Hamilton Locke

New Energy Quarterly: Mobile Power

Autumn 2022

Contents

Editorial

Bridging the gap between the transport and energy sectors to achieve universal, efficient, safe, and green mobility will play a crucial role in our efforts towards Net Zero by 2050.

Australia's transport sector is one of the most emission intensive sectors (~17.5% of domestic emissions in 2021). This has been compounded by Australia's reliance on imported transport fuels like petrol and diesel which has grown in the last three years, even as the pandemic has brought to the fore the issue of reliance on global supply chains. More recently this reliance has been enflamed by Russia's invasion of Ukraine and the recent unprecedented suspension by AEMO of the wholesale electricity spot market across the National Electricity Market.

Indeed, since the Russian invasion of Ukraine, the world has seen how a country's sovereignty and diplomacy is limited by its dependence on foreign fuels. After the invasion we have seen various announcements to decrease global reliance on Russian oil and gas by accelerating renewable wind and solar projects and increasing hydrogen production capacity.

These events, as well as other factors, have triggered significant peaks in energy prices as uncertainties around supply security and affordability grow. Therefore, the message is clear and the old adage remains the same: "Energy is politics is security is energy is politics…"

The transition to electrification

In this New Energy Quarterly, we examine how the growing uptake in electric vehicles (EVs) is set to play an important role in minimising our reliance and vulnerability to volatile foreign fuel market conditions, while at the same time reducing emissions and contributing to decarbonising goals.

However, Australia currently faces several challenges in taking EVs mainstream, including a lack of policy support or incentives, higher upfront cost, choice of available EVs for sale, and the availability of public vehicle charging infrastructure. Targeted Government support at both State and Federal levels will be essential in overcoming these obstacles and accelerating the transition. The new Labor Government seems to be cognisant of the challenges in this space and have made a lot of the right noises through its proposals, which include:

- The Powering Australia plan, which has committed to make EVs cheaper with an electric car discount;
- Australia's first National Electric Vehicle Strategy;
- The Driving the Nation Fund; and
- Building a National Electric Vehicle (EV) Charging Network.

Efforts are also underway across the States and at Federal level to transition the fleets of government vehicles from internal combustion engine power to batteries.

However, as is the case with any Government involvement in a nascent industry, the proof will be in the pudding.

We also examine the additional benefits of the widespread adoption of EVs, including the potential for EVs to be used as a power source for the home (V2H) and the grid (V2G) through bi-directional charging. With bi-directional charging, any leftover charge in the EV can be used to power the home or to export that energy to the grid at times of high demand. If used to their potential, V2H and V2G technologies are set to offer significant benefits to help reduce demand on electricity networks (solving the so called 'Duck Curve' issue), and when coupled with domestic solar systems, can enable EV drivers to use greener and cheaper electricity.

The building blocks of the New Energy transition

We discuss how certain raw minerals (eg lithium for EV batteries) are at the core of the New Energy transition. As the demand for New Energy technologies increases, so too does the pressure on the mining and processing sectors to provide a constant supply. Supply chain issues, exacerbated by geopolitical events and other factors such as trends favouring certain renewable technologies, have recently caused a significant market imbalance in supply and demand.

We argue that Australia is well positioned to supply these critical minerals and in doing so can make a huge contribution to combat climate change globally. For instance, Australia has rapidly become the world's biggest exporter of lithium by producing almost half of the worldwide supply. We also see that there are opportunities for midstream processing to be undertaken locally to minimise dependence on China.

The GH2 revolution

Although transport decarbonisation is possible via different energy carriers, including electricity, biofuels, and synthetic fuels, some sectors will be more reliant on specific energy carriers to decarbonise. Green hydrogen (GH2) (and hydrogen-derived fuels (ie ammonia, synthetic fuels)) is one of the only sustainable replacement options for natural gas and oil in the long term and is expected to be critical for decarbonising heavy transport industries like shipping and aviation.

GH2 will play an important role in reducing emissions from these traditionally hard-to-abate sectors due to the high energy requirements involved and the substantial capital costs of the vehicles. Significant reductions in the cost of GH2 through efficiencies of scale and falling technology costs, combined with the necessary evil of an increase in the costs of conventional fossil fuels, will support the decarbonisation of these more challenging transport sectors.

While hydrogen fuel cell vehicles are currently less mature in terms of market development, resulting in a lower market share, so long as the technology develops and becomes cost-competitive, it is anticipated that hydrogen fuel cell vehicles may play a role in

heavy-duty land transport after 2030. Fuel cell durability, fuel cell costs and GH2 costs, will all need to improve significantly, and this will be weighed against continuing improvements in battery-electric technology for these same applications.

From an energy independence perspective, while importing GH2 can help fill the supply gap in the short term, we argue that Australia has the expertise and infrastructure to develop GH2 supply chains at home through our abundance of renewable energy generation facilities. When coupled with decreasing technology costs, Australia is well placed to scale up its domestic production to meet its growing demand in the medium to long term.

We are seeing that prospective green hydrogen suppliers are already acquiring land rights and planning for large-scale build-up of renewables in regions with ideal solar and wind energy profiles, ensuring renewables capacity will start coming online as soon as 2024 to supply electrolysis farms. These suppliers are ready to invest in electrolysers and ammonia transformation facilities to kick-start the procurement of necessary materials and reserve manufacturing capacity. To trigger these investments, suppliers need to have confidence that Government will stimulate demand through effective support mechanisms and ensure that the required midstream infrastructure is established and accessible.

Indeed, efforts which are already in train by Government to decarbonise the transport sector in Australia can create a domestic demand market for GH2. For example, projects which might previously have struggled to get off the ground due to a lack of offtake commitments can be supported simply by Government no longer purchasing petrol vehicles and by following through on promises to buy hydrogen fuel cell vehicles or convert its existing petrol vehicles to run on GH2.

The Future

Australia must now act to capture the benefits of the abovementioned technologies and decarbonise all segments of transport to ensure it achieves Net Zero by 2050 and meets its interim emissions targets. Strong, consistent, and sustained Government and industry action is required to enable this transition and provide all Australians with clean transport options. However, the responsibility to achieve this outcome not only falls on Government and industry, but on all Australians to choose a mode of transport that will be sustainable into the future.

Welcome to this edition of the New Energy Quarterly, titled “Mobile Power”. We hope you enjoy reading it as much as we did writing it.

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Watt's happened

New Energy Team attended Smart Energy Expo in Sydney 4th and 5th May

View Article

New Energy Team hosted a networking session with our colleagues at Quintas Energy prior to Clean Energy Council's Large Scale Forum

View Article

New Energy Team attended Large-Scale Solar Forum in Brisbane 19th May

View Article

New Energy Team virtually attended Renewable Hydrogen Offtake Forum in Melbourne 23rd June 2022

View Article

New Energy Team attended SYD | Solar, Smart Grids and Storage in Sydney 23rd June 2022

Watt's new in the Market

New Energy Bulletins:

ESB Rejects CMM! Four New Ways to Deal with NEM Grid Congestions

View Article

What are the Energy Ministers discussing?

View Article

Watt we are reading:

ARENA shortlists 3GW of "advanced" big batteries essential for 100pct renewable grid Read More

AEMO reveals new roadmap for rapid switch to renewables in final ISP Read More

Labor to introduce legislation for climate targets and EV tax cuts in first week of parliament Read More

Australian Energy Market Operator suspends spot market for wholesale electricity to ensure reliability and avoid blackouts Read More

Green Hydrogen Task Force White Paper and 10 Point Action Plan released in June Read More

Energy Ministers released a communique in early June requesting the Australian Competition and Consumer Commission (ACCC) to monitor the current energy market conditions and investigate the National Electricity Market. **In addition to the most recent inquiry into the NEM**, the ACCC have been requested to:

- ensure that the factors influencing prices in these markets are made fully transparent
- bring to the government's attention any need for regulatory change to ensure electricity and gas markets function properly for the benefit of all Australians
- investigate any concerns arising about anti-competitive or false and misleading conduct in electricity and gas markets and take appropriate action

The ACCC will present their findings to the Energy Ministers in the coming weeks.

NSW commits $1.2 billion to renewable energy infrastructure, its single biggest investment in the sector. Read More

Zero-emissions hydrogen cargo airship prototype planned for 2025. Read More

Dr Penelope Crossly (Associate Professor in Energy and Resources Law at USYD) published the article **Defining the Greatest Legal and Policy Obstacle to 'Energy Storage** in 2014.

Dr Crossly's argument on how to define storage technology (with reference to the multifunctionality of storage assets) remains relevant and should be considered in transitioning the NEM.

The Waratah Super Battery EOI received more than 30 proposals. Read our bulletin on the initial announcement **here**, and NSW Government's reaction to the proposals **here**.

Registrations of Interest for the Illawarra Renewable Energy Zone (REZ) are open until 22 July. Read More

Australian renewables outfit Energy Estate seek to launch a $A500 million plus capital to fast track a development pipeline, ranging from offshore wind, to green hydrogen and pumped hydro. Read More

Lion Energy Limited awarded a front end engineering and design (FEED) contract to Wasco Australia for their first hydrogen production and refuelling station in Australia.

Included is the proposed Hydrogen Highway that will span through Victoria, New South Wales and Queensland.

