WATERING DOWN THE COST OF GREEN HYDROGEN

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EXECUTIVE SUMMARY

Green hydrogen is viewed as a key ingredient to the global transition to net zero. Water is intrinsic to green hydrogen, given it is both the electrolysis feedstock and a predominant cooling mechanism. It is therefore a core component of the *levelised (production) cost of hydrogen* (LCoH). In response, proponents will be searching for innovation to reduce the water contribution to the LCoH.

Planning and feasibility activities on green hydrogen projects being progressed are revealing that the contribution of water to the *LCoH* is much higher than originally anticipated. This paper summarises learnings and presents ideas that could reduce the contribution of water to the future *LCoH*, helping to de-risk green energy projects and maximise viability.

INTRODUCTION

Green hydrogen is viewed as a key ingredient to the global transition to sustainable energy and net zero, as it provides opportunities to decarbonise applications that are difficult to electrify. Water is intrinsic to green hydrogen production, given it is both the electrolysis feedstock and a predominant cooling mechanism for the current 'room temperature' electrolyser technologies. Water is therefore a core component of the *levelised (production) cost of hydrogen* (LCoH), which is a key basis of the overall viability of a given project.

Green hydrogen opportunity analyses completed pre 2020 were largely driven by government agencies. These activities provided projections for both the quantum and composition of the future LCoH and formed the basis of aspirational targets, including the U.S. Department of Energy's '*$1 per 1 kilogram in 1 decade'* and the Australian Government's *'H_2 under $2'.*

Consensus view from such studies and historic roadmaps was that water would be but a minor component of the projected LCoH, if water elements were even quantified at all.

Planning and feasibility activities on developing green hydrogen projects are now being progressed by private proponents. Whilst these activities are uncovering a wide array of challenges the industry must overcome, one particular revelation is that the contribution of water to the LCoH is much higher than previously anticipated. As projects progress, greater precision on green hydrogen cost of production will be sought, highlighting the importance of determining the LCoH.

HIGHLIGHTS

- The contribution of water to the LCoH is being revealed to be higher than originally anticipated
- As a mature industry, water components won't be subject to significant future cost reductions
- The water fraction of LCoH will increase if the cost of electrolysers and renewables reduce
- This paper presents suggested focus areas for reducing water contribution to the LCoH

METHODOLOGY

The methodology employed in this study was grouped into three steps:

Step 1 - Undertake a review of literature and project data relating to the contribution of water to the LCoH:

- Review of past literature, government agency statements, position papers and opportunity analyses for the production of green hydrogen
- Review actual progressed green hydrogen planning and pre-feasibility activities (noting confidentiality), and updated versions of the historical information
- Compare and contrast the initial projections and estimations to current information
- Define any water challenges (engineering and technical) being revealed in progressed projects, that contribute to the increased water fraction of the LCoH
- Based on all information gathered the above tasks, undertake a forward projection of the LCoH breakdown and the resultant water proportion of LCoH

Step 2 - Identify and develop ideas and innovations that could address the problem of water being a significant component of the LCoH:

- Ideas to reduce water usage per unit of produced hydrogen or vector
- Ideas to reduce the CAPEX and OPEX per unit of water production
- Ideas to address emerging engineering and technical challenges relating to water
- Identify other technology developments or project circumstances that may reduce water usage per unit of produced hydrogen or vector

Step 3 - For each identified idea, further develop and identify residual challenges:

- Demonstrate an example of a realised solution
- Investigate the implications and necessary trade-offs for implementing the idea
- Assess and define any residual challenges and risks for idea, including commercial and technical challenges

OUTCOMES

Early studies expected the water contribution to the LCoH to be minor (Figure 1). Potential grounds for this projection may have included simplistic assumptions on the quantum of water required to produce H_2/NH_3, or optimistic expectations on the use of fresh water sources to supply potential hydrogen projects.

Progressed projects and other data sources are revealing the water contribution to the LCoH to be significantly higher than originally projected (Figure 1).

Ambitious targets for the future LCoH are proposed. For such targets to be achieved, a significant reduction in the cost of key components such as electrolysers and renewable energy generation are required. Should this eventuate, this could result in the water component of the LCoH being multiples of that shown in Figure 1, and forming a significant portion of the future LCoH.

This paper presents potential ideas for consideration in green energy projects to reduce the water component of the LCoH, helping de-risk green hydrogen projects and maximise viability.

CONCLUSION

Recent engineering activities on planning and feasibility of developing green energy projects have revealed that water contribution to calculated LCoH is much higher than previously anticipated, and likely to increase. It therefore follows that reducing this fraction is a key focus to reducing the LCoH and ensuring the viability of projects. This paper presents potential focus areas and ideas to be examined as projects are planned and designed.

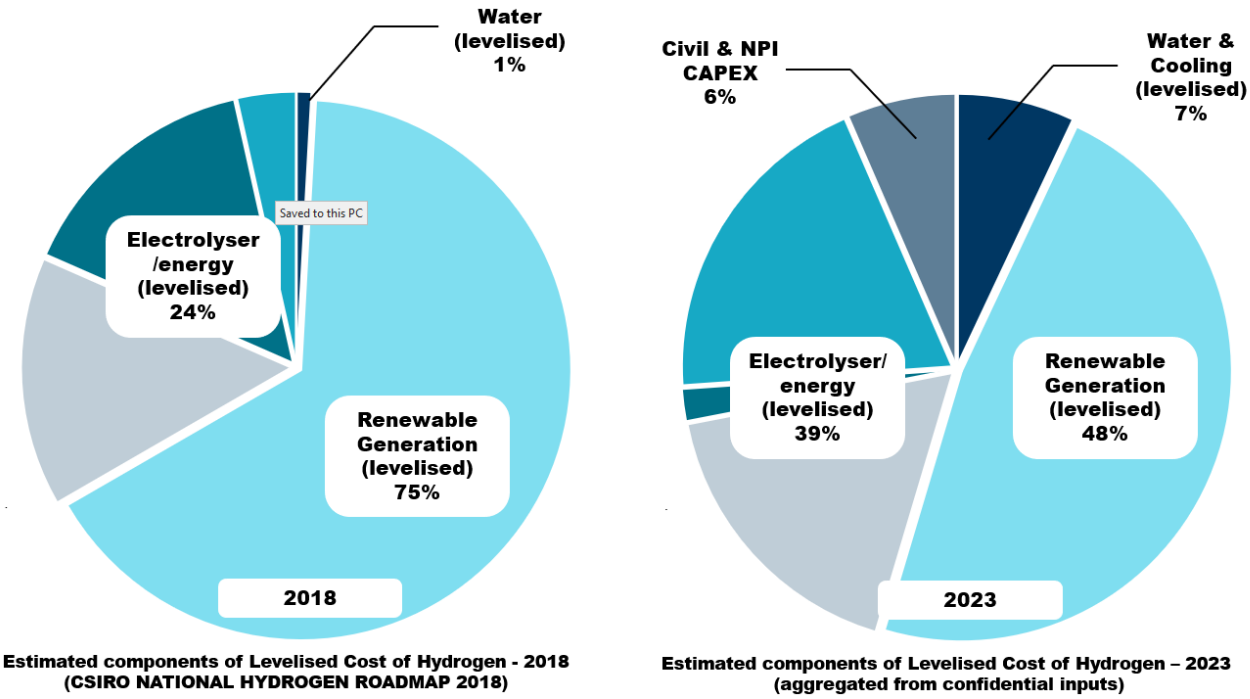

Figure 1 - Comparison of LCoH breakdown from 2018 to 2023