Navigating water's role in the green hydrogen economy

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Foreword

The expansion of the Australian hydrogen industry has been gaining momentum for several years. To date, exploratory efforts to realise the potential of a hydrogen economy have largely focused on renewable power, price, production, transport, end users and government funding. But with many of our water utility clients coming to us for answers on how they should engage with this emerging industry, it became apparent to us that the water sector was increasingly being called on to play its part – but how?

Despite its intrinsic role in hydrogen production, water has been largely absent from the hydrogen conversation and, from our perspective, hasn’t received the attention it should.

To explore this and help frame some answers, in 2022/23 we sought to generate stronger industry focus and understanding through a series of webinars to create a platform for an industry-wide conversation. Our **four webinars** aimed to tackle key questions for water utilities around how to integrate the hydrogen push into strategy, planning for demand uncertainty, the shift in water supply challenges, and hydrogen’s connection to the circular economy.

What emerged from hours of content, over a thousand participants, and copious amounts of data was a narrative around the issues and considerations that are critical to appropriately examine how the water industry might engage – and be engaged – to enable green hydrogen production.

Consolidating the learnings from these webinars, this guide lays out a pathway for operationalising the water-energy nexus, helping to enable Australia’s green hydrogen aspirations. It draws on the input of GHD’s own team of technical specialists, as well as the inputs of industry experts and participants, to provide a way forward for the water industry and those seeking to engage with it.

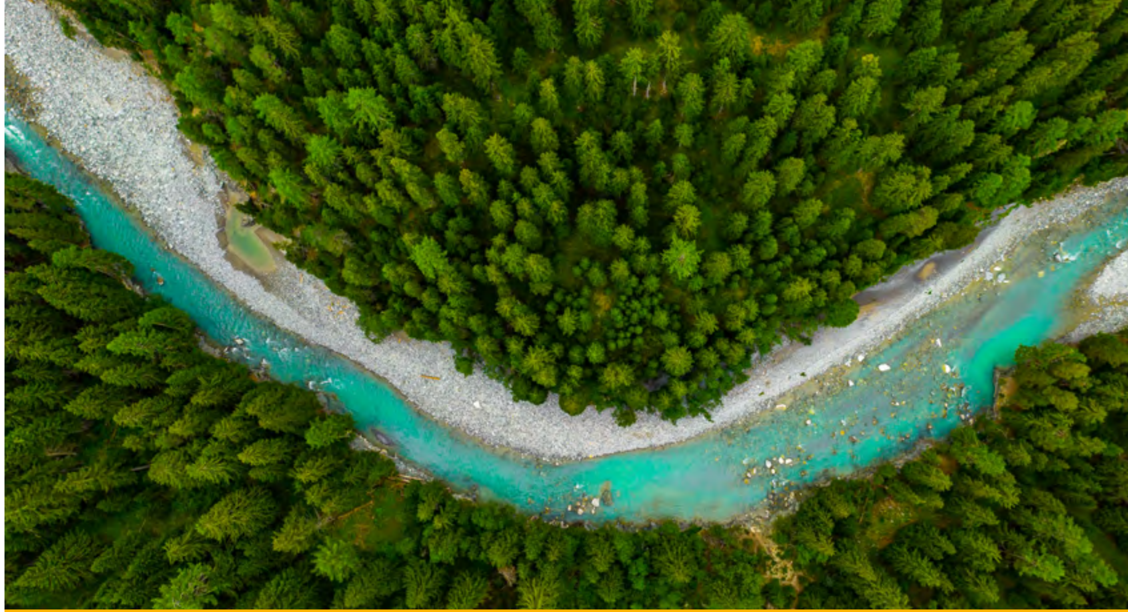
Though there are gaps in current knowledge around this topic, and not every important question has an answer – yet – this framework provides a summary of the industry’s current thinking and aims to act as a helpful guide to understand the interconnectedness of water and hydrogen.

While the steps outlined are designed to help utilities navigate their role in this new green hydrogen economy, financiers, producers and governments can benefit from understanding how they need to be engaging with utilities for the success of their projects and the impact that they will have on the communities that surround them.

We look forward to continuing the conversation as we navigate this emerging industry together.

Lindsey Brown
Australian Market Leader – Water

In this guide



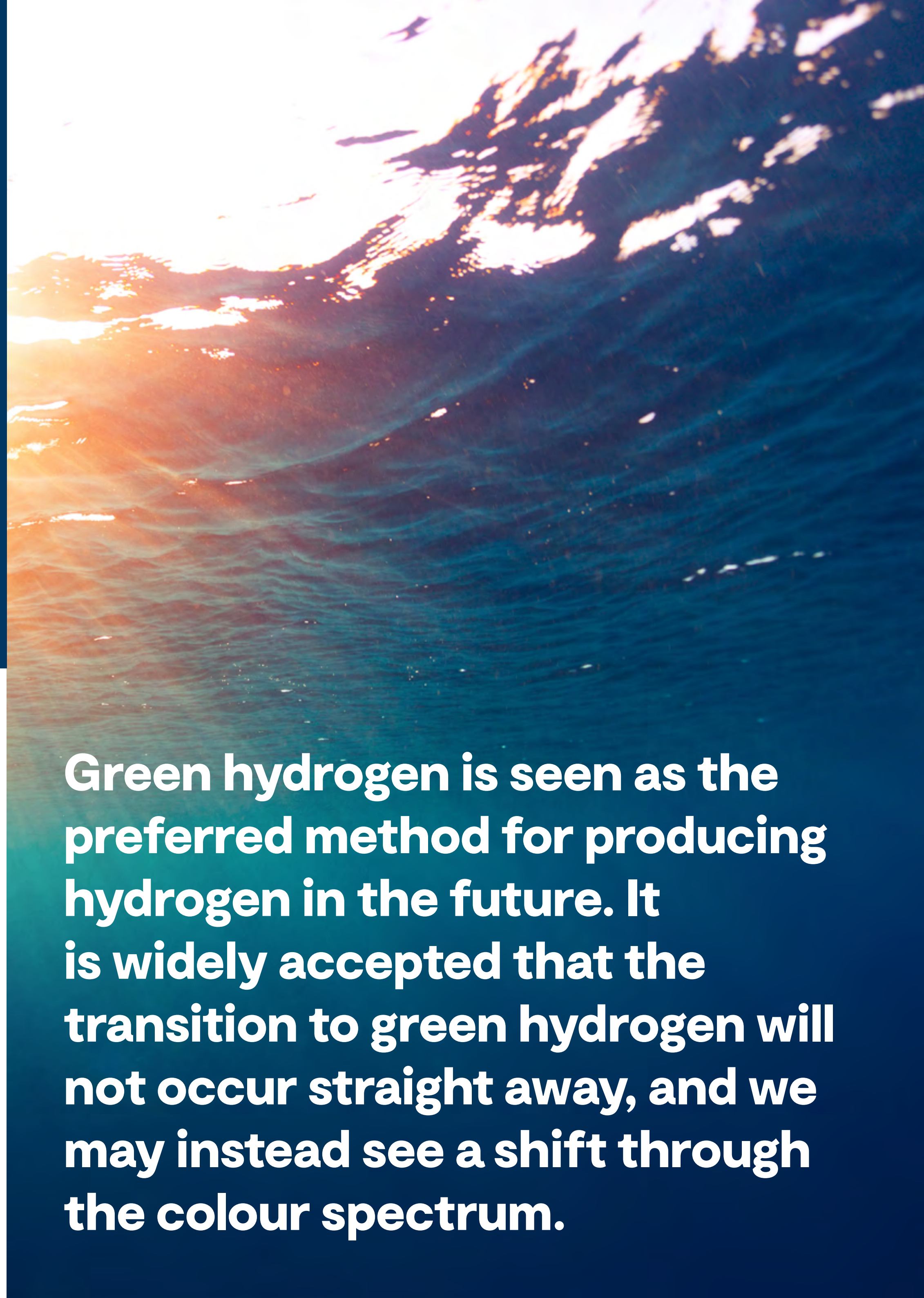
While the green hydrogen economy is still in its early days, now is the time for water utilities to get involved. The water industry's strong commitment to net zero emissions, close relationships with local communities, and specialist knowledge in advanced water treatment, makes it uniquely placed to gain a competitive advantage in this space.