Read More

Queensland based transport group Sealink received government backing of $5 million to aid their building of a world first internationally compliant renewable hydrogen-powered passenger ferry. Read More

Hyundai plan to extend technologies to include vehicle to grid and enable its EV batteries to do "Vehicle to Everything". Read More

Watt's new at Hamilton Locke

New starters

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Eunice Yao
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Iveta Sceales
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Simon Barcham
Lawyer
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Daniel Owen
Lawyer
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Jordon Rossetto
Lawyer
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James Roberts
Lawyer
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Lachlan Pethick
Lawyer
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Market Recognition

AFR Features Hamilton Locke – One of the Largest Increases to Law Firm Partnerships in Australia

Read More

Hamilton Locke Ranks 2nd in **Refinitiv League Tables**

Read More

Hamilton Lock Partners Recognised in 2023 Edition of The **Best Lawyers in Australia**

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Hamilton Locke Recognised in **Australasian Lawyer's Australasian Law Awards**

Read More

Hamilton Locke Ranks in **Mergermarket League Tables**

Read More

Hamilton Locke Ranks as a Top 30 Law Firm in **The Australian Legal Partnership Survey**

Read More

Legal 500 Recognises Hamilton Locke in 2022 Asia-Pacific Guide

Read More

Chambers and Partners Recognises Hamilton Locke in 2022 Global Guide

Read More

Lawyers Weekly Recognises Hamilton Locke as 'One of the Fastest-Growing BigLaw Firms in the Country'

Read More

Technology Scale-up Awards 2022 Launch Announced

Read More

Hamilton Locke promotes six across the firm Read More

Watt's next

Energy security will be the topic of our next quarterly publication

Australian Clean Energy Summit 2022:
19 to 20 July 2022

Connecting Green Hydrogen APAC 2022:
25 to 26 July 2022

Ammonia Energy Conference 2022 – Australia:
24 to 26 August 2022

Hydrogen Connect Summit:
7 to 9 September 2022

Spotlight – Grant Parker

Journey to becoming a lawyer

I grew up on a farm in New Zealand. Other than knowing that there was a lawyer for my family, and that he was the trustee of my father's estate, I had no exposure to what the life of a lawyer was like. When I was deciding what to study at university, I was concerned that I would not spend enough time outdoors if I studied law. The other options on my shortlist were becoming a vet or a journalist. I can't say I miss not having chosen either of those. Law suited me given English was a strength and that the degree didn't mean that I had to end up as a lawyer. It did compromise the time outdoors, although that might have been a blessing when I worked as a lawyer in New Zealand and London. I met my now wife in London (she grew up in South Africa to English parents) and we moved to Sydney in 2000, just after getting married and in time to miss the Olympics.

Proudest career moment

Currently I'm proud of the work that I have been doing recently with various clients in relation to carbon emissions reduction. It's been quite a ride from being a keen environmentalist before heading to university, though to becoming a construction lawyer and learning enough by being involved in green building projects to consequently learning about the National Greenhouse and Energy Reporting Scheme. From there it was but a short step to advising on the carbon tax and projects under the Carbon Farming Initiative, now the Emissions Reduction Fund. We are seeing significant activity in a great variety of sectors in this area, which aligns closely with our New Energy practice.

I'm also proud of having been involved with a number of significant public private partnership projects in the United Kingdom and Australia. I have been involved with these since the late 1990s, when the first job that comprised my work on the UK government's Private Finance Initiative projects was contingent on the incoming Blair government continuing with the outgoing Major government's PFI scheme. While there are differences of opinion over the worthiness of PPP projects, they have enabled much needed infrastructure to be brought forward earlier than might otherwise have been possible. I have been involved with the development of new hospital facilities (including, memorably, in Northern Ireland), new schools, school meals, new roads, new railcars and associated facilities and new student accommodation.

Why I joined Hamilton Locke

I was a partner with the founders of Hamilton Locke, being Nick Humphrey and Hal Lloyd, a few years ago. I was looking for somewhere to reinvigorate my construction practice along with building my carbon practice. The focus of Hamilton Locke on building value over team appealed to me. It's the best way of building long term and rewarding relationships with clients. The opportunities to develop those, and to bring the Hamilton Locke approach to existing clients, including with its expertise in New Energy and abilities in construction, meant that the choice was a natural one.

The Halo Group mentality

The collaboration that we achieve is a foundation of our success. I have been really impressed with the opportunities that have been pursued since I came on board. The platform for collaboration involving me was put in place before I arrived. That was most impressive. The progress that we are making is a testament to the power of teamwork.

Rising Star – Ally Frizelle

What are you most proud of in your career to date?

Learning and cultivating my practical knowledge I feel lucky to have been able to work on a few complex deals so far in my career – it is incredibly rewarding to devise creative solutions that help our clients achieve their goals. I was proud to have assisted our client with their purchase of General Pants earlier this year.

What do you enjoy about working in the legal industry?

While there is the perception that the law lacks creativity, I have found the opposite. I love that as lawyers we can invent creative solutions to solve our clients' complex problems or scenarios. One of the most exciting aspects of commercial law is that not only does it require legal expertise, but it demands a solid commercial understanding of your client's business operations and industry – every day is different and I always learn something new.

If you have taken part in the Da Vinci program, what activity did you undertake and why?

I have not taken part in the Da Vinci program just yet but am excited to get involved! When I do sign up, I would love to learn how to play the piano - it is such a beautiful instrument and I've always been in awe of people who can play.

What do you like most about Hamilton Locke?

The thing I like most about Hamilton Locke is its vibrant and collaborative culture. The firm invests heavily in its people to not only develop professionally, but to also grow personally. Everyone is more than willing to help one another, and we will always go the extra mile for our clients. I am proud to be a part of the Hamilton Locke team.

What does being a part of Halo Group mean to you?

Being a part of Halo Group means being a part of a team dedicated to providing its clients exceptional, efficient, and economical service. Halo Group is agile, innovative and it challenges the status quo, even if that means moving away from traditional and trusted processes to those that are unknown, our solutions are ultimately more beneficial and tailored to the needs of client.

Top reads / favourite movie and why / if you could invite anyone to dinner, who would it be and why?

Top reads – Girl with the Dragon Tattoo series and The Great Gatsby.

Favourite movie – again, The Great Gatsby – I think Baz Luhrmann's adaptation was incredible.

Dinner guest – Sir David Attenborough – I could listen to him for hours. He has experienced so much of the world, has so much to offer and would be fascinating to hear from.

Favourite cuisine/meal

Italian.

Fun fact

Growing up I had a pet turtle called Salty, he was the size of a 20-cent piece!

Top 3 travel destinations/ Favourite holiday to date

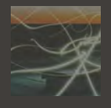
My favourite holiday to date would be the four-month Europe gap trip I took after I graduated high school – I was incredibly lucky to go before COVID-19 set in! While over there, I fell in love with Scotland, Copenhagen and Portugal!

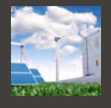
Watt is ARENA funding?

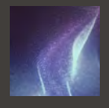
Program	Summary	Funding available	Closing Date
Regional Australia Microgrid Pilots Program (RAMPP)	**RAMPP** aims to improve the resilience and reliability of power supply for regional and remote communities. Grants between $1 million and $5 million are available to projects that have successfully completed a feasibility study. This is an open, non-competitive funding round, with funds available in two stages: 1. $30m until CY2022; and 2. $20m until CY2023.	AUD 50 million	31 December 2026
Advancing Renewables Program (ARP)	**ARP** supports a range of development, demonstration and pre-commercial deployment projects. This includes opportunities to optimise the transition to renewable electricity, commercialise clean hydrogen and support the transition to low emissions metals.	The total amount of funds uncommitted and available under s64 of the Australian Renewable Energy Act 2011 (the ARENA Act)	ongoing
Future Fuels Program (FFP)	**FFP** is designed to drive co-investment in charging and refuelling infrastructure projects for future transport needs. Intended to fund demonstration and deployment projects. Funding is available for: 1. **light vehicle fleet operators** - charging and electrical infrastructure; and 2. **heavy fleet operators** - enabling infrastructure and some vehicle costs.	AUD 177.7 million	ongoing

Check your eligibility here:
If one of the programs sparked your interest you can check your eligibility **here**.

Missed our previous quarterlies? No dramas – read them here:


The Rise of Dispatchable Renewables >>


Hydrogen's Green Horizon >>


Power Plus >>

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Driving it Home: How Australia Can Make the Switch to Electric Vehicles

First published: 23 March 2022

At the 2021 United Nations Climate Change Conference, Australia signed a global agreement committing to make electric vehicles (EVs) the new normal by 2030. Whilst a welcome initiative, and one supported by most Australians, the question of how to do this remains up in the air.

Australia currently faces several challenges in taking EVs mainstream, which includes a lack of physical and legislative infrastructure to support EVs, little private sector support and fewer models of EVs readily available on the domestic market.

What is happening domestically?

Action is being taken at both Federal and State government levels to address the issues mentioned above. For example, the Future Fuels Fund and, more recently, the Future Fuels and Vehicle Strategy aim to provide substantial funding and promote initiatives to support the smooth transition to EVs. This includes leveraging private sector investment to roll out refuelling infrastructure in both metropolitan and regional areas and capitalising on Australia's large resources of critical minerals to manufacture EVs and other battery technologies.

At the State level, New South Wales, Victoria, the Northern Territory and Australian Capital Territory have implemented financial incentives, such as excluding EVs from stamp duty and introducing rebates, to encourage greater uptake of EVs. On the other hand, South Australia, Western Australia, Queensland and Tasmania are focused on developing public infrastructure to support the use of EVs.

While these interventions are important, there are still a lot more to be done to make EVs the new normal by 2030.

What is happening internationally?

Several countries have successfully promoted the EV industry in their respective domestic markets through a combination of incentives packages, effective policy instruments with government backing and substantial investment in infrastructure which supports the move to EVs.

Since the 1990s, Norway has maintained a consistent demand and supply for Evs. Among other initiatives, Norway has promoted an incentives package which imposes a high tax for high-emission vehicles and relatively lower tax for low-emission vehicles. Alongside implementing policy instruments and initiatives, Norway has also invested heavily in the construction of appropriate infrastructure to support EVs. An example of this was equipping all main roads in Norway with fast-charging stations.

The UK introduced its own discount programme to encourage more consumers to switch to less polluting cars, with a view to phase out internal combustion engines by 2030. Currently, consumers may be eligible for discounts of up to £2,500 for new low-carbon emission vehicles, with the plan to expand the scope of the programme so a greater number of consumers can access this benefit.

Other countries, such as the US (California) and China, have implemented mandatory targets for EV sales. These targets put pressure on manufacturers to increase production of low-emission vehicles, thereby making more models of EVs available for purchase in the domestic market.

With these initiatives in mind, there are a few key steps Australia can take to expedite and sustain the switch to EVs.

A path to the future?

An important first step is to continue building the required infrastructure to support EVs – including the roll-out of more charging stations and the development of appropriate policy instruments and regulations. This could include a national subsidy plan for making the switch to EVs, regulations to maximise efficient use of charging stations (particularly during the day/'peak' hours versus off-peak/night hours), development of fuel-efficient standards and cost-effective home charging options.

