Production of Green Hydrogen via Solar Powered Electrolyser Modules and Atmospheric Water Generation

Claudia Cavallo and Caitlin Grant

Priority topic area: Clean Energy and Climate Action

1 – Creating a Novel Green Hydrogen Concept

Green hydrogen is a net-zero energy carrier produced via electrolysis of water using renewable energy. Three major barriers exist:

1. **Power –** Intermittent and fluctuating renewable energy impacts stable hydrogen production.
2. **Water –** Electrolysis requires ~9 L water/kg H_2, preferably locally sourced to reduce costs.
3. **Cost –** Large scale green hydrogen projects are commercially immature as electrolyser, balance of plant, and power and water infrastructure costs remain high.

With the goal of reducing production costs by 2030, this project proposes using solar-powered green hydrogen modules and atmospheric water generators (AWGs) to eliminate the requirement of large volumes of locally sourced water.

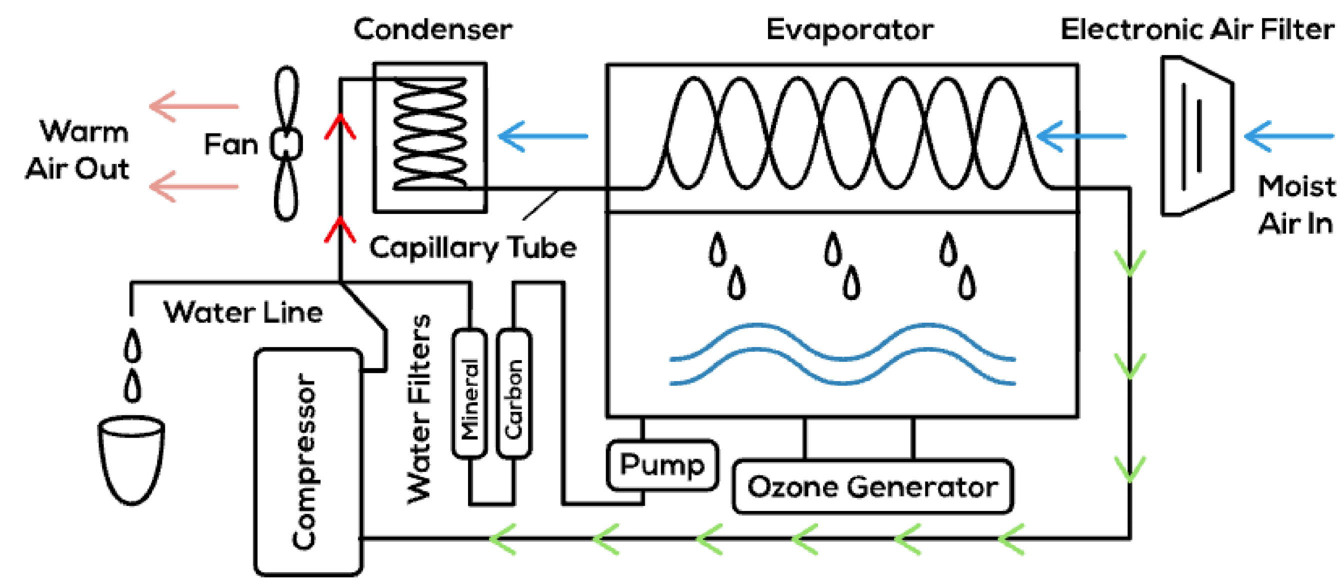

Figure 1: Atmospheric water generators (Ref. 1)

