Briefing Paper – Exploring Renewable Hydrogen for Tasmania

December 2019

In this short Briefing Paper we consider a number of issues in response to the *Draft Tasmanian Renewable Hydrogen Action Plan*, published November 2019. Our research team has been exploring the potential role renewable hydrogen could play in bolstering Australia's and Tasmania's energy autonomy and energy security. We are a social science research team, comprising expertise in law, industrial economics, public policy, private governance, sociology and human geography. The *Draft Tasmanian Renewable Hydrogen Action Plan* (hereafter *'the Action Plan'*) sets out an ambitious plan for renewable hydrogen in Tasmania, which makes use of the natural attributes of Tasmania as well as its existing energy infrastructure. Here we briefly review the *Action Plan* and highlight additional perspectives on the potential role of renewable hydrogen in Tasmania.

Defining renewable hydrogen

Renewable hydrogen, also known as 'green' or 'clean' hydrogen, is defined in the *Action Plan* as follows:

"Renewable energy can be used to electrolyse water to produce hydrogen and oxygen. Hydrogen produced in this way is commonly termed renewable hydrogen or 'green hydrogen', and has no carbon emissions associated with its production or use" (p.8).

The 2019 *National Hydrogen Strategy* uses the slightly different terminology of 'clean hydrogen': "…produced using renewable energy or fossil fuels with substantial carbon capture and storage" (p.xiv).

There are subtle but important differences between these definitions, with the 'clean hydrogen' definition including fossil fuels (with carbon capture and storage), but renewable or green hydrogen not including them. Which definition comes to dominate in Australia will have a big impact on Tasmania's role, nationally and internationally. There is a strong advantage for Tasmania in renewable hydrogen being prioritised: Tasmania should seek to delineate its product clearly, because it is rare. Close attention should also be paid to international 'green hydrogen' accreditation initiatives such as Europe's *certifhy.eu*, given the implications for export markets.

Background - Tasmania's energy sector

As the *Action Plan* outlines, Tasmania's energy sector is dominated by renewable energy sources, namely low-cost hydroelectricity and wind (p.5). When envisioning a clean, secure, and carbon neutral energy future for Tasmania, we must shift our thinking beyond electricity and include the full suite of energy resources that we use to run daily life in Tasmania, not just our electricity network, but also transport and heating fuels (see Table 1).

While Tasmania is a net energy exporter, it is not energy secure. In particular, a crucial part of the economy, comprising approximately a third of our energy consumption - transport fuels, is supplied from outside of Tasmania and requires import by sea. Importing fuels from overseas is expensive and undesirable from an energy security perspective. A renewable hydrogen industry in Tasmania would help diversify both Tasmanian and national energy sources. Australia is heavily reliant on imported oil and petroleum based liquid fuel products (ASPI 2019), having on average between 15 to 26 'consumption days' of liquid fuel stocks in reserve, assuming normal use (ADoEE 2019 p.30). While Tasmania may have slightly higher liquid fuel stocks (AdoEE p.30), there is significant vulnerability, at both national and state level, to disruptions in the import supply chain for liquid fuels. A move towards hydrogen-based transport fuels in Tasmania will assist in reducing this vulnerability.

Energy resource/carrier	GWh/a	%
Electricity	11 000	46
Transport fuels (petrol & diesel)	7 414	31
Firewood	2 917	12
Coal	1 833	8
Natural gas	800	3
TOTAL	23 964	100

Table 1 – Tasmanian major energy resource consumption (sources: ABS 2018, NGERS 2018, OTTER 2018).

Further, as Australian climate change policy aligns itself with the need for drastic cuts in carbon dioxide emissions, attention will increasingly focus on other parts of the energy sector, beyond electricity. Tasmania is well placed to achieve this major decarbonisation task, because our electricity system is already low carbon, and thus we are starting from a point of considerable relative advantage.