Grow Supply and Demand

Also crucial is the focus both at Government and industry level on growing and maintaining demand and supply. This essentially boils down to consumers consistently choosing to buy EVs over similar fossil fuel alternatives and manufacturers choosing (i.e. not being commercially deterred from) exporting their EVs to Australia - at least until domestic manufacturing becomes sustainable.

One way of doing this is by developing incentive packages for consumers and manufacturers. This may take the form of discount programmes, exemption from GST, stamp duty or fringe benefits tax, or access to funding to make the switch to EVs a reality. Another method is to diversify the EV models available on the market to cater to a wider range of Australian citizens and their needs, and to cast a wider net for manufacturers potentially interested in selling their EVs in Australia.

To encourage continued commitment to phasing out high-emission vehicles for low-emission EVs, Australia could follow the example of the US and China and introduce a national sales mandate. Given Australia will, in time, likely follow suit as a domestic EV manufacturer, a national sales mandate may stimulate and drive greater domestic production of EVs.

Turn your EV into a household battery

A potentially game changing emerging technology is bi-directional charging, which essentially enables homeowners to use their EV as a household battery to power their home and make money by selling power from the vehicle's battery back to the grid at times of peak demand.

If the energy used to charge the car comes from a free or cheap source, such as rooftop solar, a free charger at the local shopping centre, or even the workplace, the potential is there to substantially reduce consumers' home power bills. Alternatively, there is an arbitrage use by charging the EV off-peak and exporting back to the grid during peak evening hours to optimise profits.

While bi-directional charging is not yet available in Australia, a trial backed by the Australian Renewable Energy Agency (ARENA) is underway in Canberra to test the technology. The Realising Electric Vehicles-to-grid Services (REVS) trial involves 51 Leaf EVs that are part of the ACT Government fleet and when plugged in will inject power back into the grid when the vehicles are not in use. Once the charging units have been certified by the relevant authorities it is hoped the technology will be ready to roll-out in Australia.

To consumers, these developments will help normalise the use of EVs and ensure it is seen as a legitimate, viable alternative to high-emission vehicles.

The world is undeniably in a period of exciting change, where traditional sources of fuel and energy are being traded for renewable resources in a bid to ensure a greener and more sustainable future. For Australia who recently affirmed its commitment to achieving this future, EVs may be just the way to drive that point home.

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Charging Forward: Electric Vehicles and the Future of V2H and V2G

First published: 18 May 2022

The electric vehicle (EV) revolution is upon us. EVs are fast becoming the preferred primary mode of transport for homeowners. Beyond getting from A to B, an additional benefit of the widespread adoption of EVs is the potential for EVs to be used as a power source for the home and the grid through bi-directional charging – otherwise known as 'vehicle-to-home' (V2H) or 'vehicle-to-grid' (V2G) charging.

As we discussed in a previous article (Driving it Home: How Australia Can Make the Switch to Electric Vehicles), bi-directional charging works by taking alternating current (AC) electricity from the grid or the home's solar panels and converting it into direct current (DC) electricity to charge the EV. This effectively turns an EV into a home battery when not in use, with the energy being held on standby to be put towards multiple purposes. Any leftover charge in the EV can then be used to power the home or to export that energy to the grid at times of high demand.

V2H - PV your EV

The general consensus is that EVs are environmentally friendly because they do not produce exhaust emissions that harm the atmosphere. However, to charge your EV, the electricity must be generated from somewhere, meaning that in practice, EVs are only as green as their power supply. Another growing myth is that the widespread uptake of EVs will place greater strain on the power grid as more and more people make the switch from internal combustion engine (ICE) vehicles.

However, the rise of Australia's world-leading rollout of rooftop solar systems over the past decade or so offers the means to transition to a cleaner vehicle fleet fueled by sustainable carbon free solar power, while reducing energy demand during peak periods (the so-called duck curve issue) and saving consumers money on peak charges.

Notably, while EVs that take their charge from the grid are now cost-competitive with comparative conventional ICE vehicles over their lifecycle, when coupled with rooftop solar and a battery, conservative calculations have households saving up to $12,000 over a 15-year period.[1]

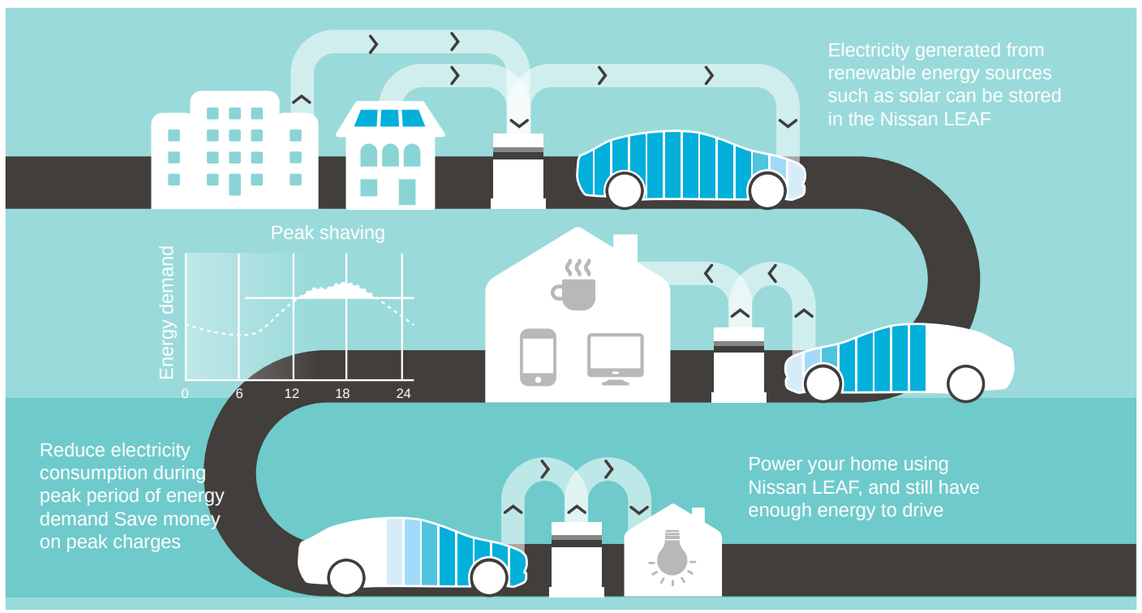
V2G and VPPs

With V2G charging, the EV battery can be used to provide grid stabilising services. EVs have large, powerful batteries with low startup, shutdown, and standby costs. When combined on a large scale, the potential energy source is massive. If enough EVs are plugged into the mains with bi-directional chargers and linked by software in a network known as a virtual power plant (VPP), they can be used like a very large commercial-scale battery.

How it works: the software programs track the performance of the grid by monitoring any generation spikes and dips during off-peak and peak hours, respectively. Network operators can then use the aggregated pools of PV systems, batteries and EVs to instantly and automatically modify generation or consumption to stabilise grid frequency and voltage.

Demonstration Projects

In Australia, V2G technology is slowly being introduced and certified for use. For instance, a multi-million dollar EV home-charging trial is looking at the role EVs can play in soaking up excess solar energy and improving grid stability. The trial will recruit 176 EV owners across the ACT, Victoria and Tasmania to participate, with smart EV charging hardware or control boxes installed at each participant's home. Jemena, AusNet Services, EvoEnergy, TasNetworks and United Energy will monitor the impact of these EVs on their networks and then take the lead role in efficiently managing the charge times of the vehicles. ARENA is providing $1.6 million in funding for the $3.4 million trial, which will help to purchase charging hardware and network monitoring equipment.



Another ARENA project looking into V2G charging technology is the Realising Electric Vehicle-to-Grid Services (REVS) project which involves 51 Nissan LEAF EVs from the ACT Government fleet deployed across the ACT to test and provide V2G services using bi-directional chargers. The REVS project will test new revenue streams for providing the grid stabilising services that avoid blackouts and improve energy security, otherwise known as Frequency Control Ancillary Services.

Regulation: The Integrated Resource Provider

The long-awaited final determination and National Electricity Rule (NER) change in relation to the integration of energy storage into the National Electricity Market at the end of 2021 will create a new participant category, the Integrated Resource Provider. This change was brought in to recognise and capture participants with bi-directional energy flows and to avoid dual registration and other deficiencies in the NER's application to hybrid and storage facilities.

As we discussed previously on the topic (read here, here and here), the rule change will enable aggregators of VPPs to recognise small-scale storage and provide market ancillary services from both generation and load. This aspect of the reform will come into effect on 31 March 2023, with the full changes coming into effect on 3 June 2024.

Barriers to Uptake

Cost

The biggest barrier to EV adoption is still upfront affordability. Bi-directional chargers cost in the region of $10,000, or a little less than a standard home battery. However, EVs have three to four times the capacity of a home battery so on a cost per storage basis this works out a lot cheaper that the standard home battery. Moreover, the cost of a bi-directional charging unit is predicted to fall in the short to medium term.

Higher initial costs of adopting bi-directional charging for EVs may also be offset by their potential long term savings. For example, if an EV can be charged using the home's rooftop solar installation or at a free charging station at work or a local shopping centre, this can work to significantly reduce household bills. Alternatively, EVs can be charged during off-peak hours and sold back to the grid during peak times to maximise profit for the owner.

Technological Advancement

Not all EVs have the capacity for bi-directional charging and there is currently no global standard for charging, meaning that few models of EVs are equipped for this new technology. There is also still lingering apprehension surrounding the use of EVs and bi-directional charging, from safety concerns to concerns about draining the battery too quickly.

From a safety perspective, there are measures built into the chargers to mitigate any safety issues. Bi-directional chargers work in a similar way to solar inverters and have a sensor to monitor the load of the house and how much power is being pumped in and out of the house. If the sensor detects that system voltage has been breached, the charger will switch off.

With regards to deterioration, while batteries by their nature do wear out faster the more you use them, bi-directional charging does not have a detrimental long-term impact on the battery because charging and discharging is less intensive than driving. Ongoing technological advancements are reducing the deterioration issue further, meaning that batteries made today and in recent years are far more durable than previous iterations.