Australia's green hydrogen ambitions and water implications

The Australian Government has publicly endorsed the ambition to decarbonise our economy by turning our nation into a renewable energy superpower. Australian-made green hydrogen will be essential to make this a reality.

Australia already has hydrogen export agreements with Japan, South Korea, Germany and Singapore to assist them with their energy transition and decrease reliance on gas supply. To facilitate this export, hydrogen hubs have been established with the Federal Government across the country including Bell Bay (Tasmania), Darwin (Northern Territory), Eyre Peninsula (South Australia), Gladstone (Queensland), Latrobe Valley (Victoria), Hunter Valley (New South Wales) and Pilbara (Western Australia).

Whilst there are many forms of hydrogen, green hydrogen is seen as the preferred method for producing hydrogen in the future. It is widely accepted that the transition to green hydrogen will not occur straight away, and we may instead see a shift through the colour spectrum increasing blue hydrogen production as technology advances to better support green hydrogen production.



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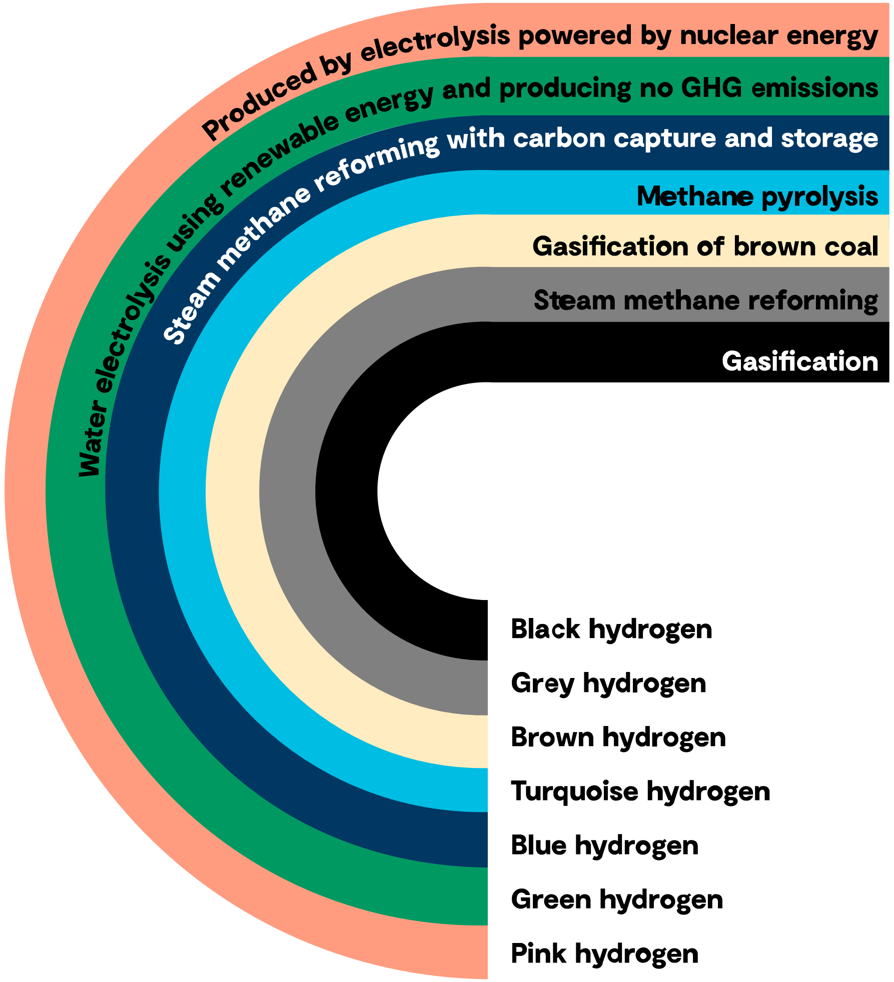


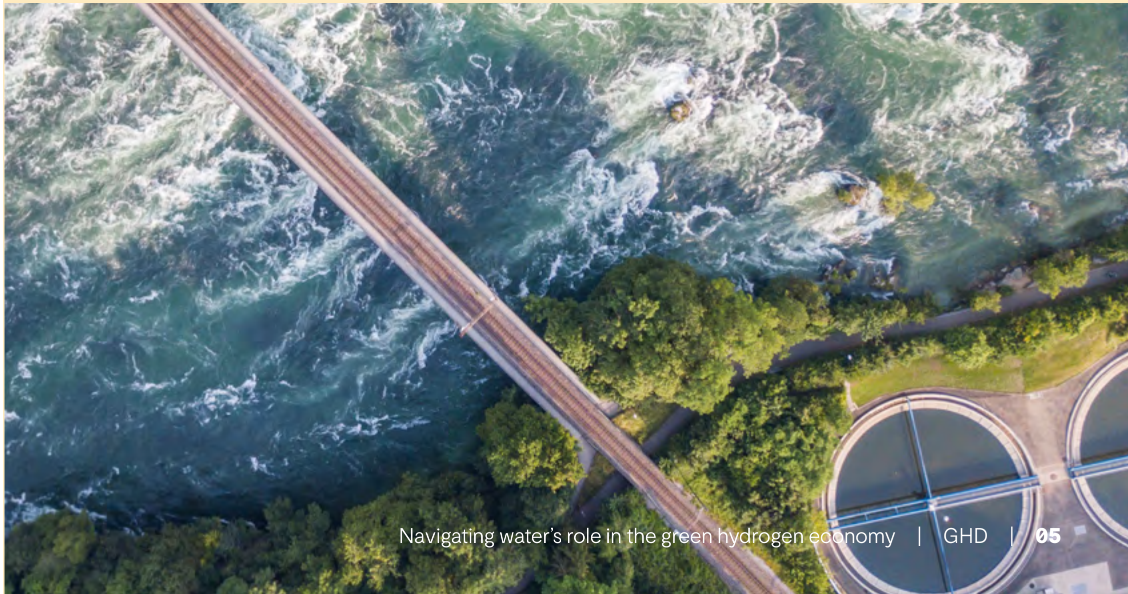
- Gasification of black coal — emissions to atmosphere
- Steam methane reforming, without carbon capture storage
- Gasification of brown coal — releases emissions
- Pyrolysis of natural gas — produces solid carbon as a byproduct
- Steam methane reforming, with carbon capture and storage
- Electrolysis of water powered by renewable electricity, no harmful emissions
- Electrolysis of water powered by nuclear energy

Green hydrogen uses renewable energy to separate hydrogen and oxygen molecules from water through a process known as electrolysis. Depending on the technology selected, large amounts of water can be required for electrolysis, for both raw water intake and cooling.