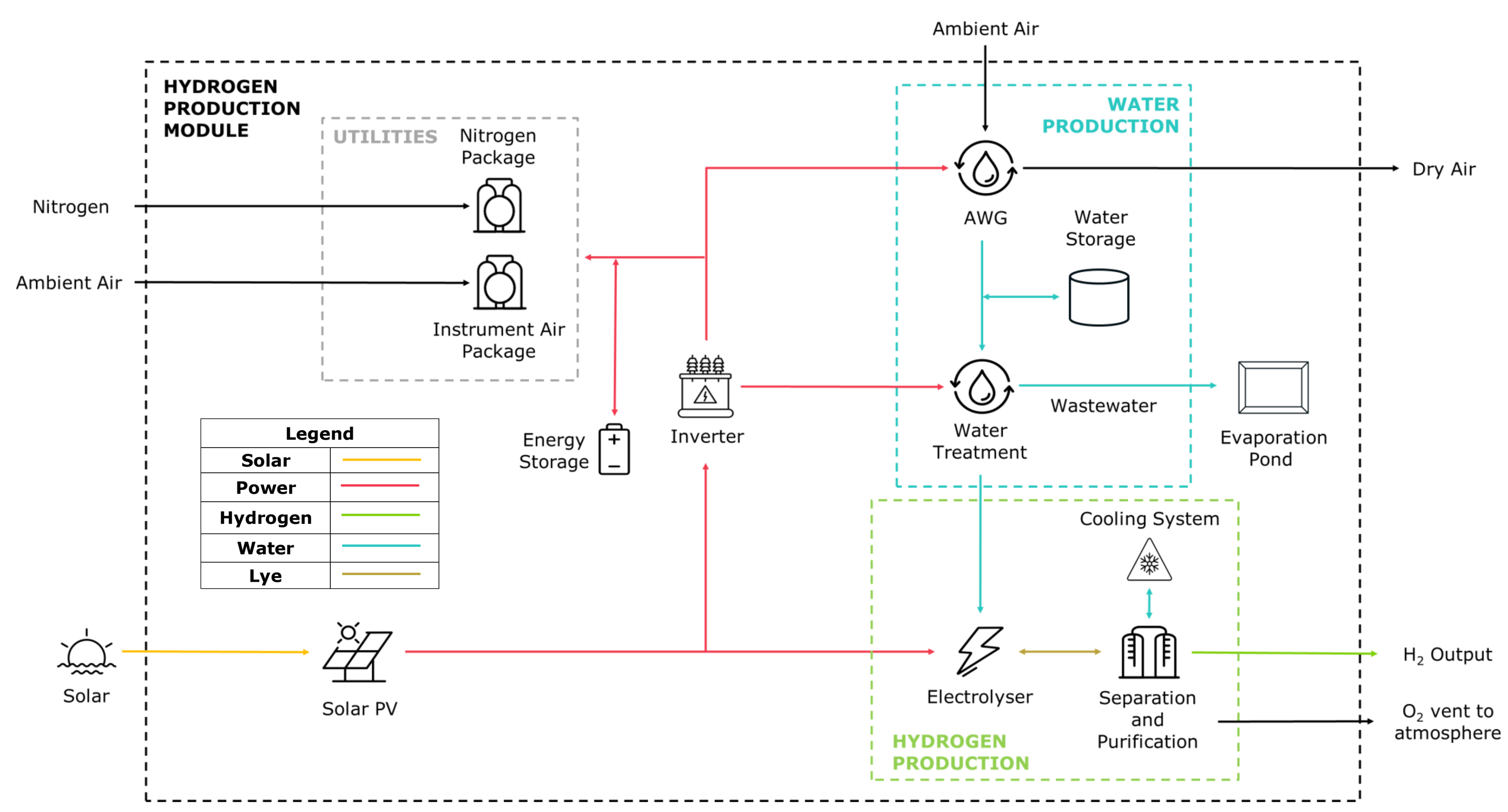

Figure 2: Hydrogen production block flow diagram

2 – Optimising the Project Configuration to Achieve the Lowest LCOH

The methodology included hourly production modelling and:

1. Analysis of the relative performance of solar PV technologies
2. Determining the project configuration with the lowest Levelised Cost of Hydrogen (LCOH) by optimising solar farm size, AWG capacity and water storage, incorporating:
   1. Site-specific solar profiles and climate data
   2. AWG operating performance
   3. AWG capacity vs water storage volume analysis
3. Forward cost projections – using technology learning rates to compare current vs future costs and LCOH