Government and Industry

As discussed above, the electrification of transport provides significant opportunities to provide energy storage and grid balancing services, but this will require effective and targeted government and industry intervention to facilitate the transition.

In the short term, measures that can help to support and manage the transition are:

- Tax rebates and similar relief for consumers who buy EVs, including reduced or no stamp duty, free registration for the first couple of years and no road user charges for EVs until EVs account for a proportion of annual vehicle sales. In Western Australia, the recently announced Clean Energy Car Fund will include $36.5 million to provide up to 10,000 rebates of $3,500 to Western Australians that buy a new electric up to a value of $70,000.
- Industry support for the introduction of smart charging programs, providing electricity bill credits to EV owners that voluntarily opt-in to managed charging regimes.
- Incentives from Government and utilities to residents to charge their EVs during the day when energy demand is lower. This might mean, for example, providing EV charging facilities at workplaces and in public areas. From a transmission perspective, timing is key to maximise the use of a network connection without overloading it. If everyone charged their vehicle in the evening after they got home from work, this would put further pressure on electricity supplies at this peak time.

In summary, V2H and V2G technologies have the potential to offer significant benefits to help reduce demand on electricity networks, and when coupled with domestic solar systems, can enable EV drivers to use greener and cheaper electricity – and fundamentally, help to achieve Net Zero.

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1 https://thedriven.io/2022/03/31/solar-charged-electric-vehicles-already-a-no-brainer-for-australian-car-owners/

Ready, Steady, GO! 17 hydrogen projects across Australia have signed up to the CER Guarantee of Origin scheme

First published: 19 May 2022

With the consultation of industry and key stakeholders, Australia's Clean Energy Regulator (CER) announced in December 2021 that it is working to develop an internationally consistent Guarantee of Origin (GO) scheme for hydrogen. On 17 May 2022, the CER confirmed that 17 hydrogen projects have signed up to a trial to help it understand how a GO scheme could work in practice.

As explored in our article, Fifty Shades of Green, there is no internationally agreed upon definition for green hydrogen (GH2), which complicates its certification. Unlike other certification schemes, the GO scheme will not focus purely on certifying GH2 but will also measure the emissions produced from several production methods and display key attributes of how and where a unit of hydrogen is produced. The scheme is said to work like a ticket, which may be distributed by third parties but will be validated on a single shared registry. This registry would ensure that the CER can monitor and trace tickets and alleviate the need to cross-check contracts.

While such a scheme will involve additional compliance costs to quantify emission intensity, the resulting emission transparency will boost the credibility and business case of renewable hydrogen producers. The GO trials will not only inform an Australian hydrogen certification scheme, but also play a role in shaping international certification standards.

A list of the hydrogen projects involved in the GO trials announced on 17 May 2022 can be seen in the table below.

Project name	Company	Production technology	State
Hydrogen Park South Australia	AGIG	Electrolysis	SA
Hydrogen Park Gladstone	AGIG	Electrolysis	QLD
Hydrogen Park Murray Valley	AGIG/ENGIE	Electrolysis	VIC
Clean Energy Innovation Park	AGIG/ ATCO	Electrolysis	WA
Blue Economy CRC	Blue Economy CRC/ Pitt & Sherry/ BOC	Electrolysis	TAS
Renewable Hydrogen Production and Refuelling Project	BOC	Electrolysis	QLD
Renewable Hydrogen Production and Refuelling Project	BOC	Steam Methane Reforming	VIC
Geraldton Export-Scale Renewable Investment	BP	Electrolysis	WA
H2Kwinana	BP/ Macquarie Capital	Electrolysis	WA
Clean Energy Innovation Hub	ATCO	Electrolysis	WA
Christmas Creek Renewable Hydrogen Mobility Project	FFI/FMG	Electrolysis	WA
Hydrogen Energy Supply Chain Pilot Project	Hydrogen Engineering Australia on behalf of a consortium	Coal gasification	VIC
Singapore Green Energy Supply Chain	Incitec Pivot/ Keppel New Energy/ Temasek	Electrolysis	NSW
Dyno Nobel Renewable Hydrogen Project	Incitec Pivot	Electrolysis	QLD
Western Sydney Green Gas Project	"Jemena Origin Coregas"	Electrolysis	NSW
Port Kembla Hydrogen Hub	Jemena	Steam Methane Reforming	NSW
Moomba Hydrogen Project	Santos	Steam Methane Reforming	SA

Source: Clean Energy Regulator

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What Labor means for energy

First published: 24 May 2022

With the election drawing to a close, we set out what a Labor government means for energy policy.

Climate Change

Policy: Cutting carbon emissions by 43% from 2005 levels by 2030 and achieving net zero by 2050. Australian Public Service to reach net zero emissions by 2030.

Commentary: With a substantial cut in carbon emissions already being achieved in the last 17 years, the emission reductions targets are not overly ambitious (especially when compared to the Greens' net zero policy by 2030).

With Australian business (and voter sentiment) already driving the green economy (see our articles here and here), it will be interesting to see how this target will be adjusted in future.

Renewables

Policy: Targeting 82% renewable energy by 2030.

Commentary: With electricity generation being the largest contributor to Australian greenhouse gas emissions, a robust renewable energy policy is crucial to achieving climate goals.

According to the Clean Energy Council (CEC), renewable energy supplies 32.5% of Australia's electricity. This has led to relatively low electricity prices compared to the rest of the developed world, with Australians on average paying US17.6 c/kWh when adjusted for purchasing power parity, compared to the OECD average cost of 24.2 US c/kWh.

An increase in renewable penetration will however come with cost challenges due to the continued rise in the cost of materials used in generation, transmission and storage infrastructure.

An increased support for renewable energy sends a strong market signal, and will lead to the unlocking of substantial investment if supported by the correct policy interventions.

Storage

Policy: $100 million investment in the creation of 85 community co-operative solar banks which will exclusively service approximately 25,000 low income households and renters, who are unlikely to have the opportunity to install solar.

$220 million investment in installation of 400 community batteries, with a focus on storage of rooftop generated solar energy.

Commentary: It will be interesting to see how government plans to deliver on its storage ambitions, especially with regard to technology selection, storage location and effective regulation to ensure a redesign of the National Electricity Market that facilitates this massive uptake in dispatchable generation.

EVs

Policy: Removing taxes from low priced EVs to boost demand.

Labor will introduce an Electric Car Discount (Discount). As part of the Discount, Labor will exempt many electric cars from:

Import tariffs – a 5% tax on some imported electric cars; and

Fringe benefits tax – a 47% tax on electric cars that are provided through work for private use.

These exemptions will be available to all electric cars below the luxury car tax threshold for fuel efficient vehicles ($77,565 in 2020-21).

The Discount will begin on 1 July 2022 and be reviewed after three years, in light of electric car take up at that time.

Commentary: With the transport sector generating more than 20% of Australia's total emissions, the uptake of electric vehicles will be crucial to reaching net zero emissions by 2050. The rollout of a national charging network will be important to realise this goal. An unintended win may very well be the storage capacity and grid balancing services that EVs add to the grid (see our article here for more on vehicle-to-grid).

Safeguard mechanism

Policy: Setting pollution limits on Australia's 215 biggest carbon polluters.

Commentary: Labor has stated that it intends to "Adopt the Business Council of Australia's recommendation for facilities already covered by the Government's Safeguard Mechanism that emissions be reduced gradually and predictably over time, to support international competitiveness and economic growth – consistent with industry's own commitment to net zero by 2050." To ensure Australia remains competitive and relevant, this may require a larger commitment.

Grid

Policy: Modernising Australia's electricity grid through the $20 billion Rewiring the Nation plan.

Commentary: The lack of government intervention in recent years has led to the private sector solving capacity constraints by installing storage at their generation facilities. While grid upgrades are welcomed it is important to undertake these in line with a national energy plan.

Labor seems to be aware of the challenges in this space, with Labor's energy spokesman Chris Bowen saying that the investment test for transmission (RIT-T) can delay projects unreasonably and has called for a major reworking of the scheme.

Manufacturing

Policy: Allocating up to $3 billion from Labor's National Reconstruction Fund to invest in green metals (steel, alumina and aluminium); clean energy component manufacturing; hydrogen electrolysers and fuel switching; and agricultural methane reduction and waste reduction.

Commentary: Reducing carbon emissions requires a whole of market approach. See our article on the Business Drivers for Australia's green economy here. The CEC is of the opinion that low-cost electricity provided by renewable energy can help expand Australian manufacturing capacity, create more regional jobs and growth, and reduce Australia's greenhouse gas emissions.

In the short term, the scaling up of electrolysers and a massive expansion in renewable energy infrastructure will be hugely important to make the overall cost of green hydrogen production cost-competitive with the incumbent fossil fuels (i.e. coal).

Jobs

Policy: 10,000 New Energy Apprentices and a $10 million investment in the New Energy Skills Program (to establish training (and retraining) pathways in the renewables sector).

Commentary: The CEC estimates that the transition to a clean energy market could support 80,000 jobs. Specialist engineers and trades will be required to construct infrastructure required to achieve this renewable future.

Movement on policies

As it is unclear whether Labor will win enough seats in the lower house to govern in its own right, there are two energy policy scenarios that may unfold:

1. Labor wins a majority in the lower house: Labor will be free to push ahead with its renewable energy policy in its current form. However, getting the policy through the lower house is only part 1 of the battle. Passing it through a fragmented Senate will prove another challenge.
2. Labor forms a minority government: Labor will need to negotiate with the Greens and other independents to guarantee confidence and supply in the lower house. This will open the door to the Greens or independents to push for a more ambitious renewable energy policy. This will put the Labor government between a rock and a hard place given that Anthony Albanese made it clear during the election campaign that he would not negotiate his policies to form a minority government. Energy policy is a touchy subject for Labor following its deal with the Greens after the 2010 federal election which saw the introduction of a carbon price that played a part in the downfall of the Labor government.

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Will it Fly?
The Future of Hydrogen Aviation

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As the world searches for new ways to combat climate change, hydrogen has emerged as a potential saviour for many polluting industries, including aviation. The aviation industry accounts for approximately 2.5% of global carbon emissions. These emissions are expected to soar in the coming decades, unless changes are made to aircraft fuelling and operation. Despite the current focus on electrification and batteries as alternative solutions, hydrogen is a strong contender to be the sustainable aviation fuel of the future.