With estimates that green hydrogen production will reach one million tonnes per annum by 2030 and 45 million by 2050, there will be significant implications for water[1].

In the context of a drying climate, where water is already a scarce resource, there will be less water available for new and large uses like hydrogen production.

1 *ACIL Consulting for ARENA, (2018). Opportunities for Australia from Hydrogen Exports.*



Given the increasing role green hydrogen is expected to play in decarbonisation, the Australian water sector has been called on to play its part in the global energy transition, especially to enable domestic hydrogen production. While political and industry support is growing, many key questions remain about how Australian water utilities can – or should – deliver on these expectations within their scope, mandate and budget.

As Australia's green hydrogen ambitions develop, proponents need to appropriately consider the water supply challenge as a critical and complex aspect of project development.

They will need to engage with the water industry and community over feasible options, pathways and trade-offs, as well as emerging opportunities to advance a more circular economy, integrating with existing recycled water systems and future infrastructure.

Navigating water's role in the green hydrogen economy

Step 1: Define the role the utility will play

Can we get involved? Should we?

Does it fall within the remit of water utilities?

Do we have enough water for this?

How do we balance the costs to customers?

Step 2: Understand the variables

What technical aspects do we need to consider?

What water source should we use?

What is the quality and availability of that type?

What are the cooling options for hydrogen production?

What kinds of waste management strategies should we adopt?

What technologies and processes will we select?

Step 3: Realise the full potential

How can we maximise the opportunities?

Can we augment existing systems?

How can we contribute to a circular economy?

Where can efficiencies be established?

What opportunities exist for collaboration?

Step 1:
Define the role the water utility will play

Can we? Should we?

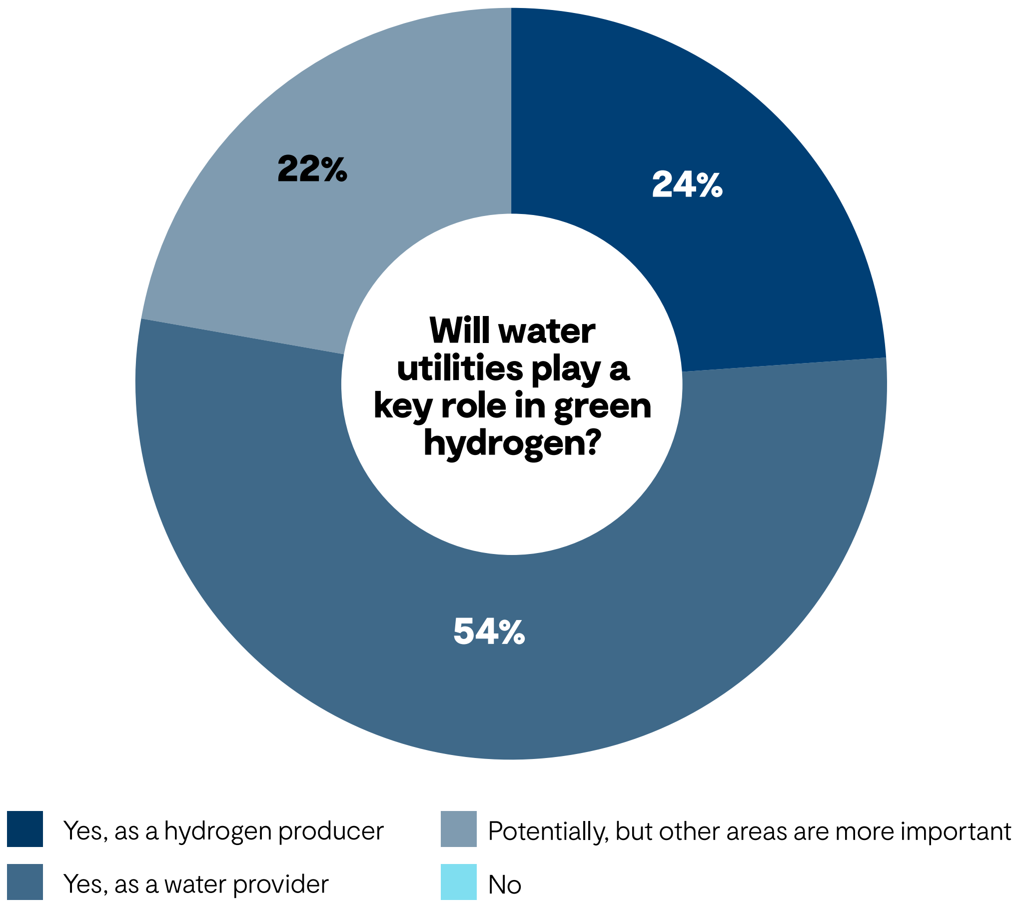
Generally, water utilities have historically been responsible for provision of water for human consumption, and the removal and treatment of recycled water for the protection of human health and the environment.

Given water utilities' existing access to water, land, expertise in implementing relevant technologies like desalination, and the network required to transport water, they are uniquely positioned to play a role in hydrogen production. The question is what role that should be.

Will they be hydrogen producers leveraging their existing asset base? Will they be suppliers of bulk water to the hydrogen industry, rather than having them secure their own supplies? Will they play some other role, such as a hydrogen user, or take on the role of advisors to the hydrogen industry?

In general, the answers are underpinned by the response to the simple but daunting question: Can we do it; and if we can, should we? This simple but effective query challenges water authorities to examine their key assets and capabilities (can we?), as well as the tensions existing in their regions around water availability, affordability, and community values (should we?).

There is a clear expectation that water authorities will engage in the hydrogen economy in some regard. In our survey of water and energy industry professionals, more than half of respondents believe water utilities will play a key role in green hydrogen as a water provider. This could be because of the relative simplicity of providing bulk water to hydrogen producers as industrial customers (something very familiar to many utilities), as opposed to other options that might involve greater investment or expansion into new frontiers of operation. No respondents believed that water utilities would not play a role.



More than half of water and energy industry professionals believe water utilities will play a key role in green hydrogen as a water provider.

1. Does it fall within the remit of water utilities?

While the role of utilities has historically been focused on drinking water and sewage collection and treatment, in recent times this has evolved to include a wider scope of related responsibilities. Many utilities now provide water for industrial uses, such as food processing and manufacturing, as well as managing their associated trade waste discharges – which is combined with sewage and fed into recycled water treatment plants to produce recycled water. With this growing scope and the inherent role that water plays in hydrogen production, there are several ways that water utilities will engage – or could be engaged.

Water utilities could work with hydrogen producers as they do with industrial customers , however the volumes of supply required and the potentially large and difficult waste stream to manage this may be beyond the existing infrastructure capabilities of many utilities currently and require significant investment to service.

Water utilities may also be interested in producing hydrogen for their own consumption for energy-intensive activities and processes. However, with generally limited overall demand, inefficiencies in manufacturing and using hydrogen onsite can often mean a stronger business case for electrification.