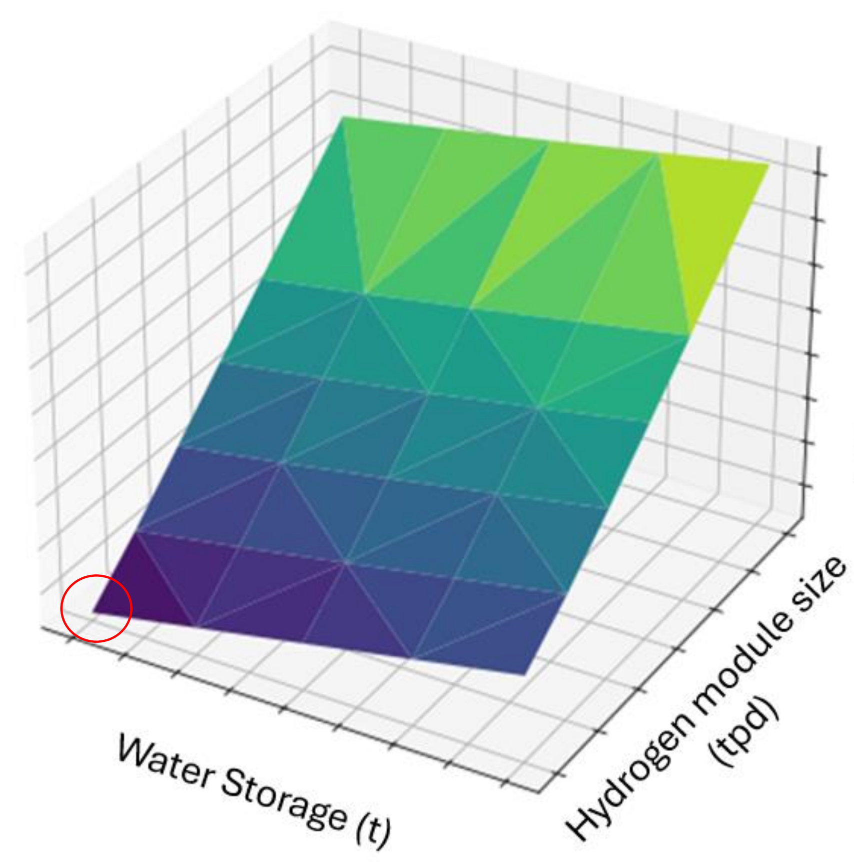

Figure 5: Impact of project configuration on LCOH

3 – Lowest Cost Solution

Alternative equipment sizing configurations were compared, using the LCOH metric, which considers all costs associated with hydrogen production over the complete project lifecycle. Key production capacities and technologies were reviewed to develop the project configuration that delivered the lowest LCOH:

- Optimum solar PV farm size for each solar tracking technology (Figure 3)
- AWG capacity vs water storage volume (Figure 4)
- Hydrogen production module size (tpd) and water storage size (Figure 5)
- Identification of protentional project cost reductions and application of projected learning rates of key equipment to recognise potential improvements