Advantages of hydrogen-powered aviation

Hydrogen and air travel have a complex relationship, with history buffs quick to point out the 1937 Hindenburg airship disaster. The Hindenburg, which contained more than 70,000 tonnes of hydrogen, caught fire and crashed, causing the deaths of 35 people. The Hindenburg was however not fuelled by hydrogen, but merely used the gas to provide buoyancy.

In the past 85 years hydrogen powered aviation technology has progressed and the advantages of using hydrogen as an aviation fuel are now evident.

Hydrogen-powered aircraft emit only water and tests suggest they can be just as fast as regular planes, carrying over a hundred passengers per flight across thousands of kilometres. Hydrogen propulsion would significantly reduce climate impact as it eliminates carbon dioxide (CO2) emissions in flight and can be fully carbon free when green hydrogen (produced using a process called electrolysis) (GH2) is used as a fuel source.

A recent report assesed the potential of hydrogen-powered aviation (see table below).

The table demonstrates that as the size of the aircraft increases, its climate impact reduction decreases, and costs increase. Long-range aircraft require new aircraft designs to utilise hydrogen in an economic way. This is because the weight of the hydrogen tanks would increase energy demand, resulting in significantly higher costs per flight. The smaller aircraft (commuter, regional and short-range) will play an important role in developing more energy efficient, climate-friendly and cost-effective larger aircraft as technologies are tried and tested.

Progress

Hydrogen-powered aviation could potentially be realised by running liquid hydrogen through a fuel cell. Storing hydrogen in a liquid state is promising, as it offers high volumetric density compared to hydrogen in its gaseous form. A complication of liquid hydrogen storage is the necessity of cryogenic cooling, that is, cooling below -253 degrees Celsius. Liquid hydrogen storage would require planes to be remodelled as the wings on traditional aircraft cannot support the weight of the heavy insulated tanks required to regulate temperature.

Progress has been made in developing the underlying technology for hydrogen planes. In 2008, Boeing flew the world's first hydrogen-powered plane, a two-seater glider, propelled by battery power and hydrogen fuel-cell generated energy - proving the technology is viable. In 2016, the first four-seater hydrogen plane powered solely by a hydrogen fuel cell took flight, developed primarily by Germany's DLR Institute of Engineering Thermodynamics.

In 2022, Delta Air Lines and Airbus announced a partnership to collaborate on industry-leading research to accelerate the development of a hydrogen-powered aircraft. The two aviation behemoths will explore its technical and commercial viability, assess the infrastructure (and cost) required to develop or procure their own GH2 production and implement it at airports, and advocate for a decarbonised future in aviation with key industry stakeholders. Airbus has already embarked on designing liquid hydrogen tanks and is building a "ZEROe" demonstrator to test hydrogen propulsion in one of its A380 jets.

Plane manufacturer, Boeing, has built a cryogenic fuel tank designed for space launches that it said could eventually store liquid hydrogen on commercial aircraft. While innovation is not hard to come by, work still needs to be done to overcome the more significant barriers to take-off.

Barriers to take-off

Shifting to hydrogen as a fuel for aviation is not without its challenges and there are several barriers to overcome before take-off is possible. As a disruptive innovation, it will require extensive research and development, investment by Government and industry, and regulation to ensure safe, cost-effective and climate friendly hydrogen powered aircraft and infrastructure.

Hydrogen storage technologies will need to advance to carry enough liquid hydrogen in planes for longer journeys. A substantial increase in GH2 production is also required to produce sufficient volumes for the aviation industry and to reduce production costs. However, as demand for hydrogen from other transport sectors increases and supply rises in tandem with renewable energy capacity, GH2 costs will likely fall.

Another challenge is the modification of existing airport infrastructure, with distribution, storage and production facilities all needed at scale. This scale-up will bring its own challenges including finding more suitable refuelling technology than refuelling trucks, establishing parallel refuelling infrastructure at airports, and adapting parking stands to accommodate larger aircraft. Synergies with existing gas pipelines could be used to facilitate hydrogen transportation to airports.

To initiate a hydrogen decarbonisation path, bold steps will need to be taken. A sector roadmap to reduce climate impact, increased research and innovation activity and funding, and a long-term policy framework will be necessary to transition to a new propulsion technology. While these obstacles are significant, there are no fundamental technical barriers that would prevent implementation, if planned and addressed in a timely manner.

The sky's the limit

Hydrogen propulsion has the potential to lessen the climate impact of aviation and contribute to decarbonisation goals. Technological development, a commitment to phase out gas and diesel aircraft, and buy-in from key stakeholders will shape the future of hydrogen-powered aviation. The benefits of hydrogen are obvious, and it offers a promising solution to significantly reducing greenhouse gas emissions.

Project name	Commuter	Regional	Short-range	Medium range	Long range
Propulsion power	Fuel cell system	Fuel cell system	Hybrid	H2 turbine	H2 turbine
Passengers	19	80	165	250	325
Range (km)	500	1,000	2,000	7,000	10,000
Cruise speed (km/hr)	500	543	889	1012	1050
Energy demand	-10%	-8%	-4%	+22%	+42%
CO2 reduction	100%	100%	100%	100%	100%
Climate impact reduction[1]	80-90%	80-90%	70-80%	50-60%	40-50%
Additional cost (CASK)[2]	0-5%	5-15%	20-30%	30-40%	40-50%
Entry into service	< 10 years	10-15 years	15 years	20 years	20-25 years
MTOW[3]	+15%	+10%	+14%	+12%	+23%

[1]Measured in CO2 equivalent compared to full climate impact of kerosene-powered aviation
[2]Cost per available seat kilometre
[3]Maximum take-off weight

Boeing Fuell Cell-Powered plane (source: Boeing)

ZEROe demonstrator (source: Airbus)

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Hydrogen Olympics Part 3 – How can Hydrogen fuel future Olympics in 2024 and 2028

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This is the third article in our Hydrogen Olympics series, exploring the adoption and use of hydrogen at the world's most famous sporting event.

Following last year's success in Tokyo, the Olympic Commission's focus has quickly shifted towards future host cities and how those cities may support the Commission's commitment to building sustainable infrastructure which lasts beyond the Olympic Games itself.

In the second part of our series, we looked at some of the countries that are establishing solid frameworks to build either hydrogen economies or create infrastructure to expedite hydrogen uses in day-to-day life.

In this third part, we consider the potential for the adoption and use of hydrogen as an alternative fuel source in Paris 2024 and Los Angeles 2028. Recent developments, investments and partnerships established within both cities have opened endless possibilities to ensure the Olympic Games continues to build consensus on sustainable and practical hydrogen uses in large-scale global events.

Beijing 2022

China was most recently host to the 2022 Winter Olympic Games. Beijing (also host of the 2008 Olympic Games) has taken the global spotlight regarding the emergence of electric vehicle technologies, and indeed the 2022 Beijing Winter Olympic Games became the standard bearer for the largest use of hydrogen-powered vehicles in Olympic history, bettering the standard set by Tokyo last August. Provided primarily by the city of Zhangjiakou, close to 1,200 hydrogen-powered vehicles were used within the competition zones of the Winter Olympics. This included around 800 buses alongside Toyota's Mirai cars and vans which transported athletes and staff.

The implementation and success of these hydrogen vehicles in cooler winter conditions may be more practical in comparison to electric vehicles whose batteries are susceptible to draining faster in colder weather. When temperature drops from 15-20 degrees Celsius to -5, on average, hydrogen fuel cell buses will only lose 23.1% of range as supposed to battery electric buses which lose 37.8%.[1] Moreover, refilling a hydrogen vehicle takes less time than recharging an electric vehicle and the Winter Games allowed for the construction of 30 new refuelling stations across the streets of Beijing and Zhangjiakou.

Paris 2024

In January 2017, the bid committee for the 2024 Paris Olympic and Paralympic Games announced a bold strategy to host the most sustainable Games ever – consistent with the aims of the Paris Climate Agreement. This bold roadmap, set seven years before the Games, was the first indication of Paris building towards an ambitious clean energy target by 2024.

In May 2021, NepTech and EODev were named winners of the 'Olympic & Paralympic Games Paris 2024 Mobilities call for new passenger shuttles. NepTech designed innovative ships which will transport passengers on the Seine in collaboration with EODev hydrogen solutions which have been developed in conjunction with Toyota.[2] This creative collaboration will bring together three major players within hydrogen mobility, with EODev's maritime hydrogen distribution stations set to be secured in close vicinity to Olympic venues to increase the feasibility of their operation during the Games.

Additionally, HysetCo is a venture partly owned by Toyota Motor Corp and Air Liquide who plan to operate approximately 20 hydrogen stations in Paris by the end of 2024.[3]

The rollout is intended to supply a growing fleet of hydrogen-powered taxis in Paris, as HysetCo plans to convince 10,000 Parisian taxi drivers driving internal combustion engine (ICE) vehicles to switch to zero-emission vehicles by the time the Olympic Games are held in France's capital. The trial process has already begun with HysetCo's recent acquisition of Parisian taxi operation Slota Group. As part of the takeover, 600 diesel taxis will be replaced with Toyota's Mirai hydrogen-powered cars by the end of 2022. Slota's hydrogen-powered fleet will be operated by HysetCo through its subsidiary Hype, which will be the world's largest fleet of hydrogen taxis.

Representatives from Marie de Paris, who overlook the administration of the City of Paris, remain bullish on the role of hydrogen in an emissions-free Paris. The city has set an ambitious target of only permitting zero-emission vehicles in the French capital by 2030, and an intermediary goal of no diesel vehicles by 2024. HysetCo will actively look to promote the parallel emergence of other relevant hydrogen mobility solutions, to replicate this model in other regions of France after the conclusion of the Paris Olympics.

German company Volocopter has successfully begun test flights of a fully electric Volocity air taxi, intending to be up and running for passenger services for the 2024 Games. There are rough plans to create at least two flight paths to ease traffic congestion by the time the Games roll around. Successful implementation may create a path for countries to begin implementation of light urban taxi services.

Los Angeles 2028

Looking further ahead to Los Angeles in 2028, building an early roadmap to smarter energy solutions and specific uses of hydrogen will help to create an easier path to ensuring its effective implementation.