Hydrogen manufacturers may also seek approval for their own water supply or water manufacturing options, such as private desalination or water recycling facilities. This practice is quite common in remote communities across Australia, including central west New South Wales, the Pilbara region in Western Australia and in the Northern Territory. In these remote locations where companies use fly-in fly-out workers, they operate water and waste plants as an additional business overhead. Water utilities have the technical specialists that could help optimise these types of systems at hydrogen plants. This would remove the need for utilities to play a direct role but may reduce the benefits of leveraging existing knowledge, capability and assets. Specialist understanding of the detailed processes and inputs required in hydrogen production would be necessary, and potentially better served by other parts of the sector.

Instead of producing green hydrogen on their own, water utilities could benefit from forming a partnership with a hydrogen producer. This would allow a water utility to operate and maintain the recycled water plant, supplying treated water straight to the electrolyser without the need for additional treatment by the hydrogen producer. Water utilities will need to assess the risks and benefits to decide where to draw the battery limit depending on the local environment and priorities. Nevertheless, the water industry has an inherent advantage over other industries when it comes to advanced water treatment.

Given their responsibility for the delivery of safe, secure and affordable water to customers and the community, ultimately, water utilities will need a seat at the table as Australia pursues its green hydrogen ambitions.

2. Do we have enough water for this?

A frequently asked question at the heart of the water and hydrogen conversation is whether we have enough water to support a sustainable green hydrogen economy. While Alan Finkel describes Australia's potential hydrogen export market as "shipping sunshine", it will also involve shipping a lot of embedded water with it.

Depending on the cooling method and water source quality, green hydrogen can be a thirsty industry. Australia is already a water-constrained country, susceptible to drought and a changing climate, and Australians may question whether water is a resource too precious and valuable to export to other countries at such a large scale.

To respond to this, water utilities need a thorough understanding of their water assets, including where the water to produce hydrogen can be sourced and whether water supply can be guaranteed in the event of a drought. If hydrogen production is being explored, site location is another crucial factor. A checklist of consideration should include:

- ☑ **What water quality can be made available?**
- ☑ **When will the water be available?**
- ☑ **Who can have access to the water?**
- ☑ **What is the minimum viable size for hydrogen production based on the water available?**
- ☑ **How long will the water be available?**
- ☑ **How long will the existing infrastructure last to be able to supply the water?**

Green hydrogen can be a thirsty industry.

These considerations help unpack the quality, volume, and reliability of water that might be made available for hydrogen production. This can give certainty to the market of what water could be made available to improve investment feasibility.

Another important consideration is the trade-offs that need to be made. Recycled water may have competing uses such as commercial irrigation, water for urban greening, or to reduce reliance on surface water for existing industrial or residential customers. Communities may see other uses for our constrained resources as more valuable than a new industrial user. Engagement is key in establishing the mandate for using water for hydrogen production.

3. How do we balance the costs to customers?

Green hydrogen will require large amounts of renewable energy and water and would require significant investment to augment the supply of both – in addition to maintaining and sustaining existing systems as well as managing existing issues. Net Zero Australia suggests **renewable energy generation is required to the scale of solar array farms the size of Tasmania.**

Water utilities looking to produce hydrogen, either for their own use or to sell, will need to carefully consider and understand all the risks so that only appropriate costs are passed onto customers, and they are not taking on unacceptable investment risk without appropriate benefit.

There is potential for the government to provide water utilities with greater clarity on their role by creating either a mandate or subsidy to reduce the cost risks to rate payers and the local community and guard against the creation of white elephant infrastructure to treat water to the high quality required for hydrogen production.

One thing is clear; all stakeholders involved in the production of hydrogen – private industry, government, regulators, local councils, water utilities, end users and the local community – must engage in open discussions to balance competing interests and ensure public confidence in the investment and appropriate distribution of costs and benefits.

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Adaptive planning and scenario planning is particularly important for water utilities considering investing in hydrogen to appropriately manage risk in such an emergent industry landscape. There are still many potential risks and uncertainty to hydrogen outside of assets, costs and water availability. Recent geopolitical events have demonstrated how energy can be weaponised to impact the global economy and national security. The geopolitics of global trade will change significantly as we move away from fossil fuels. Economics will favour countries with plentiful low-cost renewables, which are able to process and manufacture onshore, ready for export.

Within Australia, there are approximately 112 hydrogen projects currently underway, although most of these are small in scale and few have reached the final investment decision. Ultimately, government regulation will play an important role in what scope water utilities are given to engage in the hydrogen economy through their pricing processes and other regulatory mechanisms. Early engagement with regulators and government agencies on how different roles in the hydrogen economy link to regulatory objectives, corporate plans, established strategies and community outcomes will all help to make the case for utility involvement. This must be supported by community values and priorities to help utilities play their part in decarbonisation without compromising their ability to meet community expectations.

Step 2:
Understand the variables

Understanding the many variables to produce green hydrogen can help water utilities decide how best to use their existing assets or where to make investments. Scenario planning is particularly useful here as it allows water utilities to envision multiple futures and avoid locking themselves into a particular pathway or investment.

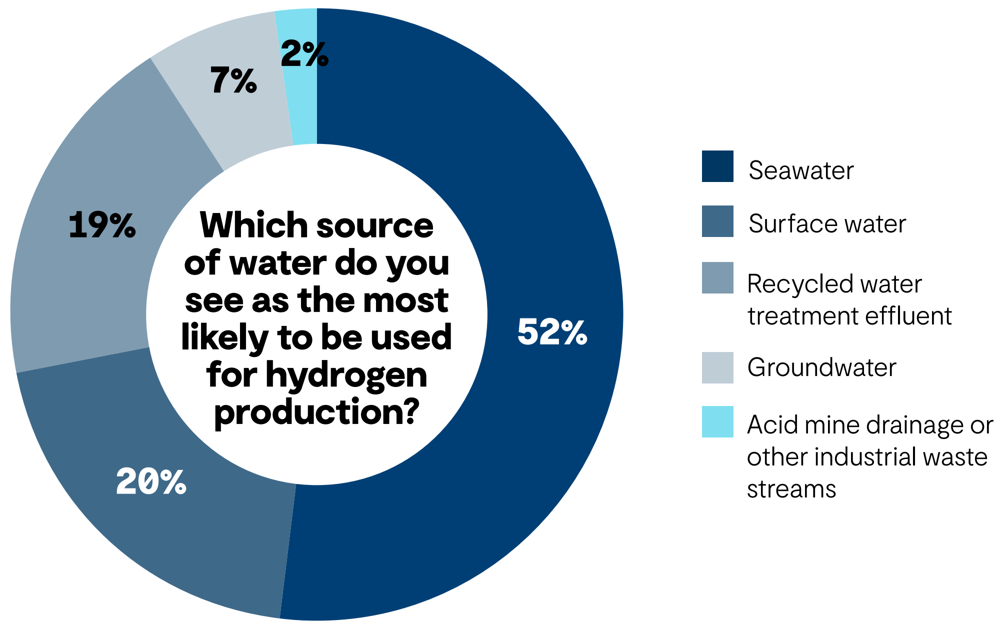
From a water perspective, there are four critical areas that can impact a project's overall costs: water source, quality and availability; cooling options; waste management; and technology and process design. Understanding the energy and infrastructure required in these four critical areas can help water utilities identify the right solutions for their environment, assets and customers.

