# AHC DISCUSSION PAPER: BARRIERS AND INCENTIVES TO GRID CONNECTED HYDROGEN PRODUCTION

## Overview

Production of hydrogen to meet Australia's decarbonisation ambitions will require significant additional renewable electricity generation. AEMO's 2020 Integrated System Plan (2020 ISP) took the preliminary steps needed to plan for hydrogen production and use, but recognised that significantly more work is required to build an accurate picture of how plan for the hydrogen revolution. As the ISP 2020 Final Report points out "As the hydrogen sector will eventually be coupled with Australia's energy, water and transport sectors, it is critical that future hydrogen policies are coordinated with the policies and needs of those sectors. The 2022 ISP will investigate in more detail the role of hydrogen as it relates to Australia's electricity system."[1]

AHC is aware that it is still unclear how hydrogen production and usage in the NEM will bear out but is committed to engaging with the AEMO process and building on the small steps taken in the 2020 ISP to assist in planning for a decarbonised energy grid. We envisage that this process will include a number of key facets including:

- Engaging with market participants to gather an evidence base to illustrate the future direction of hydrogen;
- Engaging with market bodies (namely AEMO and AEMC through regular informal dialogue to share the latest views and developments and keep one another abreast of work plans.
- Participating in formal AEMO consultation processes as required.
- Through AHC Working Group 2, continue to raise issues which are pertinent Australia's ability successfully fold hydrogen into the broader energy framework.

AHC will engage the services of Oakley Greenwood to assist with economic and technical analysis of the ISP Methodology and to provide guidance on contributing toward the various scenarios developed in the ISP. One of the key considerations for system planning is the extent to which electrolysers will be grid connected or stand alone. The following paper examines some of the

[1] AEMO (2020), *Integrated System Plan for the National Electricity Market*, July, p.22.

system and market settings which may impact the extent to which electrolysers are connected to the future NEM.

It stands to reason that the same considerations apply to the connection to the South West Interconnected System however the planning processes for this grid (and other standalone grids) are not as visible at the present time.

In discussions with various stakeholders it has become apparent that the extent to which electrolysers will be grid connected or stand alone is a contentious issue with a range of viewpoints. The following paper will outline the issues which are likely to determine the final mix of on and off grid electrolyser capacity in order to inform the AEMO ISP Process and to assist with the development of regulatory settings to optimise this mix.

## Electrolysers in Australia

Grid connected electrolysers currently operate in Australia without posing system planning challenges. The main reason for this is that the total load is quite small. Each electrolyser is relatively small in capacity, and they are relatively few in number (and in most cases they are attached to specific projects). In a future energy system where hydrogen is envisaged to play a much larger role, challenges arise as both the capacity of the individual electrolyser and the number of electrolysers needed will increase significantly.

In May 2021, ARENA funding for three 10MW electrolysers was announced[2]. Each of these is 8 times the size of Australia's largest currently installed electrolyser[3]. Although Australia's hydrogen ambitions will require a considerable number of even larger electrolysers, this step change provides an insight into the scale of the challenge and the pace at which it needs to be addressed.

In some instances, the decision whether these new electrolysers are grid connected will be determined by project specifics such as geography or end use. System planning and market settings are unlikely to impact these decisions. In other cases, however, a decision as to whether an electrolyser should be installed on or off grid will depend on these settings, and it is crucial that they are optimised to facilitate efficient investment and reliable and secure grid operation.

## Load and load flexibility

In producing hydrogen, electrolysers place a load on the grid which must be planned for. Continually installing additional load requires the construction of additional electricity transmission and distribution infrastructure. The characteristics of electrolysers coupled with an increase in small scale distributed renewable generation means that any increase in electrolyser load does not necessarily require a commensurate network infrastructure upgrade. With appropriate incentives for demand response and load flexibility, the additional infrastructure required to facilitate the connection of large scale electrolysers may be only a fraction of their total load.

[2] ARENA (2021) *Over $100 million to build Australia's first large-scale hydrogen plants,* press release, 5 May.
[3] The 1.25MW AGIG in SA.