Los Angeles itself, traditionally defined by bounding long highways and endless lines of cars in traffic, is launching an initiative to cut greenhouse gas production by 25% ahead of the 2028 Olympic Games with the help of major companies such as Tesla, Nissan, BMW and electric bus makers Proterra and BYD.

In July 2021, the Mayors of Namie in Japan and Lancaster in California, signed a Memorandum of Understanding in their respective cities, signifying concrete documentation towards the world's first bilateral agreement by municipalities to use hydrogen as their green energy strategy. Termed the 'Smart Sister Cities', the collaboration between the two countries further consolidates their positions as trailblazers within municipal clean energy innovation.[4] The transition towards clean energy began nearly a decade ago in Lancaster, and in 2019 it was termed as the world's first net-zero emissions city, having fully transitioned to solar energy.

This ambition has now progressed into a desire to integrate hydrogen power and production at small and large scales across the city. Several industry leaders have already begun investing in Lancaster's proposed hydrogen-based future like electric bus manufacturer BYD and hydrogen gasification company SGH2. In 2020, Namie became home to the world's largest solar to hydrogen facility at the time, creating a reliable supply of hydrogen to help light the eternal flame at the 2021 Tokyo Olympics.

With an eye towards hosting the Olympics later this decade, officials have challenged the city and decision makers in the Los Angeles Olympic Organising Committee to build on hydrogen's newfound home in the Games. Could Lancaster supply the hydrogen used to fuel the 2028 Olympics?

Projects like the Smart Sister City which focuses on investment in hydrogen infrastructure aim to promote innovative hydrogen-related projects and general engagement in hydrogen-based solutions. The decision to build on this partnership will look to reinforce hydrogen's home at future Games.

What next?

We are now just over 2 years and 6 years before the Olympic and Paralympic Games begin in Paris and Los Angeles respectively. Not to be forgotten, 2026 will see the Winter Olympics return to Italy in Milan for the first time since 1956. Whilst the difficulties in reducing costs and generating constant supply of renewable hydrogen remain, future Olympic host cities are encouraged to continue the initiative to develop innovative solutions and create ambitious yet attainable benchmarks.

Whether through internal reform or forming a collaborative partnership with other countries, the potential for the prominent use of hydrogen at every future Olympic Games may become the most impactful and important gold medal victory of all.

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Store, Explore, Encore – How to make GH2 easier to transport

First published: 30 May 2022

Earlier this year, the Suiso Frontier embarked on a voyage from Port of Hastings, Victoria, to Kobe, Japan; marking the first time that liquid hydrogen has been transported by sea to an international market. As recent news has shown, it will not be the last.

Global events from the Russia-Ukraine war to COP26 to COVID-19 have collectively contributed to a strong impetus for countries to depart from traditional fossil fuels in favour of renewable fuels such as green hydrogen (GH2). With the capacity to support the large-scale decarbonization of heavy and lightweight vehicle industries, as well as generate electricity and heat, GH2 has endless applications – the only issue is: how do we store and transport it?

Key Issues

While GH2 is favored as a future fuel of choice, the reality is that there is still much development needed in both infrastructure and transportation to get GH2 from remote production sites to its destination in heavily populated and industrial areas. The following factors must be considered as part of the development process:

- Time and Costs – large-scale conversion/re-conversion and transportation of GH2, as well as developing technologies in this space, are complex, energy-intensive and expensive processes with a reliance on both the public and private sector to provide the funds and labour.
- Feasibility – according to a report by Roland Berger,[1] renewables must provide a significantly greater output of energy to perform on par with fossil fuels in sustaining an industry, and beyond that, to reduce emissions in that industry. For example, the report notes it would require up to 10 million tonnes of hydrogen per year to adequately power the European steel industry and reduce emissions. To supply that hydrogen requires 120-180 GW of renewable energy capacity, currently 2 to 3 times more than Germany's total installed capacity for wind power.

Other considerations include the availability of physical space for renewable energy facilities and the capacity of the electricity grid to support such large projects alongside other domestic, public and industrial needs.

Despite these challenges, several initiatives are currently underway – particularly in Europe – to streamline the process of transporting and storing GH2, as we will explore below.

Gas Pipelines

Compressed hydrogen is capable of being transported via pipelines, which are fitted with metering stations, control valves, gates and storage facilities, to ensure a steady flow of hydrogen to end users.

A benefit of the pipeline delivery method is its use of the natural environment, such as using salt caverns as natural storage facilities or the existing gas grids as 'pipelines', which reduces the need to build new infrastructure, and the associated costs, whilst also contributing towards sustainability.

Where new pipelines must be built, they incur high capital costs and are subject to strict approval processes, both of which act as barriers to the efficiency of implementing and expanding pipeline networks. Additionally, there are unresolved questions surrounding how hydrogen supplied using this method can be converted for use by consumers.

Overseas, Middle Eastern and African suppliers have started blending and exporting hydrogen to Europe via international pipelines. In Europe, the European Hydrogen Backbone is an initiative in line with REPowerEU that aims to construct a hydrogen network comprised of 53,000 km of pipelines by 2040 at a projected cost of $84 – 151 billion. The European Commission has also set aside funding for hydrogen research and stated it will support the development of three major hydrogen import corridors via the Mediterranean, North Sea and (geopolitical conditions permitting) Ukraine.

In Australia, the Australian Gas Infrastructure Group recently completed a feasibility study and set out a roadmap for introducing hydrogen blending into the Dampier-Bunbury Natural Gas Pipeline, one of the largest capacity natural gas pipelines in Australia. Ultimately, the goal is to develop a commercial GH2 supply chain in Australia.

Green Ammonia

GH2 can also be stored and transported as ammonia. This method involves nitrogen and hydrogen reacting together to produce liquid ammonia, which is then transported in refrigerated tanks to its destination. The ammonia can then be cracked back to its components and purified to extract the hydrogen.

The method of using ammonia to transport GH2 is comparatively cheaper than other options and offers ease of storage and transport, as the GH2 is contained in a liquid form. As the use of ammonia has been well established on an industrial scale for some time now, there is also existing infrastructure for storing, transporting and handling the substance; as well as accepted policies and safety standards regulating its use.

The downside is that ammonia is a toxic chemical that can adversely affect human health and poses a potential risk to water and soil quality if mishandled. Accordingly, as GH2 will primarily be delivered for use in densely populated areas, there are some safety concerns in using ammonia as a transport vessel.

Projects for green ammonia are currently underway in the Netherlands. The companies Gasunie, HES International and Vopak have joined forces to develop an import terminal for storing and converting green ammonia called the 'ACE Terminal'. The ACE Terminal has a purported start date in 2026 with plans to integrate it into a national hydrogen transport network.

Liquefied Hydrogen and Liquid Organic Hydrogen Carriers (LOHC)

Besides ammonia, GH2 can still be transported in liquid form if cooled below its boiling point of - 253°C or put through a process called 'hydrogenation' which chemically binds hydrogen to a liquid compound, to be released upon arrival at the destination.

Both options are supported by well-established technology and provide high-purity hydrogen to the end user. As mentioned previously, liquid hydrogen is also easier to store and transport. The main drawback is the high energy consumption for the liquefication process and extensive temperature regulation required in both these methods. For LOHC, there is the additional upstream costs of procuring high volumes of LOHC liquid to bind the hydrogen.

Other Options

Natural hydrogen – also known as native or 'gold' hydrogen – is continuously generated by geological processes and contained in the Earth's crust and is considered a source of 'truly green' cheap hydrogen. Natural hydrogen has the potential to be three to four times cheaper than hydrogen produced via the methods outlined above due to the hydrogen being directly extracted rather than being produced after a lengthy manufacturing process. The extraction process has already been developed in the oil and gas industry saving further time and cost in research and development. Thus, whist difficult to find, natural hydrogen remains a potential option to enable a faster transition to more sustainable forms of hydrogen.

The Future Fuel

GH2 is fast becoming the future fuel of choice to pioneer the large-scale decarbonization of many hard-to-abate industries. While its widespread use is currently impeded by a lack of established infrastructure, as well as the costs and feasibility of further development, there is plenty of work underway in this space to develop new, sustainable ways of transporting and storing GH2. Indeed, given the already frantic pace of the renewable energy transition, do not be surprised if there are more cost effective and efficient methods of transporting GH2 developed before the year is out. Ultimately, the market will decide which method becomes the dominant way of transporting this ubiquitous gas.

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[1] Uwe Weichenhain, Hydrogen Transportation: The Key to Unlocking the Clean Hydrogen Economy, Report for Roland Berger (2021) 4.

Green Shipping Corridors – Australia's Hydrogen and Ammonia outlet

First published: 01 June 2022

Shipping was, until recently, the only transport sector not subject to emission reduction targets. However, there has been a global push to decarbonize shipping and 'green shipping corridor' (GSC) is a trending buzzword. In this article, we look at what GSCs are and where the first projects are likely to be located.

What is a Green Shipping Corridor?

A GSC is essentially a zero-emission maritime route between two or more ports, which includes decarbonised landside infrastructure and shipping vessels. The purpose of a GSC is to cut down, if not eventually eliminate, the estimated 1 billion metric tons of carbon dioxide (CO2) currently generated by the shipping industry each year, equating to around 3% of global carbon emissions.

Compared to regular shipping, GSCs mobilise all value-chain actors to invest in zero-emission shipping. For example, a GSC offers a prime location with offtake certainty for zero-emission fuel producers. Like a special economic zone, a GSC also allows policymakers to create fit-for-purpose regulatory measures, financial incentives and safety regulations, as well as a standardized tracking registry, to apply exclusively to the GSC zone. This gives clear rules and regulations to any vessels moving through the GSC and serves as extra security for any stakeholders involved in the project.

Against these advantages, there are some regulatory wrinkles to smooth over such as approving safe fuel handling guidelines for sustainable marine fuels such as ammonia and hydrogen. Furthermore, there must be collaboration and common agreement between all parties involved in the GSC.

