The Implications of 'Green Hydrogen'
for SA Grain Growers

Report by
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The SA Grain Industry Blue Print calls for innovation to address the carbon footprint of grain growing.

'Green Hydrogen' addresses the future footprint of fuel use and N-fertiliser supply; which collectively make a major contribution to a grain growers greenhouse footprint.

Input costs for fuel and N-fertiliser are fundamental to farm operations. Green hydrogen and related technologies offer a pathway for landholders with renewable energy assets to generate their own fuel and N-fertiliser.

The technical side of the green hydrogen is continually improving and it is in the early stages of deployment by multinational producers of energy and N-fertiliser.

Even though the realistic adoption of green hydrogen at a farm scale is still some years away, the awareness and decision-making process needs to begin sooner than later.

Using hydrogen derived from fossil fuels to make N-fertiliser via the Haber Process has been an industrialised practice at a global scale for nearly a century.

Historically, the hydrogen has been generated from fossil fuels using a carbon emissions intensive process called Steam Methane Reforming (SMR). (Fig 1)

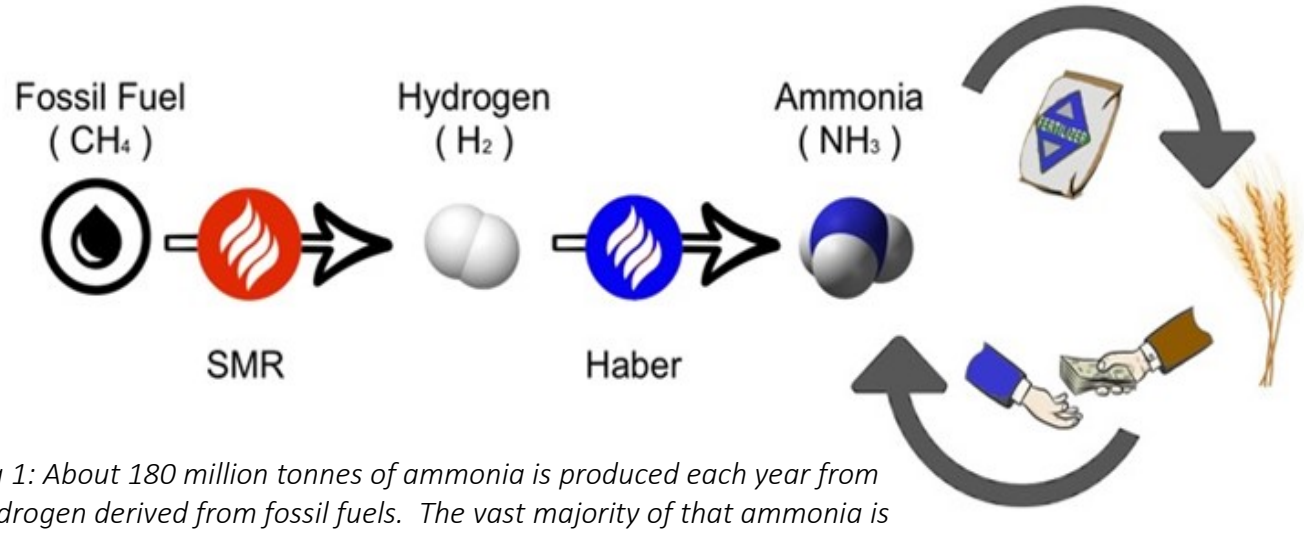

Fig 1: About 180 million tonnes of ammonia is produced each year from hydrogen derived from fossil fuels. The vast majority of that ammonia is used directly as fertiliser (anhydrous ammonia) or upgraded to urea.