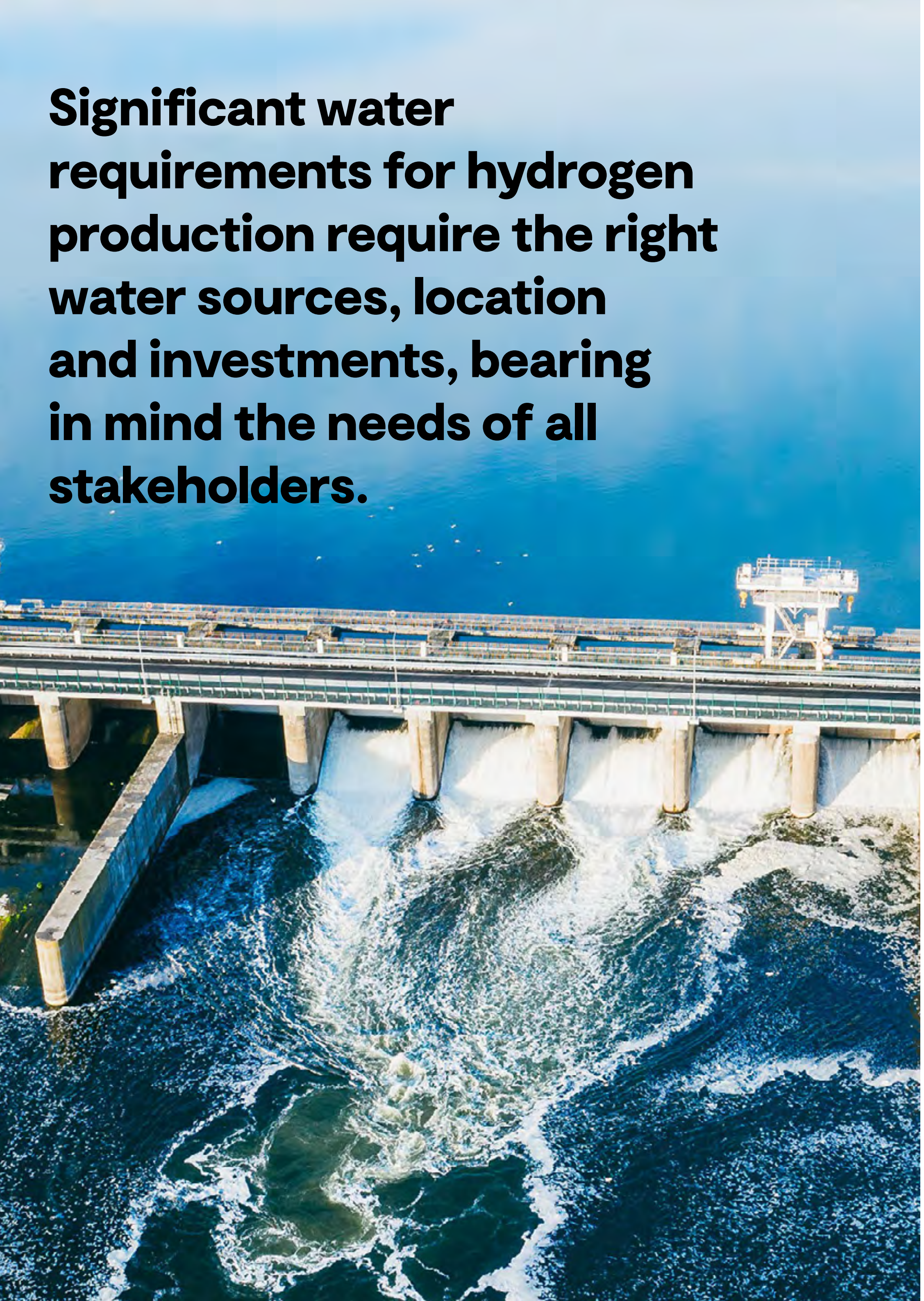
Water source, quality and availability

At any location, there may be several potential water sources for feeding hydrogen production, each with varying water qualities. The type of feed water can drastically change the water requirements, the quantity and quality of waste produced, and the complexity of the process design. Determining the long-term availability of a water source, both in terms of volume and quality, against the required treatment costs is a balance that must be weighed up. In fact, it is unlikely surface and groundwater will be sufficient to service all the planned hydrogen projects; sea water, and potentially recycled water, will be required as a major feed source.

Introducing new users could create scarcity on already stressed water resources and difficult decisions will need to be made to support a change to application in hydrogen production. Relieving pressure by using new water sources not currently being utilised may be positive, but these sources may be harder to treat or access than existing sources.

In today's world, the most potentially viable water sources that may be accessed by a water utility for hydrogen production include seawater, surface water and recycled water treatment effluent. Surveyed participants saw desalinated seawater as the most likely source of water for hydrogen, presumably because of its relative reliability and abundance compared to other sources. However, the requirements for site selection near large populations centres may make it difficult to find available sites near port locations for export or near hydrogen production facilities without considering the competition with potable water desalination plants.





Significant water requirements for hydrogen production require the right water sources, location and investments, bearing in mind the needs of all stakeholders.

As feed water for hydrogen production, the use of seawater is appealing because there is ample supply, its treatment steps are well known and understood, and the waste can be disposed of back into the sea, pending regulatory approval. As a coastal resource, climatic conditions mean cooling is much cheaper and once-through cooling with seawater may be possible.

However, location siting can be difficult due to competing stakeholders including housing and recreational, as well as the potential impact on other nearby streams, particularly in terms of brine dispersion and salinity or solids management. In addition, seawater desalination can be energy and capital intensive, requiring careful consideration of construction materials due to the coastal environment. Rivers and bays are also problematic due to changing turbidity and organics, making treatment challenging particularly in terms of flushing and dispersion of brine waste.

Availability of surface water is often dependent on consistent rainfall. Using surface water as feed water for hydrogen production can be riskier from an environmental and social perspective, as there are likely to be more regulations surrounding water licencing and social license to operate.

The benefit to using surface water over seawater is the lower salinity and solids content in surface water, which requires less or less intensive treatment steps to remove. However, surface water has other parameters of concern such as organics and some metals which can become problematic for advance treatment processes such as reverse osmosis (RO) and continuous electrodeionisation (CEDI) but can be removed beforehand.

While most recycled water from wastewater has traditionally been discharged to the environment, it is increasingly recognised as a valuable resource that can be used in many ways including to supplement drinking water supplies, for example in Perth and many US cities. It can also be put to good use as hydrogen feed water.

Recycled water can also be decentralised across a utility’s service area, where there are several smaller systems spread out across a large area. This can make it difficult to congregate the recycled water effluent for processing and may mean it is only viable as a decentralised option where recycled water is only contributed from one plant with sufficient water output.

Ideally, multiple routine samples of potential sources should be obtained over three or more years to determine seasonal, depth or weather dependent variations in source water quality as this will affect decisions around cooling and waste management strategies as well as technology and process selection.

Hydrogen production cooling options

Cooling strategies have water implications through both water demand (input) and water produced (output). The efficient management of both aspects is key to project success.