Planned Green Corridors

Europe

In Copenhagen, the Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping is collaborating with the Port Authorities of Hamburg, Gdynia, Roenne, Rotterdam and Tallinn to build GSCs in Northern Europe and the Baltic Sea. These GSCs symbolize the European Union's commitment to reduce CO2 emissions in all its transport industries. Looking to the future, these GSCs will also serve as the trial projects and blueprint for establishing a full European Green Corridors Network.

US and China

Elsewhere, Los Angeles and Shanghai have partnered up with the ambitious goal of creating a GSC on one of the world's busiest shipping routes – between the US and China. The key goals of this partnership include:

- Developing and introducing zero-emission ships and best practice guidelines throughout the 2020s; and
- Reducing the emissions surrounding the ports in Los Angeles and Shanghai.

For now, the project is still in the early stages of preparation for the GSC, with a view to finalising an implementation plan by the end of 2022.

Australia

A consortium including the Global Maritime Forum, BHP, mining company Rio Tinto and other shipping companies, have signed a letter of intent to support a proposed Australia-East Asia iron ore GSC, aimed to reduce carbon emissions along this route. The project originated in a 2021 study report called 'The Next Wave' by the Getting to Zero Coalition. The report proposed the implementation of an iron ore corridor between Australia and East Asia where shipments would be fueled with green ammonia. In line with this proposal, the consortium will assess green ammonia supply, bunkering and first mover support mechanisms. It will further invite public-private dialogue and focus on the development of decarbonised fuel production and infrastructure to ensure the smooth transition to a viable GSC.

Conclusion – what does this mean for Australia?

With the introduction of GSCs, international shipping will become increasingly reliant on sustainable maritime fuels, such as ammonia and hydrogen. According to the Global Maritime Forum, ammonia may even be the preferred fuel due to its zero-carbon combustion, cheaper cost, higher energy density and low maintenance storage compared to hydrogen; making it a suitable fuel for powering global shipping vessels.

In previous articles, we outlined Australia's advantageous position to produce green ammonia via its existing resources, workforce and domestic market (read it here), as well as its capacity for hydrogen production (a list of Australian hydrogen projects can be found here). This remains true in 2022, with works currently being undertaken to create dual hydrogen / ammonia production facilities to the south of Perth, WA (H2Perth Project) and in Bell Bay, TAS (Origin Green Hydrogen and Ammonia Plant)

Given its position and proven capability to produce both hydrogen and ammonia, Australia can scale and export these resources beyond its borders to cater to this consistent, and no doubt increasing, demand for renewable shipping fuels. Accordingly, the more the world is connected by GSCs, the more Australia can reinforce its role as a new, renewable energy superpower.

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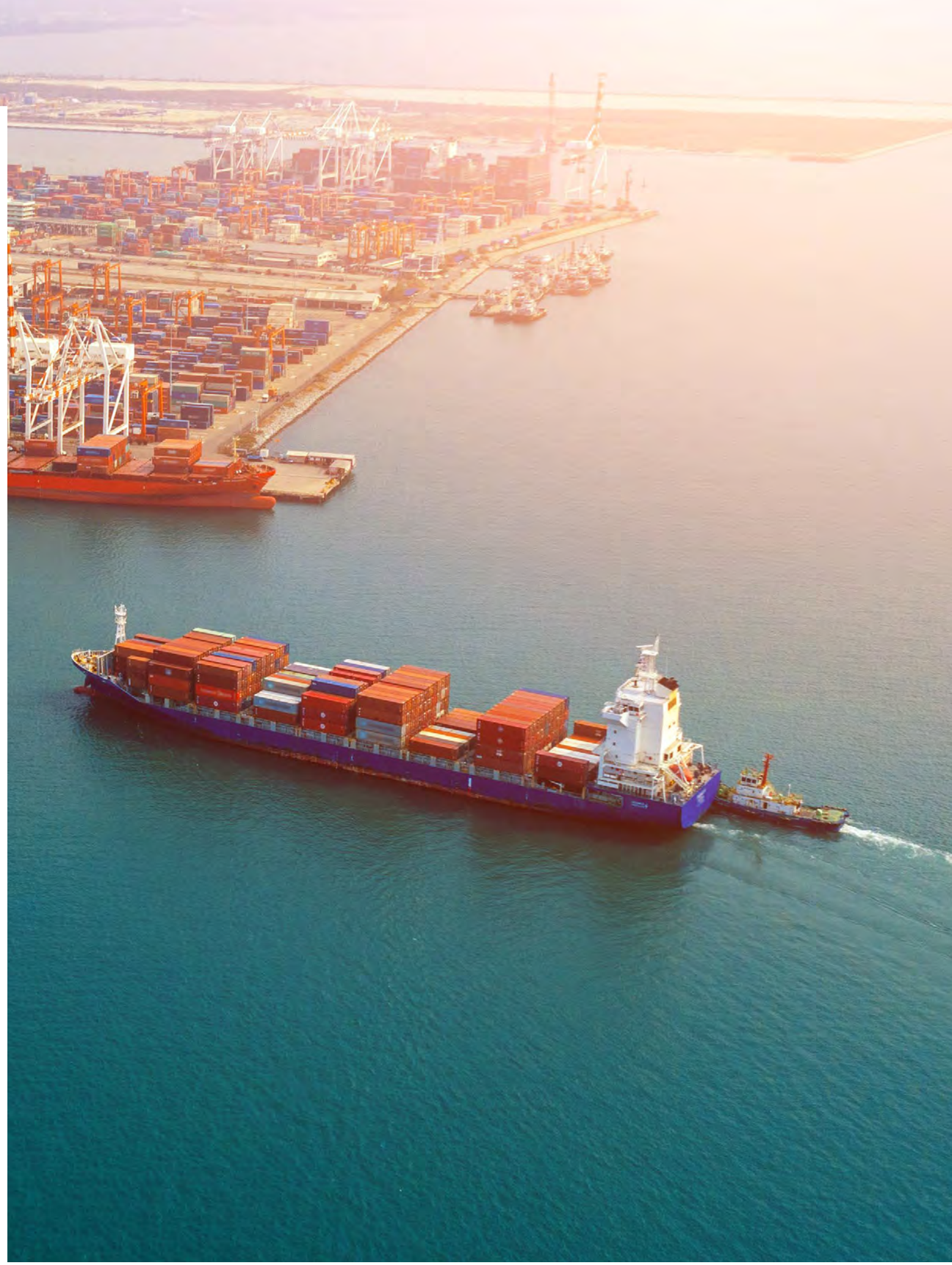


The Birthplace of Batteries and other Rare Minerals: Opportunities for Australia

Published: July 2022

Increasing demand for New Energy technologies – predominantly battery storage - is an ongoing, common trend in many industries including electric vehicles (EVs), heavy haulage, public transport and renewable generation projects. As this demand increases, so too does the demand for the metals and minerals which form these technologies, and the pressure on the mining sector to provide a constant supply.

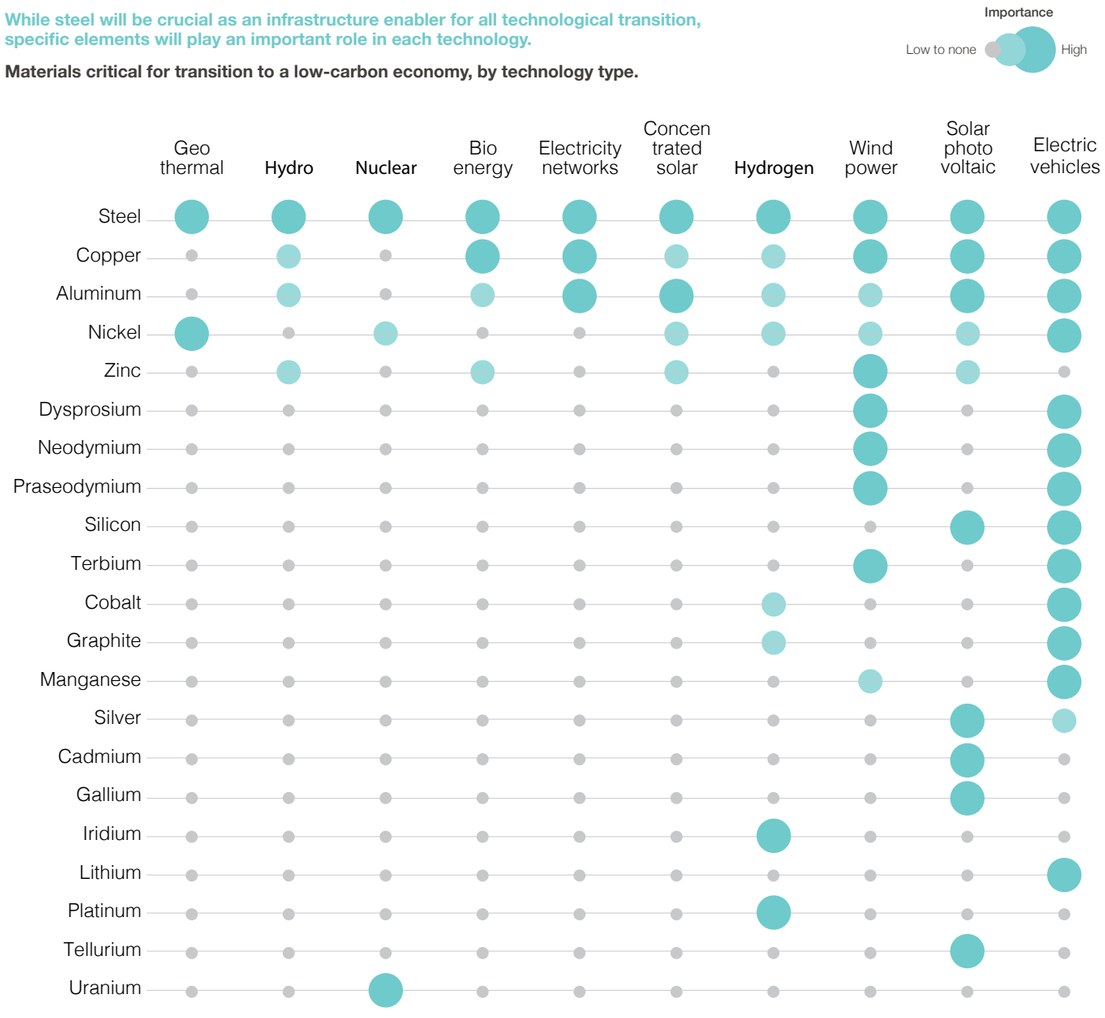
In this article, we identify the materials that are in high demand and the fundamental role played by the mining sector in the New Energy transition. We also consider the key issues facing this transition, mainly in the form of supply chain shortages and look at some of the steps to achieve market balance for these materials in the future.