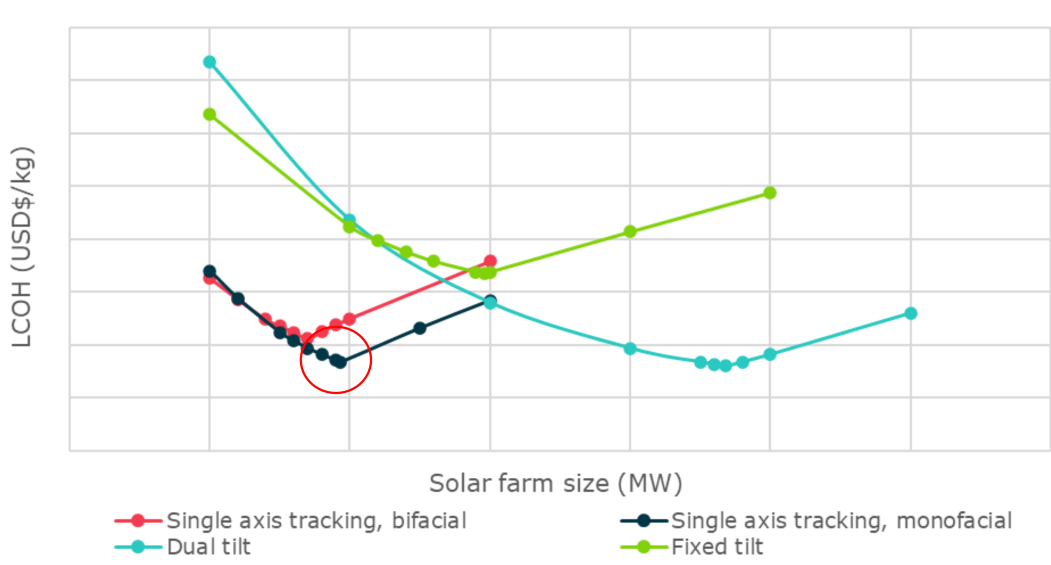

Figure 3: Solar capacity and technology optimisation

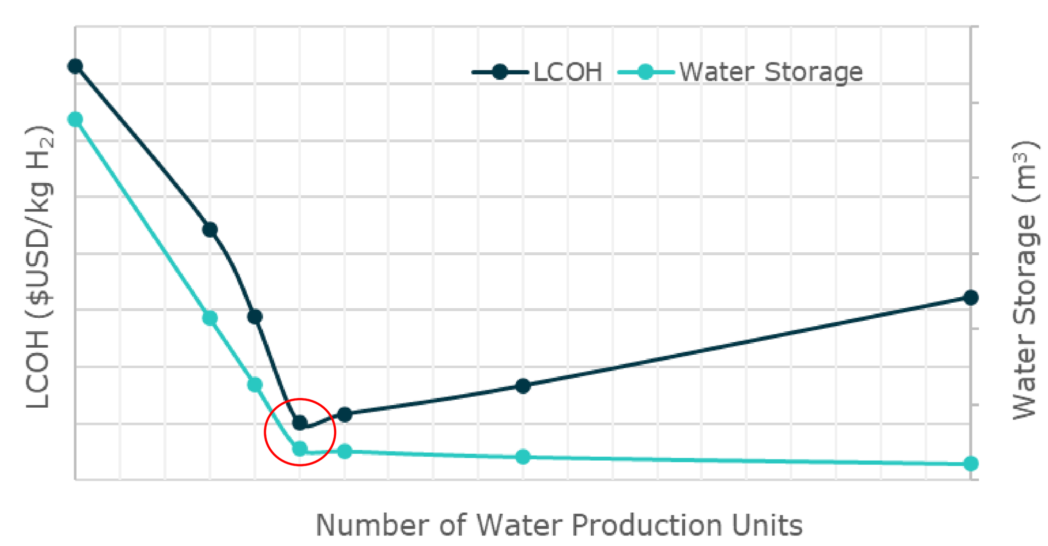

Figure 4: AWG capacity versus water storage size

4 – Green Hydrogen for the Future

By using solar energy and atmospheric water generators, this project would:

- Reduce the strain on scarce local water supplies prevalent in Australia's arid regions
- Support the decarbonisation of hard-to-abate sectors like transport, energy, steel, and industrial chemicals
- If costs are lowered, aid the development of Australia's hydrogen export industry, driving economic growth and positioning the nation as a global leader in clean energy

Future commercialisation of green hydrogen will require global collaboration across digital platforms and ethical behaviour in knowledge sharing.

5 – The Path to 2030

To further reduce the project costs and reach the 2030 target, a cost reduction roadmap is needed to achieve the forecast cost reductions. Cost reduction initiatives could include:

- Optimising module integration – e.g. utilising common utilities systems
- Improving electrical efficiency
- Enhancing electrolyser performance
- Optimising the operating profile of the AWG

IChemE YOUNG ENGINEERS AWARDS for Innovation and Sustainability

References/Acknowledgements

1. Altitude Water. (n.d.). The Process. Retrieved from https://altdwater.com/the-process/

IChemE