Potential cooling strategies include once-through cooling, evaporative cooling, air cooling, adiabatic cooling, chillers or refrigerants and waste heat utilisation. The type of cooling used can drastically impact the volumes of water required as well as the CAPEX and OPEX of the system.

For once-through cooling, seawater or surface water from a large lake might be used. For evaporative cooling, surface water is typically used, though there is strong potential to use desalinated seawater. For air cooling or chillers, only small amounts of water are typically required but these are usually treated to a high level for closed cooling circuits or adiabatic cooling sprays.

Cooling strategies are also climate dependent, with air cooling more beneficial in certain locations and once-through cooling for seawater only possible to coastal locations. Like all aspects of water for hydrogen, the demand of water and waste stream production is dependent on the specific project, site and regulatory constraints.

Types	Water treatment required	Water quantity required	CAPEX or OPEX ↓↑	Energy required
Once through cooling	Surface or Sea Water	↑ (Very high)	↓ (Low) ↑ (Medium)	↓ (Low)
Evaporative cooling	Surface or sometimes Sea Water	↑ (High)	↑ (Medium)	↓ (Low) ↑ (Medium)
Air cooling including adiabatic	Demin or town water	↑ (Medium)	↑ (Medium)	↑ (Medium)
Air cooling	Demin or town water	↓ (Very low)	↑ (Medium) ↑ (High)	↑ (Medium)
Chillers or refrigeration	Demin or town water	↓ (Very low)	↑ (High)	↑ (High)
Waste heat utilisation	Demin or town water	↓ (Very low)	↑ (Medium) ↑ (High)	↓ (Low)

↓ Very low ↓ Low ↑ Medium ↑ High ↑ Very high

Waste management strategies

Waste management is a critical component of the water treatment process and is dependent on the location and quality of the source water used. Co-locating water and hydrogen infrastructure has many benefits operationally, including the potential to integrate waste and feed systems. However, extra treatment steps can create additional waste streams which need to be considered and managed.

Brine waste management is an important consideration in the hydrogen production process because it needs to be managed adequately to protect the environments around the plant location as well as having entrained water which can be removed and recycled within the process. Unlike coastal desalination, brine from inland water-fed systems cannot simply be managed through ocean discharge. In these locations, there is an opportunity to implement zero liquid discharge systems which use thermal treatment as a brine management strategy.

Another approach, which is currently a more typical base case for industrial proponents, is to use solar evaporation ponds or brine injection. The solar evaporation ponds require a large surface area to maximise the evaporation and concentration of the salt which then requires offsite disposal. Brine could also be released to the environment at inland sites or discharged via trade waste, however, this is dependent on contaminant load and project size (e.g., volume). A beneficial option is thermal treatment, where waste heat from the cooling system could be used to drive thermal desalination or as steam for thermal treatment systems.

When considering how to manage waste, it is essential to understand the regulatory requirements and approval processes, including discharge licenses, environmental impact statements, and receiving location of the waste.

By optimising the synergies between water treatment, brine management and hydrogen production, utilities can help create a localised circular system. This benefits businesses and reduces the impact on the environment.

Technology and process selection

Technology and process selection is critical to understanding water requirements, with the water source impacting the type of technology required for treatment. The size of the project will impact decisions around technology and process selection. For larger projects, it may be more complex with the recycling of various waste streams. For smaller projects, processes should be kept as simple as possible to minimise CAPEX and increase operability.

The first step is to select the treatment plant type. This could be desalination, conventional water treatment or demineralisation, depending on the water source. From there the specific technologies for treatment can be chosen. These could include conventional filtration, clarifiers, chemical dosing, micro or ultrafiltration, reverse osmosis (RO) membranes, ion exchange, or CEDI, to name a few examples. The type of pre-treatment required will depend on the quality of the feed, with higher quality feed needing less pre-treatment before membranes.

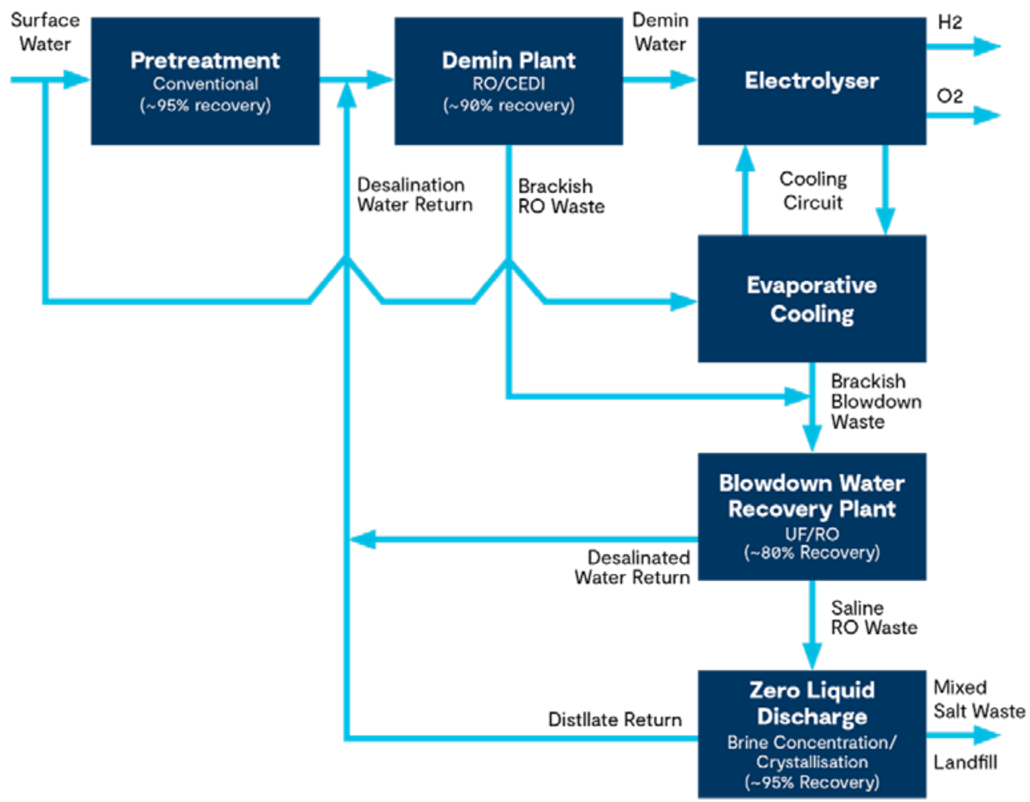
For seawater, combining filtration prior to multiple stages of RO membranes with final polishing via CEDI is the most typical form of technology and process used.

For surface water, conventional water treatment processes are possible upstream followed by RO and CEDI with smaller units needed due to quality of feed water compared to seawater.

The process flow sheet (right) demonstrates the types of considerations that need to be addressed to produce water for hydrogen production. In this example, surface water undergoes treatment via conventional water treatment processes such as clarification, chemical dosing and filtration. As a separate stream, the raw surface water is used for evaporative cooling. Following the filtration, the electrolyser water treatment continues through a demineralisation plant where CEDI is used with some pre-treatment to prepare the water for the electrolyser.

Waste from the demineralisation plant is combined with the blowdown from the evaporative cooling to be recovered through a blowdown treatment plant. It is then recovered through ultrafiltration and reverse osmosis and the saline waste is put through a process of zero liquid discharge at a thermal brine treatment plant where even more distillate is recycled to enhance recovery. This process outlines how to maximise the recovery of the existing system and minimise the waste needing disposal or management.