However, hydrogen can be generated in other ways and the rise of renewable electricity has paved the way for so called 'green hydrogen'. (Fig 2)

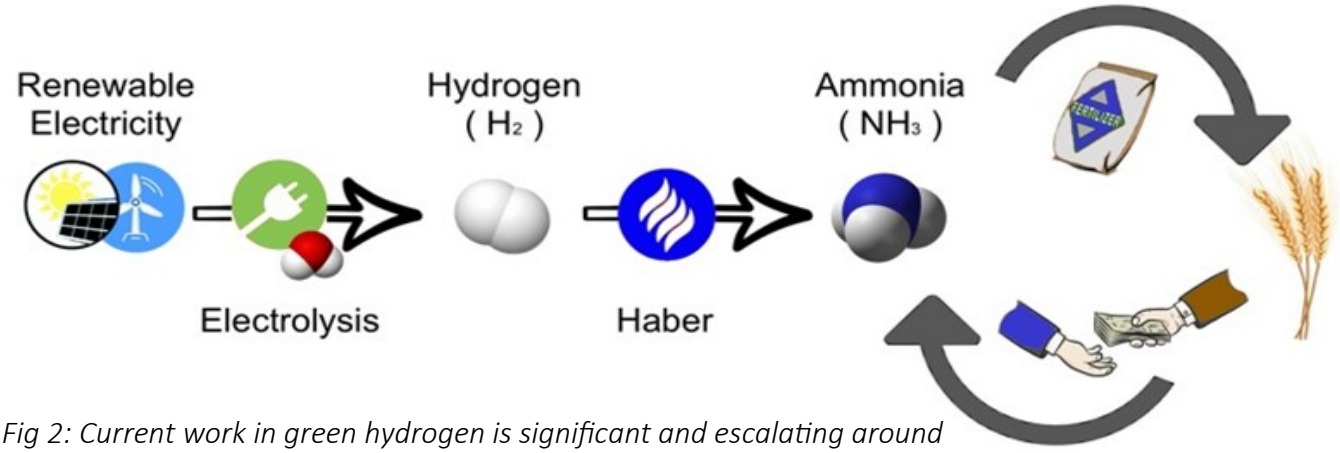

Fig 2: Current work in green hydrogen is significant and escalating around the world, including in Australia.

It is important to note that "green hydrogen" is not one thing. It is a concept that can materialise in many different forms. Similarly, "NoTill" is not one thing. It is a concept that can take many forms and is ideally customised for specific circumstances.