The Australian Renewal Energy Agency (ARENA) commissioned Energysynapse to undertake a study of load flexibility in the NEM to 2040. Electrolysers were identified as a key source of load flex. Similarly, Beyond Zero Emissions sees a role for electrolysers in providing demand response due to their ability to rapidly reduce load to around 20% of design capacity[4]

With this ability electrolysers can play a role in 'trough filling' during times of low electricity demand when both network and centralised electricity generation is low due to a large portion of demand being serviced by distributed renewables. Electrolysers operating during these times will face low wholesale prices and will play a role in ensuring more efficient network utilisation as the delta between maximum and minimum network demand will be reduced. When load increases, electrolysers can respond by reducing production and shaving the demand peak which would have otherwise been achieved.

Each electrolyser's ability to respond in this manner will not depend simply on its technical capacity to do so, but also the contractual arrangements to supply hydrogen to end users and the extent to which on site storage can be used to meet these requirements. Other market settings must be established however, to ensure that all else being equal, electrolysers are encouraged to participate in the demand response market.

Furthermore, a formal demand response mechanism is set to commence in the NEM in October 2021. This mechanism would value demand response and allow load which has the ability to rapidly flex down to bid in to offer this service. Due to COAG's appetite to pursue additional demand response and the ESB's approach to planning for the post 2025 NEM, it is likely that opportunities will arise for the settings of the current mechanism to be adjusted to better suit electrolyser load.

- With firm contracts for offtake being a precondition to the development of an electrolyser project, to what extent will electrolysers have the capacity to flex to take advantage of the DRM?
- Will adjustments to the DRM settings reduce the need for firm offtake contracts?

## Network tariffs

To allow them to assist with demand management challenges, electrolysers should face network use of systems (NUoS) charges which incentivise desired behaviour.

More efficient network utilisation should result in lower NUoS charges for all consumers. Rationally, this should provide an incentive for all consumers to shift load so that they face lower costs. Practically however, parties need to be incentivised to take steps which will facilitate the macro benefit.

In the work undertaken for ARENA, Energysynapse consider that electrolysers will respond to the top 15% of price periods[5]. The extent to which this materialises (or can be bettered) will rely to a degree on the network tariffs which correspond with these periods.

[4] Beyond Zero Emissions (2018), *Zero Carbon Industry Plan: Electrifying Industry*, p. 75.
[5] Provided in stakeholder workshop pack. Have asked for a public paper which has something similar.

The development of network tariffs which encourage electrolysers to respond to changes in system load will be crucial to ensuring that benefits are captured. Depending on the characteristics and location of each electrolyser, they may be connected to the low voltage distribution network or direct to the transmission network and both TUoS and DUoS tariffs should be designed to optimise response.

- What type of network tariffs are likely to incentivise demand response from electrolysers?
- Do these tariffs currently exist?
- Is there a role for new network tariffs to be designed with a sunset period in order to incentivise electrolyser connection in the near term?

## Ancillary services

In addition to simply responding to price signals, electrolysers may seek to participate in grid services markets to bolster their business case or enable them to produce hydrogen at a lower cost.

Analysis by Macquarie Capital found that "Allowing the electrolyser to participate in the FCAS markets significantly offsets electricity costs, even without storage or demand flexibility"[6]. As the Energy Security Board continues to focus on the post 2025 NEM it will be important to monitor developments in design and regulation of ancillary services markets. It will be necessary to ensure that settings provide electrolysers with the opportunity to offset costs by participating in these markets.

Processes are already underway to investigate reforms to FCAS markets and the outcomes of these may materially impact the viability of the grid connected electrolysers. The current suite of rule change proposals outlined in the AEMC's System Services Rule Changes Consultation Paper propose a number of new ancillary services markets including the Ramping FCAS services which could "provide a price signal for alternatives such as demand response and storage technologies such as hydro, battery and hydrogen that may, in the long term, form the bulk provision of this service."[7]

Once again, the regulatory and market settings for FCAS services have the potential to impact investment decisions and ultimately influence the price of clean hydrogen. The AHC should engage with AEMC and ESB processes to ensure appropriate incentives for electrolysers to engage in FCAS markets.

- Are current FCAS settings optimal to encourage grid connected hydrogen production?
- Will the current suite of FCAS reforms materially impact AHC members' grid connected hydrogen ambitions?