In summary, each project will have varying water demands, with the source type, cooling systems and waste management restrictions drastically affecting the level and quality of water required to produce hydrogen. The use of digital design technologies will be key in early-stage investigation projects to screen and consider a range of potential sources and site locations for hydrogen production.



Case Study: Hydrogen production in Tasmania

Summary

Tasmania has a well-established renewable energy system, including hydropower and wind energy, with an abundance of fresh water and land availability to pair with industrial partners. The volumes of water required for hydrogen production are yet to be determined and dependent on several factors, with source water being a key consideration.

Potential options include recycled water, seawater, recycled water, surface water and bore water. These are all available sources in Tasmania without considering more niche applications to pair with rehabilitation drivers like acid mine drainage or industrial waste or mining tailings sources. Technology selections and surrounding environments will also dictate the water requirements.

Five potential scenarios were developed in a Tasmanian-focused study to highlight a range of source water, cooling and waste disposal options. For consistency across the scenarios, electrolyser sizing was set to 300MW with a PEM electrolyser efficiency of 75% and the hydrogen being produced as a gas for sale.

The five scenarios were input into GHD's Water for Hydrogen Early-Concept Model to understand the various water demands for key plant sections across the system.

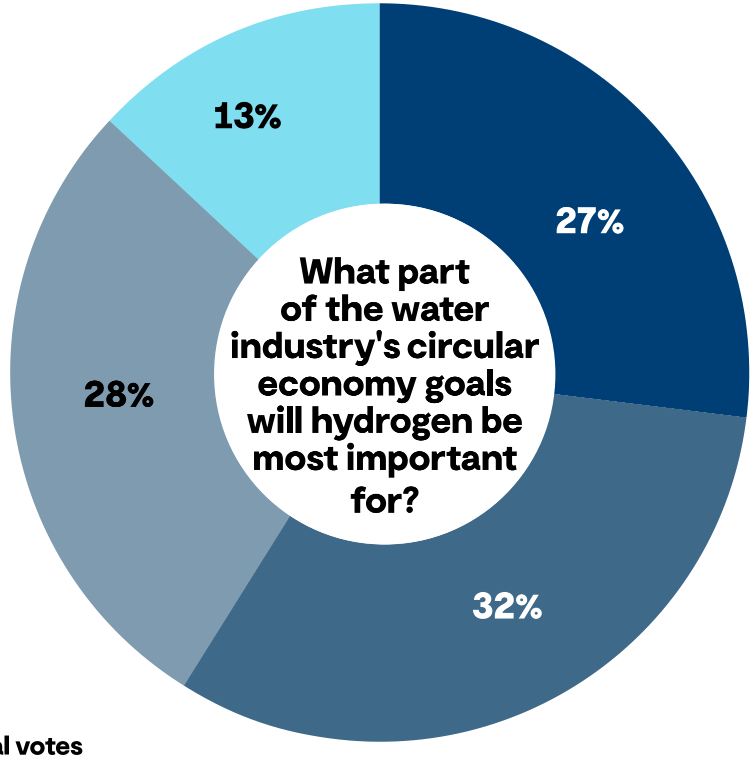
The comparison showed that the port-based seawater-fed systems with once-through cooling used more water per kilogram of hydrogen (almost 200 L/kg of H2), while the inland irrigation system using blowdown water treatment and zero liquid discharge brine treatment used the least (46 L/kg of H2).

Each project will inevitably have varying water demands depending on the water source, technology selection, cooling system and waste management restrictions. Hydrogen plant siting will also impact water demands and the potential for project feasibility.

Table 1: Water requirements for five hydrogen production scenarios in Tasmania

	Scenario 1 Bell Bay Port (port-based, evaporative cooling)	**Scenario 2 Bell Bay Port** (port-based, evaporative direct seawater cooling)	**Scenario 3 Bell Bay Port** (port-based, once-through cooling)	**Scenario 4 Midlands Irrigation Scheme** (inland-based, evaporative cooling)	**Scenario 5 King-Yolande** (dam-based, once-through cooling)
Intake capacity (ML/d)	**14.7**	**16.3**	**269.2**	**6.3**	**267.5**
Outfall capacity (ML/d)	**7.9**	**10.1**	**268**	**-**	**266**
Reverse osmosis plant capacity (ML/d)	**14.37**	**3.56**	**3.56**	**1.8**	**1.8**
Demin plant capacity (ML/d)	**1.44**	**1.44**	**1.44**	**1.44**	**1.44**
Blowdown plant capacity (ML/d)	**-**	**-**	**-**	**1.01**	**-**
Zero liquid discharge plant capacity (ML/d)	**-**	**-**	**-**	**0.19**	**-**
Total raw water demand (L/kg of H2)	**107**	**119**	**1964**	**46**	**1952**
Demin raw water demand (L/kg of H2)	**27**	**26**	**26**	**14**	**14**
Cooling raw water demand (L/kg of H2)	**81**	**93**	**1938**	**38**	**1938**
Reverse osmosis concentrate production (L/kg of H2)	**57.7**	**14.3**	**14.3**	**2.6**	**2.6**
Mixed slat waste production (kg mixed salt / kg H2)	**-**	**-**	**-**	**0.11**	**-**

Source: Dagg, B., Swan, A., Potts, K. Brannock, M. 'Introducing Hydrogen for Energy as a New Water User', AWA Tasmania (2022)



Step 3: Realise the full potential

How can we maximise the opportunities?

One of the benefits of an emerging industry like hydrogen is the ability to explore a growing range of opportunities associated with the introduction of new infrastructure and entities. This includes circular economy synergies such as producing renewable energy from waste, providing a high value use for recycled water, using by-products like oxygen within other processes, and assisting with methane emissions through reusing recycled water treatment biogas, as well as metal or phosphorus recovery.

Recycled water from a recycled water treatment system could produce higher quality permeate to feed the hydrogen production process. Cooling water can be used for many cycles of concentration within the cooling system. This water, when spent, can be combined with waste from the electrolyser and trade waste, then discharged to the local sewer network, with the brine sent to the zero liquid discharge systems. Sending this back to the initial recycled water treatment plan to be combined with sewage flows for reprocessing eventually creates an infinite loop with recycled water entering the system and hydrogen being produced.

Locating hydrogen on old mine sites or using acid mine drainage or tailings from mining sites as the feed source will further assist in the decarbonisation movement whilst also promoting the circular economy by assisting with rehabilitation. There is also an opportunity to investigate the potential for metal recovery from the brine stream produced.

Waste streams from other processes, which may contain valuable materials, could be removed from the water for hydrogen and become more concentrated through membrane treatment. The material can then be sold or used within other aspects of the water or hydrogen production process or even combined with hydrogen for end use.

Achieving a circular economy will mean reusing, rather than minimising waste.

As part of our webinars we asked what the biggest perceived risks for water utilities engaging with hydrogen were, the response was a lack of water and competing water users, regulatory approvals, and demand forecasting and feasibility constraints.

There are many lessons learned from the power and coal seam gas industries and other industrial water projects where efficiencies can be established regarding cooling water and water treatment. These efficiencies help us understand the capital requirements and potential modularisation for larger systems to scale up in future and mitigate risk early on.