Current Business Development

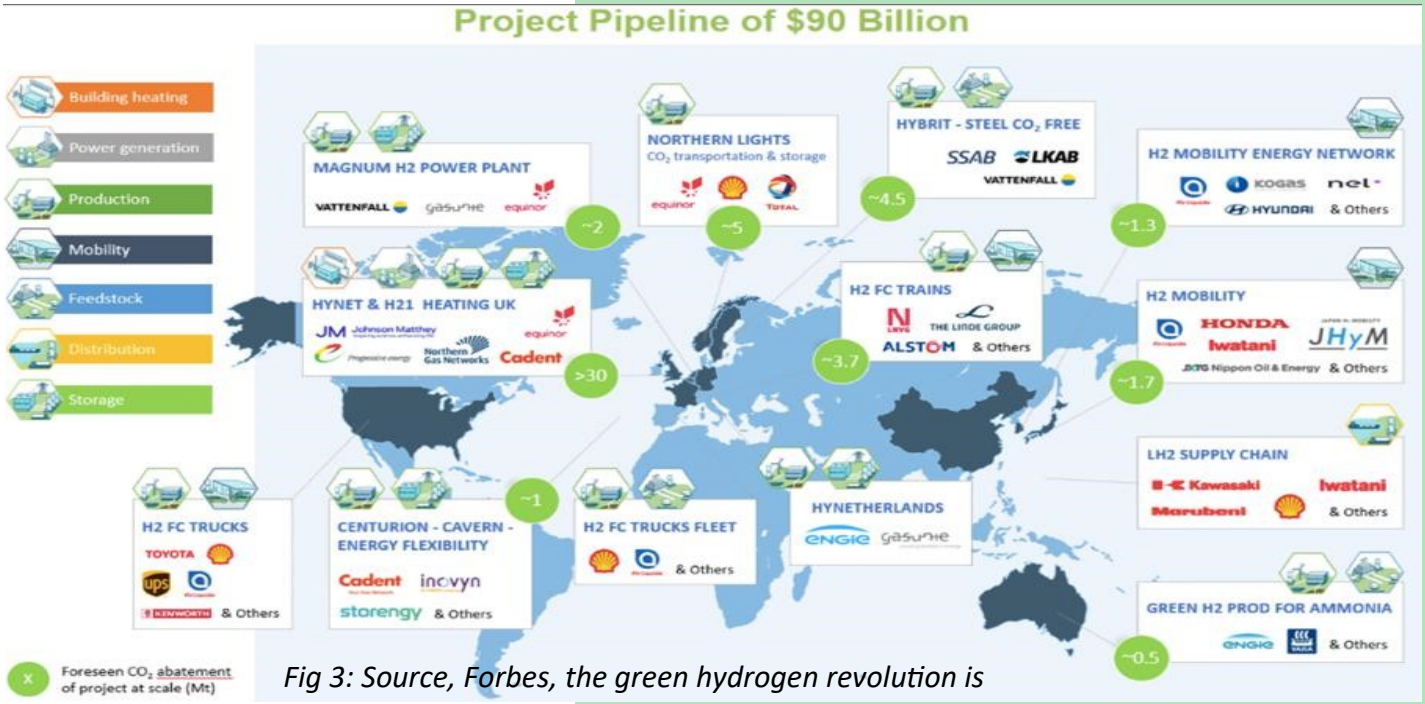

Fig 3: Source, Forbes, the green hydrogen revolution is

Governments around the world are engaging green hydrogen and Australia's National Hydrogen Strategy was published by the Chief Scientist in 2020.

Generally speaking, green hydrogen deployment is being led by multinational corporations from the electrical and chemical engineering fields (Siemens, Thyssenkrupp), as well as established energy companies (BP, Shell, AGIG,), fertiliser suppliers (Yarra, Incitec,) and investment banks (Macquarie, CEFC,).

According to Bloomberg, the 2021 global pipeline for green hydrogen investment exceeds $90 Billion, which includes various projects in Australia. (Fig 3)

Australia is very well positioned to develop green hydrogen compared to other countries.

AUSTRALIAN EXAMPLES OF GREEN HYDROGEN DEPLOYMENT INCLUDE:

1. To evolve Yara's Pilbara ammonia facility from one that relies entirely on fossil fuel for its hydrogen to one that employs renewable energy for a portion of its hydrogen production.
2. BP Australia has received funding support from ARENA to accelerate their green hydrogen production facility.
3. Sumitomo aims to develop a device that can produce 300 tons of hydrogen annually. *300 tons of hydrogen could be converted to more than 1,500 tons of anhydrous ammonia.*
4. Germany company, Thyssenkrupp will support H2U to build a multi-megawatt electrolyser plant and ammonia production plant.

It is important that farmers increase their knowledge about self-installation and self-sufficiency for hydrogen fuel and N-fertiliser. As this knowledge has the potential to circumventing the traditional corporate supply chain.

Relevance to Grain Growing

Green hydrogen has a lot of potential on Australian farms. The multinational supply chain default business models, which are backed up by governments, researchers, investment bankers, and project developers, tend to limit farmer participation. Generally, farmer participation is limited to:

- Suppliers of land where renewable energy can be generated, for example: a windy hill.

Farmers are signing over renewable energy generation resources to project developers and energy companies under long-term deals (20 – 50-year leases) with limited knowledge of alternative business models that will emerge in the next decade.

- The corporate supply chain also categorises farmers as buyers of fuel and N-fertiliser. For example: the purchase of urea from an agri-merchant.

The corporate supply chain expects to keep selling N-fertilisers like urea at a profit to farmers as they transition away from fossil derived hydrogen products to green hydrogen products.

If farmers cooperate and acquire their own green hydrogen technology, they create the opportunity to close the loop on their own future supply chain for fuel and N-fertiliser.