Tasmania's key advantages with regard to renewable hydrogen

As the *Action Plan* notes, Tasmania has many natural and engineered advantages in relation to renewable hydrogen, including plentiful renewable energy, access to abundant water (though not in all parts of the State), high quality supporting infrastructure (e.g. deep ports), as well as other attributes such as a skilled workforce, and being geographically compact. We suggest that the addition of renewable hydrogen into Tasmania's energy mix will involve developing, maintaining, and operating a more complex energy system. While more difficult to achieve in the short-term, in the long run it could entail more 'value-adding' than sending electrons back and forth across Bass Strait, or recharging car batteries. To manage risk, as outlined in the *Action Plan*, it is important to develop both a domestic market for Tasmanian renewable hydrogen, as well as an export market.

The *Action Plan* outlines several possible applications for renewable hydrogen, including transport fuels, export, industrial applications and remote power supplies. This is positive as it will increase system flexibility, and reduce the negative impacts of existing fuels, e.g. local air pollution from cars and domestic wood heaters.

What are different ways of thinking about renewable hydrogen that are not covered directly in the *Action Plan*?

A Circular Economy and Just Transition perspective

Instead of the current linear, 'take, make, waste' economy, a Circular Economy's (CE) goal is to minimise virgin inputs by eliminating waste through the redesign, reduction, reuse and recycling of material and energy inputs (Ellen MacArthur Foundation 2019). Coupled with a Just Transition (JT) for affected workers to ensure they receive the required assistance to retrain, move or retire (ILO 2016), the CE/JT approach could help deliver genuine shared, public sustainability value (Gale 2018). Although the importance of community acceptance and social licence is acknowledged in the *Action Plan*, the CE/JT perspective could be a valuable addition by providing a framework for evaluating the social, economic and environmental sustainability of renewable hydrogen in a more holistic and systems-focused way.

As an example, the CE/JT concept is applied here briefly to the transportation sector to highlight how such framing can provide contrasts when viewing different technology options. The following question is posed: *Is fuel cell technology better positioned than battery technology to support a Just Transition to the Circular Economy in transport?* The short answer to this question is that we do not yet know. However, the CE/JT concept points to several critical issues that need to be further investigated to assess the degree to which these two technology pathways, which may yet prove complementary, are impacted (see Appendix 1 for details).

A focus on the automotive sector is especially timely given the emerging competition between battery electric vehicles (BEVs) and fuel cell electric vehicles (FCEVs) for market dominance in the next decade. This competition is redolent of the Betamax/VHS struggle of the 1980s in the video industry. Tesla's Elon Musk has famously described FCEVs as 'mind-bogglingly stupid'; yet, despite this, automakers like Hyundai are introducing them on the basis that they might ultimately out-compete EVs based on a combination of personal, technical, social and environmental criteria.

Implications for Australia and Tasmania

If FCEVs become competitive with BEVs, then there will be a significant rise in worldwide demand for hydrogen, especially renewable hydrogen. Whereas it is unlikely that Tasmania could become a hub for producing Lithium ion batteries, there is at least a potential that it could control its own transportation fuel sector, with important consequences for our economic independence and budget bottom line.

From an energy cultures perspective

The 2019 *National Hydrogen Strategy* starts somewhat unusually with a quote from Jules Verne's 1874 novel *The Mysterious Island*, reminding us how policy decisions are guided by a mix of cultural, social, political and economic factors. In other words, any decision about whether to invest in renewable hydrogen in Tasmania is not just about economics. It is also about Tasmania's vision of the future and our view of Tasmania's position in the world.

A recent book published by Laura Watts, *Energy at the End of the World: An Orkney Islands Saga,* considers this relationship between energy and society through an in-depth case study of the Orkney Islands in Scotland. *Energy at the End of the World* makes the case for energy innovation increasingly taking place in rural areas, away from urban centres, and thus speaks closely to the context in Tasmania – also an island at the (other) end of the world.

In a beautifully written book, Watts draws on the rich history of the Orkneys to better understand how they have come to be such an innovative place with regards to energy. Of specific interest to exploring the potential for renewable hydrogen in Tasmania, the Orkneys already have several years experience of renewable hydrogen manufacture and use. The shift towards a hydrogen economy on Orkney was prompted by a constrained under-sea cable – meaning that Orkney often produced too much renewable electricity from wind and tidal sources, above what could be exported via the cable. The Orkney Islanders were forced to innovate and consider ways to use or store electricity on the islands. Hydrogen production and storage is just one of the solutions that has been put in place. Renewable hydrogen now fuels the Orkney ferries, as well as providing some lighting and heating.