[6] Carter, O'Sullivan, Nolan and Saba, Flexibility of Hydrogen Electrolysers. Opportunities in the Australia National Electricity Market. Macquarie Capital, Energy and Technology Solutions, October 2020 P.6

[7] Delta Electricity, Introduction of ramping services — Electricity rule change proposal, 4 June 2020,p10

## Accreditation of grid connected hydrogen

Demand response capability, network tariff design and ancillary services markets will be key factors which will influence the attractiveness of gird connection for electrolysers. AHC will continue to engage with processes which will impact these factors.

Issues outside the actual market energy market are also likely to play a role. As part of the global push to decarbonise, demand for green hydrogen will grow. AHC has been proactively engaging with the Federal Government regarding the design of a certification scheme which will allow consumers to identify the provenance of any hydrogen purchased. The ease with which hydrogen produced from grid connected sources can be certified as green will be a crucial factor in decisions regarding grid connection.

In its recently released discussion paper, A Hydrogen Guarantee of Origin scheme for Australia, DISER has proposed that voluntary surrender of LGCs, is a relatively simple and cost effective way to certify grid connected hydrogen production as renewable. If this approach is not reflected in the government's final decision, it could potentially impact investment decisions. AHC will continue to engage with DISER on this matter.

## Next steps

A range of market, regulatory and system settings will impact the viability of grid connected hydrogen. Due to the specific attributes of electrolyser load and the complexity of the National Electricity Market it will be necessary to ensure that each of the elements outlined above is examined at both in isolation and as part of the bigger picture.

The variety of potential hydrogen projects also leads to the potential for disagreement among project proponents on setting for any of the identified elements.

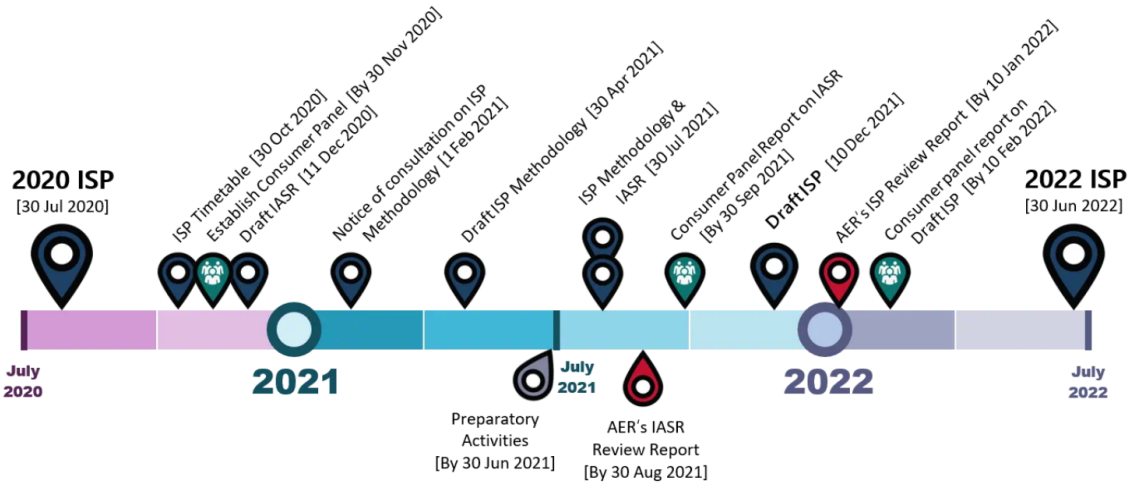
**Proposed action**

In order to manage this, AHC should develop a clear set of principles to underpin any future positions to be used in discussion on these matters. Draft principles to be completed by August 2021.

It is also crucial to identify any areas where system and regulatory settings align with other incentives or obstacles encountered, for example, whether DRM or FCAS markets can alleviate the need for certainty in offtake agreements.

Led by Working Group 2, AHC should continue to engage with AEMO's ISP 2022 process in line with its current timeframes (outlined below) to ensure that issues relating to the hydrogen's role in the future NEM are adequately captured and can inform future energy market design.

Key milestones relating to the 2022 ISP are shown below.




**Proposed action**

AHC Secretariat to invite AEMO to future working group to discuss opportunities for input to the 2022 ISP

AHC Secretariat to engage with Oakley Greenwood to conduct high level analysis draft methodology by mid July 2021, with a view to revise upon receipt of final ISP Methodology.

In parallel, the AHC secretariat will engage with the AEMC processes around FCAS markets to monitor changes which impact opportunities for grid produced hydrogen.