Refuelling – most petroleum companies, Ampol leading in Australia
- FCEBs – Bustech from Australia, many in Europe (WrightBus) and China (Bon Luck and Hyzon)
- Massive corporate investment in green hydrogen – Cummins, BP, Shell, Fortescue, Origin, Linde, Siemens, ThyssenKrupp, Plug Power
- Significant Government funding support to reduce emissions

Melbourne Hydrogen Hub



About CRH

Renewable HYDROGEN project originator and developer

Three projects in Australia:

1. **Melbourne Hydrogen Hub (MHH)**
2. **Hydrogen Tasmania**
3. **Hydrogen Portland**

MHH to supply hydrogen to 90 fuel cell buses across three companies

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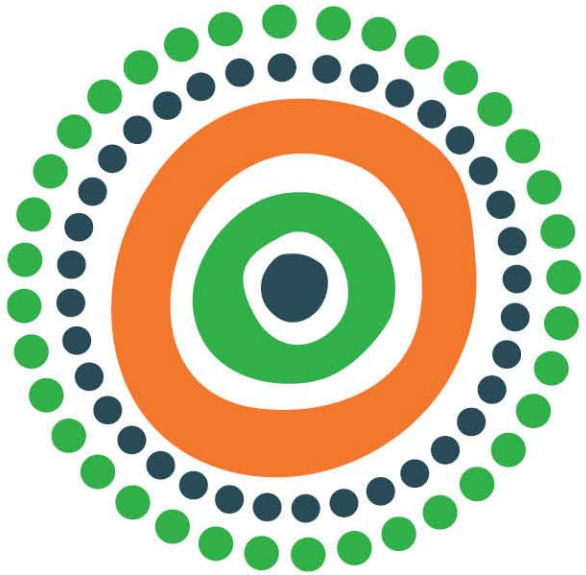

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