There are also opportunities to pair hydrogen with existing assets or into future planning already in place. For example, existing desalination plants could have additional side treatment added to produce water for hydrogen. Alternatively, drought resilience planning involving desalination could install side stream hydrogen and recycled water as a by-product to mitigate against that capital investment risk. Harnessing recycled water treatment plants and potentially large volumes of recycled water effluent or biogas from digesters could also be investigated.

The key part of assessing these opportunities includes considering how to augment existing systems to have side streams for hydrogen production whilst maintaining existing challenges like water supply for existing users and challenges associated with existing asset maintenance and life. Utilities already face issues around managing water and recycled water assets and balancing funding, so it is essential to make sure these aspects are under control before adding hydrogen as a separate item to already high workloads and asset loads.

The benefit of investigating potable water desalination could offset CAPEX and OPEX by selling hydrogen. If the potable water from desalination isn't required – as might be the case in periods of heavy rainfall – water could still be produced for hydrogen to keep the plant operational and minimise maintenance costs and damage. In addition, from reverse osmosis permeate, there isn't as much treatment required to meet the requirements for hydrogen feed.

Industry should look for opportunities to pair hydrogen infrastructure with existing assets to realise greater value.

North East Water is looking to use a 10 MW electrolyser as a pilot plant. Using less than 0.2% of Wodonga's annual water consumption, and it will provide oxygen for the aeration processes at the recycled water treatment plant and the hydrogen will fuel hydrogen transport vehicles along the highway. This creates a unique opportunity for water utilities to combine with heavy industry to transition to a more sustainable future and work with new entrants to the market.

Conclusion → moving forward

While the green hydrogen economy is still in its early days, now is the time for water utilities to get involved.

Given the water industry's strong commitment to the United Nations' Sustainable Development Goals and net zero emissions, close relationships with local communities, and specialist knowledge in advanced water treatment, it is uniquely placed to gain a competitive advantage in this space. Being informed at the start is key to developing a deeper understanding of green hydrogen and the role water authorities can play in this emerging industry.

Hydrogen cannot be produced without water, but the financial cost is not the only challenge; it is the social, environmental and economic costs and risks that must be addressed for hydrogen development. There are also non-trivial technical challenges in the hydrogen-water system that still require innovative solutions. Only through radical collaboration between the water and energy industries, communities and governments of all levels can these challenges be resolved.

Heavy industry has been producing energy and valuable minerals for use within the Australian economy and for export for several years. The water industry has managed potable water and recycled water services across the country for the same period, if not longer. By combining the expertise of these two industries, we can transition the workforce away from fossil fuels, strengthen Australia's position as a world leader in green hydrogen, and deliver sustainable outcomes for all.

*Contact us

If you have any questions or would like to explore how we can assist you with the emerging hydrogen economy, please contact us.

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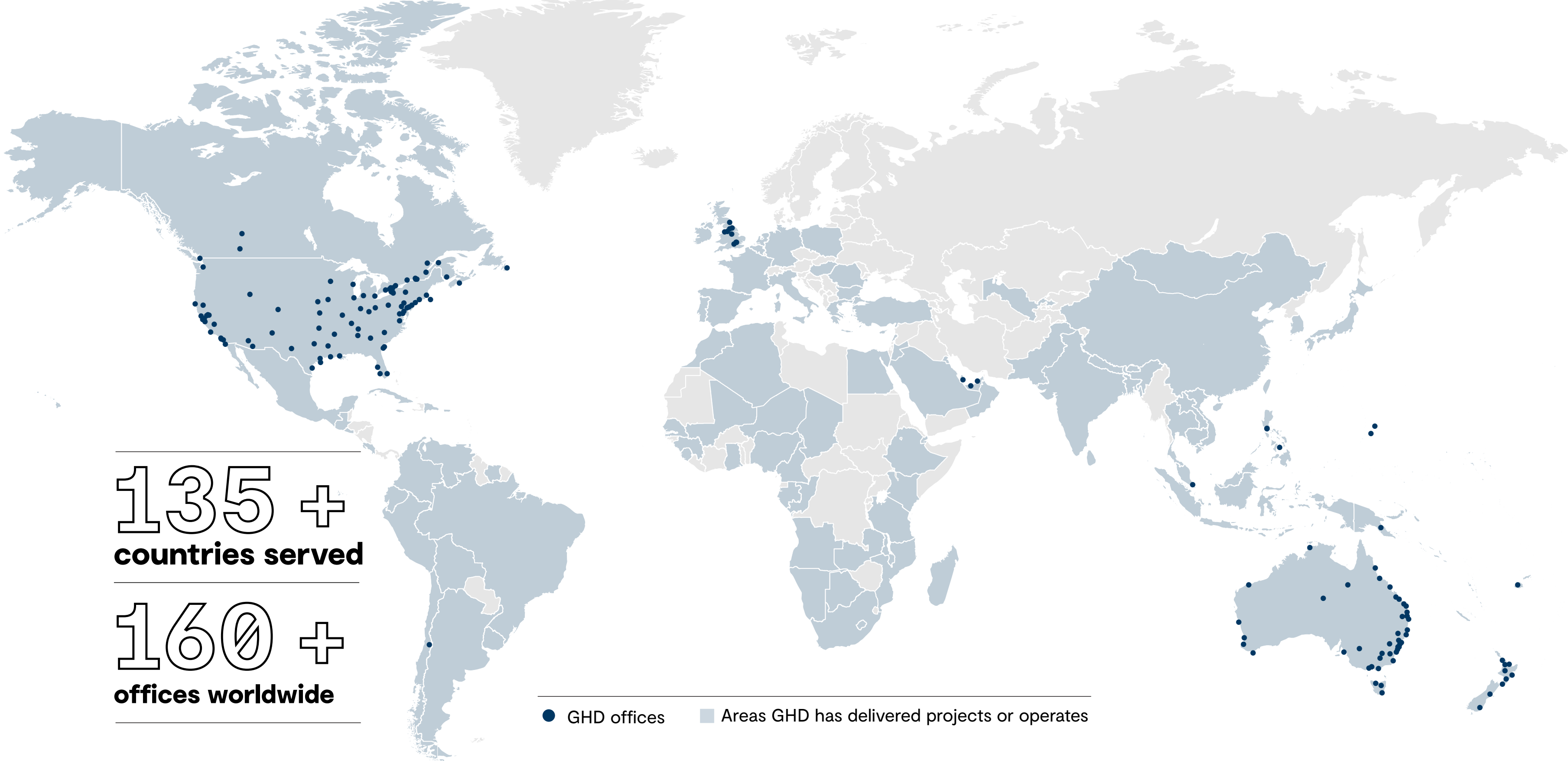

About GHD

GHD recognises and understands the world is constantly changing. We are committed to solving the world's biggest challenges in the areas of water, energy and urbanisation.

We are a global professional services company that leads through engineering, construction and architectural expertise. Our forward-looking, innovative approaches connect and sustain communities around the world. Delivering extraordinary social and economic outcomes, we are focused on building lasting relationships with our partners and clients.

Established in 1928, we remain wholly owned by our people. We are 10,000+ diverse and skilled individuals connected by over 200 offices, across five continents – Asia, Australia, Europe, North and South America, and the Pacific region.

Find out more about us at ghd.com

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