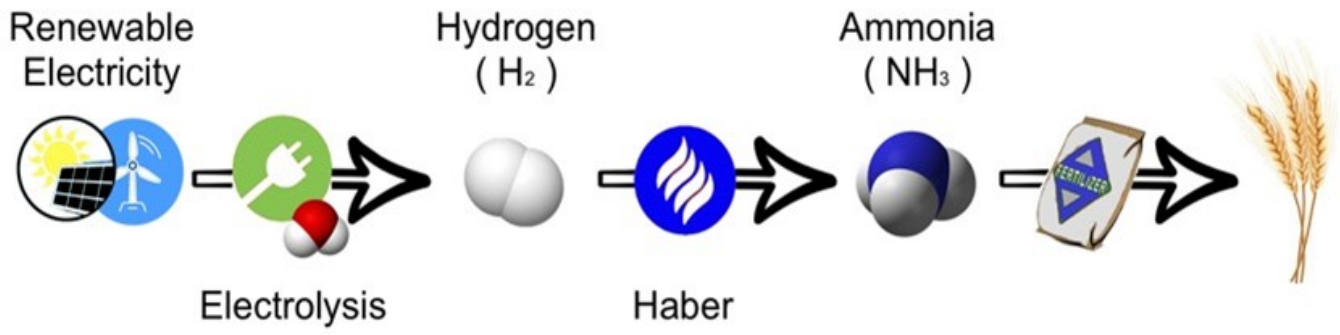

Fig 5: Grain growers bookend the green hydrogen opportunity and can close the loop on future fuel and N-fertilisers supply.

Fig 6: Siemens electrolysis demonstration plant in the UK produces ammonia from renewable electricity, water and nitrogen from the air.

Supply side

The ammonia energy association is an excellent resource for market and technology information on a diverse range of green hydrogen and green ammonia developments. https://www.ammoniaenergy.org

Significant work is being conducted to produce green hydrogen in the following ways:

a. Electrolysis of water (H2O) is currently the most popular means to produce green hydrogen for ammonia fertilisers at pilot scale (Fig 5) & 6).

b. The production of hydrogen from water using photocatalysis (sunlight and a catalyst) has been demonstrated in various forms. Currently small scale with ongoing innovation in this field.

c. The creation of hydrogen directly from biomass and/or waste. Greenhills Energy, Peats Soils and the Thebarton City Council recently announced a feasibility study into generating hydrogen from municipal waste.

d. Plasma pyrolysis of air is an emerging method that mimics nitrate fixation in a lightning strike. ($N_2 + O_2 > 2NO$).

e. Pyrolysis of methane as demonstrated by Monolith Materials at their low emissions anhydrous ammonia fertiliser plant in Nebraska.

Demand Side: N-fertiliser

Regardless of the source of hydrogen (from fossil fuels or from renewable energy), all sources of hydrogen can be upgraded to N-fertiliser.
South Australian grain growers are very familiar with the use of urea and ammonium fertilisers.

There is also some interest from growers with highly calcareous soils in anhydrous ammonia or even acidic nitrates.

Demand side: Hydrogen Fuel

If a supply line of green hydrogen or green ammonia can be established, there will be hydrogen powered vehicle options. (Fig 7). For example, New Holland has already indicated they are ready to scale production of hydrogen fuel cell equipment as supply lines of hydrogen fuel develop.

In addition, Australian company, H2X is developing a hydrogen powered tractor range. In conversations with SANTFA, the CEO of H2X, Brendan Norman, has indicated that one of their strategies is to develop OEM hydrogen fuel cells that can be retrofitted directly into major tractor brands such as John Deere.
Due to technical reason, H2X prefer to retro-fit large-scale tractors and this makes grain growers a primary market for H2X hydrogen fuel cell retro-fits.

Australian company H2X to manufacture hydrogen vehicles in NSW

ABC Illawarra / By Ainslie Drewitt Smith
Posted Mon 15 Jun 2020 at 11:48am

A hybrid tractor being developed by new Australian hydrogen vehicle manufacturer, H2X. (Supplied: Brendan Norman)

Fig 7: Farm vehicles that can run on hydrogen have been developed in anticipation of green hydrogen supply chains.

Summary

By participating in local green hydrogen developments, grain growers can position themselves to self-supply, collaboratively-supply or locally source renewable hydrogen fuel and N-fertiliser.

In doing so, grain grower may gain cost advantages, reduce freight, ensure timely supply and significantly reduce their carbon footprint.

The default outcome of a ‘do nothing strategy’ is a corporate controlled supply chain that may limit the options for future grain grower participation.