Energy at the End of the World is a deeply inspiring book, and there is much that we can learn from the Orkney experience in Tasmania, particularly at the moment when it feels like there are many different energy futures that

Tasmania could create. Watts provides a model for how we might engage Tasmanians in questions about our energy future, as she writes of Orkney electricity and its relationship to the communities on Orkney:

“The Orkney electron... has both electrical and political power... it is constituted by islander people and their engagement, who make it brighten and flow.” (p.72).

However, there are some important practical differences between the Orkneys and Tasmania, some key ones being that Tasmania has plentiful (hydro)electricity, a functioning undersea cable with plans for a second, and only relatively limited marine (wave and tidal) energy research. So, the characteristics that have spurred on energy innovation in the Orkneys – no large-scale electricity generation, an aging and small undersea cable, and an international marine energy research centre – are not present in Tasmania. However, Tasmania does have a distinctive advantage over the Orkneys in terms of the emissions-free ‘firming’ capabilities of our large-scale hydropower generation, which will enable highly efficient hydrogen production at low cost (see *Action Plan*, p.14).

From a climate change perspective: negative emissions

The *Action Plan* recognises ‘the global push to decarbonise..’ (p.5), but overlooks the potential for renewable hydrogen to be used to draw carbon dioxide from the atmosphere (i.e. produce ‘negative emissions’). Negative emissions may play a significant role in addressing climate change and meeting the temperature stabilization targets set out under the 2015 Paris Agreement. In its 2018 special report, the Intergovernmental Panel on Climate Change indicated that negative emissions will need to be produced on a large scale to limit global warming to $1.5^{O}C$ above pre-industrial levels (Allen et al 2018). Negative emissions will also likely be necessary to meet the $2^{O}C$ target.

Renewable hydrogen could contribute to delivering these negative emissions. This could be done by modifying the electrolysis reaction in renewable hydrogen production to use saline, rather than fresh, water and capturing the CO_2 produced through an enhanced mineral weathering process (Rau et al 2018). The development of negative emissions hydrogen is at an early stage, and further research would be needed to determine its suitability in a Tasmanian context. However, preliminary research suggests that renewable hydrogen could deliver a greater volume of negative emissions at a lower cost compared to bioenergy with carbon capture and storage (BECCS), a leading negative emissions proposal, and may also avoid competing land use and biodiversity impacts that may limit the feasibility of BECCS (Rau et al 2018). Renewable hydrogen therefore has the potential to address climate change on two fronts, first by providing a clean source of energy, and second, by delivering negative emissions.

Summary

The *Action Plan* identifies Tasmania as having inherent advantages for renewable hydrogen production, and recognises that Tasmania could significantly benefit from prioritising the development of a renewable hydrogen export industry, while also developing it domestically. This Briefing Paper builds on these two priorities, highlighting how Tasmanian renewable hydrogen could significantly enhance our State’s energy security and resilience in an increasingly uncertain world. The three perspectives we identify here may deepen our understanding of what renewable hydrogen may mean for Tasmania not just economically but also socially, culturally and environmentally.

List of contributing authors in alphabetical order**: Kerryn Brent,** Lecturer, UTAS Faculty of Law; **Fred Gale,** Professor of Politics and International Relations, UTAS School of Social Sciences; **Heather Lovell,** Professor of Energy & Society, UTAS School of Social Sciences & UTAS School of Technology, Environments & Design**; Jeff McGee,** Associate Professor in Climate Change, Antarctic and Marine Law, UTAS Faculty of Law & Institute for Marine & Antarctic Studies**; Philip Peck,** Senior Lecturer, The International Institute for Industrial Environmental Economics, Lund University, Sweden.

Acknowledgements
This Briefing Paper and associated research was supported by a Hothouse grant from the College of Arts, Law and Education at UTAS.

UNIVERSITY *of* TASMANIA

References

ABS, 2018 *9208.0 Survey of Motor Vehicle Use*, Australia, 12 months to end of June 2018.
ASPI 2019 '*Asleep at the Wheel: Australia's fuel vulnerability all our own making'*, Online at: https://www.aspistrategist.org.au/asleep-wheel-australias-fuel-vulnerability-making/
Australian Department of Environment and Energy (ADoEE) 2019 'Liquid Fuel Security Review: Interim Report', April 2019 https://www.environment.gov.au/energy/liquid-fuel-security-review-consultation
Allen, Myles et al 2019, 'Summary for Policymakers' in V. Masson-Delmotte et al (eds), *Global Warming of 1.5°C. An IPCC Special Report.* Online at: https://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf
Certifhy.eu. 2019. '*What is a guarantee of origin for green hydrogen?'* Online at: https://www.certifhy.eu/project-description/why-a-guarantee-of-origin-for-green-hydrogen.html.
Department of State Growth (2019) *Draft Tasmanian Renewable Hydrogen Action Plan*. Online at: https://www.stategrowth.tas.gov.au/__data/assets/pdf_file/0003/207705/Draft_Tasmanian_Hydrogen_Action_Plan_-_November_2019.pdf
Ellen Macarthur Foundation, 2019 https://www.ellenmacarthurfoundation.org/
Commonwealth of Australia, 2019, *Australia's National Hydrogen Strategy.* Online at: https://www.industry.gov.au/sites/default/files/2019-11/australias-national-hydrogen-strategy.pdf
Gale F. 2018 *The Political Economy of Sustainability*. Cheltenham: Edward Elgar.
IEA 2019 *Oil security: the global oil market remains vulnerable to a wide range of risk factors*. Online at: https://www.iea.org/areas-of-work/ensuring-energy-security/oil-security
ILO 2016 International Labour Organisation *Just Transition Guidelines*. Online at: https://www.ilo.org/global/topics/green-jobs/publications/WCMS_432859/lang--en/index.htm
NGERS 2018 *Electricity Sector Emissions and Generation Data.* Online at: *http://www.cleanenergyregulator.gov.au/NGER*
OTTER 2018 *Energy in Tasmania Report 2017-18.* Online at: *https://www.economicregulator.tas.gov.au/Documents/Energy%20in%20Tasmania%202017-18%20Report.pdf*
Rau, G.H., Wilauer, H.D. & Ren,Z.J. 2018 The global potential for converting renewable electricity to negative-CO2-emissions hydrogen, *Nature Climate Change* 8, 621-626.
Watts, L. 2019 *Energy at the End of the World : An Orkney Islands Saga*, Boston USA: MIT Press.

APPENDIX 1: Critical Issues in BEVs and FCEVs for a Circular Economy and Just Transition

Technical Issues		
BEVs	**FCEVs**	**Comment**
Lithium-Ion batteries comprise Aluminium, Cobalt, Copper, Iron, Lithium, Nickel, Manganese	FCEV's PEM technology are composed of platinum and platinum group metals	What processes are and can be used to recover these elements? How energy and resource intensive are these processes? What are the by-products?
Behavioural Issues		
Currently only 2% of BEVs are recycled and 98% make their way to landfill	Unable to identify data on FCEV recycling rates but likely extremely low	Are the incentives to recycle BEVs and FCEVs the same? Is the opportunity for extended producer responsibility the same? Is it easier to put in place a recycling system for one or the other?
Social License to Operate Issues		
Major source of Cobalt is the Democratic Republic of Congo (DRC), with human rights, democracy and poverty issues	Major source of Platinum is South Africa, which raises many fewer concerns regarding social license to operate. Use of scarce water resources to produce hydrogen.	Is it possible to mitigate the social impact of cobalt mining in DRC? Does Australia and Tasmania have sufficient water resources to produce hydrogen at scale? What impact will future climate change have on water resources?
Consumer Performance Concerns		
Major concerns: price, range anxiety, refuelling time, lack of refuelling infrastructure	Major concerns: price, lack of refuelling infrastructure	BEV technology has advanced over past 5 years; however, almost all have a range under 250 kms; FCEVs can travel between 320 and 450 kms
Outside the Box Considerations		
● Will the rise of autonomous vehicles become established and, if so, what will that mean for car ownership generally? ● Will there be a greater emphasis on high quality public transport and, if so, will that impact the individual ownership of cars? ● How might new digital technologies and telecommuting reduce the demand for personal passenger vehicles?		