The Building Blocks of the New Energy Transition

Several raw materials are at the core of enabling the New Energy transition. Copper is a valuable material in bioenergy, electricity networks, wind power and solar photovoltaic technologies and in the manufacture of EVs. Wind, solar and electricity-powered technologies are also highly reliant on a range of other raw materials including aluminium, and neodymium. The required pace of transition means that the availability of these materials will need to be scaled up within a relatively short time scale and, in certain cases, at volumes ten times or more than the current market size to prevent shortages and keep new technology costs competitive.

While steel will be crucial as an infrastructure enabler for all technological transition, specific elements will play an important role in each technology.

Materials critical for transition to a low-carbon economy, by technology type.



*Includes energy storage.
Source: *Critical raw materials for strategic technologies and sectors in the EU, A foresight study, European Commission, Mar 9, 2020; The role of critical minerals in clean energy transitions*, IEA, May 2021; McKinsey analysis

Certain metals and raw materials increase the performance of these technologies for longer periods of time, which in turn maximises efficiency and sustainability while reducing waste. Lithium metal anode, for example, is used to boost energy density in batteries, allowing the battery to perform better and for longer compared to a graphite anode alternative.

Battery Manufacturing

The following minerals are used in battery manufacturing:

- Lithium – a key ingredient to produce traction batteries used in EVs and other consumer electronics; it is also used in energy storage and air mobility technology.
- Cobalt and nickel – cobalt prices peaked at $100,000 / metric ton in 2018, leading to a switch to nickel, which similarly grew more expensive and proved ineffective in facilitating maximum design capacity. Currently, both materials are less commonly used.
- Manganese – a useful alternative to cobalt and nickel for its sheer abundance in global production and supply (4-5x greater than nickel production and 140x greater than cobalt production), plus reserves.

Supply Chain Issues

In the short-term, the outbreak of war in Ukraine and the ongoing energy crisis have forced countries around the world to reassess their reliance on fossil fuels, particularly when imported from overseas. Renewables, most notably in the form of wind and solar power coupled with battery storage and/or green hydrogen production, are going to be increasingly important in providing energy security.

Therefore, while increasing renewable energy capacity seems an obvious solution, high prices, the challenges in bringing projects to production, the cost of new technology and uncertainty in the supply chain are a growing concern for the New Energy sector.

These supply issues may also be exacerbated due to other factors such as:

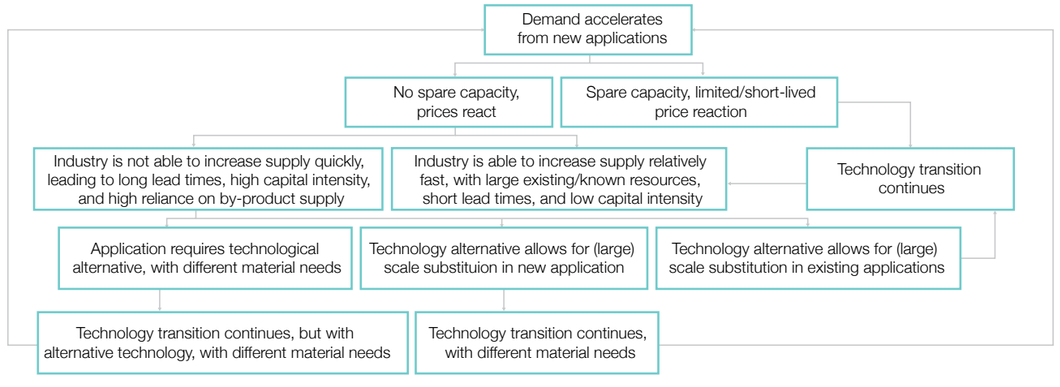
- Environmental trends favouring certain renewable energy generation – for example, where solar panels may not be performing well due to weather or seasonal changes, there may be a shift towards wind-generated power and accordingly, an increased demand for neodymium; and
- Greater volume of raw materials for sustainable technologies compared to fossil fuel-based alternatives - renewable energy capacity is generally lower than its fossil fuel-based counterpart (eg an EV needs about six times more minerals than a petrol-powered car), therefore more raw materials are needed to generate the same amount of energy.

One method of achieving future market balance in supply and demand is refining the existing methods for extracting raw materials and being willing to explore alternative extraction sites. This method can help to balance future supply and demand by maximising the safe intake of raw materials from each site and reducing supply time delays, leading to lower financial and environmental costs in the long-term. However, this depends on a number of factors including the location of the relevant sites and the technology required to be applied, which is often new and developing. An example of this is in China, where companies have invested in new hard rock and brine lithium projects over the past few years, but there remains a question mark as to the quality of these resources and their ability to produce battery-grade product.

Alternatively, technological innovation may accelerate to the point of being able to make material substitutions in the case of any deficit, reducing the pressure to supply one specific material altogether. In either case, sufficient capital investments both at Government and industry level will be necessary for these innovative measures.

The table below illustrates the supply and demand imbalance issue in more detail, including potential solutions:

Supply, demand, and price reactions will lead to feedback loops, resulting in supply reactions, technology shifts, and material substitution.



Australia's Prime Position

The supply chains for critical minerals will be dominated by the switch to renewables. The International Energy Agency's most conservative forecasts expect demand for lithium to grow 13-fold in the 20 years to 2040, rare earth demand to triple, copper to double and cobalt is expected to increase at least six times.

Whilst acknowledging the recent press from some of the investment banks in relation to a lithium over-supply as a result of the number of projects potentially being brought to production, the broader industry view appears to reflect a position that any balance in the supply and demand of lithium, and in particular battery-grade product, is more likely to be some years away.

Australia is well positioned to supply these critical minerals and in doing so can make a huge contribution to combat climate change globally. For instance, Australia has rapidly become the world's biggest exporter of lithium by producing almost half of the worldwide supply.

As Australia still exports the majority of its critical minerals overseas, there is an opportunity for midstream processing to be undertaken locally. At present, particularly in rare earths, this midstream processing market is heavily dominated by China. Countries including Australia have begun to make a concerted effort to encourage midstream processing onshore, with grants and other incentives being offered in a bid to create an industry and additional jobs. For instance, a $120 million deal for a commercial-scale processing facility was recently struck between Australia's Lynas Rare Earths and the U.S Department of Defence, to operate in Texas by 2025. This deal is particularly significant as it creates a secondary supply chain for the processing of heavy rare earths elements outside of China.

Australia's mining industry also has a strong incentive to adhere to strict environmental standards and technological advancement is on foot to develop new methods that allow us to mine these important minerals sustainably.

Government Assistance

On 4 April 2022, the Federal Government approved a $1.25 billion loan to Iluka Resources to develop Australia's first integrated rare earths refinery in Western Australia. This is a crucial step under the Government's Critical Minerals Strategy, which aims to turn Australia into a global critical minerals powerhouse by 2030.

The refinery will produce rare earth oxide products such as neodymium and terbium, which are used in the manufacture of EVs, clean energy generation and defence technologies. The refinery project is projected to secure Australia's manufacturing capability and provide a range of job and economic opportunities in the New Energy space.

In the future, the refinery project will be further supported and sustained under the Government's Modern Manufacturing Strategy, which will seek to explore potential offtake and investment opportunities to continue meeting the increasing global demand for critical minerals. As part of this strategy, the Federal Government has announced a series of grants through its $1.3 billion Modern Manufacturing Initiative which aims to support midstream projects.

A Sustainable Transition

The transition to a net-zero, clean energy-based economy will be heavily reliant on rare earths and critical minerals. A rush to make the switch will place a strain on critical mineral reserves, resulting in a range of issues from disproportionate supply and demand to material shortages and high costs for products. However, with technological innovation, advances in extraction methods and sufficient Government and private capital investment, the transition to a New Energy society should be secured.

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New Energy Expert Insights: The Truth about Blue Hydrogen – a Necessity in the Energy Transition? Part I

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In this two-part New Energy Expert Insights series, we sat down with Nicohan van der Merwe, Senior Process Engineer at GHD, to discuss the truth about blue hydrogen and explore the role it has to play in the global transition towards clean, renewable energy. Nicohan has substantial experience in blue hydrogen projects and has been an engineer in the energy sector for over 10 years. GHD is a global professional services firm committed to solving the world's biggest challenges in the areas of water, energy and urbanisation. It provides advisory, engineering, architectural, environmental and execution phase services. GHD is providing significant services for clients to support their decarbonisation journey, including the development of both green and blue hydrogen projects and believes that production via both routes should form part of the energy transition, given the complexity of challenges with transitioning energy systems globally.

In this Part I, we discuss some of the obstacles facing the transition to a green hydrogen economy. In Part II, we take an in-depth look into the specifics of blue hydrogen emissions and how blue hydrogen is already well placed to facilitate the transition to a green hydrogen future.

Part I

Green hydrogen has received significant attention as an efficient low-carbon fuel and has been heralded as the hero to net-zero. Recent negative media coverage of blue hydrogen, on the other hand, has left many people questioning its role in our future energy system. However, is all hydrogen fundamentally the same?

Green hydrogen is produced through water electrolysis with the electricity that powers the process originating from renewable energy sources such as wind and solar. Blue hydrogen on the other hand refers to hydrogen that has been produced using natural gas but with a portion of the carbon emissions captured and stored using carbon capture and storage (CCS) technologies.

The end-product of both blue and green hydrogen production – a source of fuel that can be used without emitting harmful emissions into the atmosphere – is exactly the same. It is the lifecycle greenhouse gases emitted during its production that really matter in considering what role it should play in the decarbonisation of our global energy systems The issue is not what the definition of blue and green hydrogen is, but rather the lack of a clear regulatory framework defining what "low-carbon" hydrogen is (read more **here**).

Blue hydrogen does not necessarily equate to low carbon hydrogen, but it is reduced carbon hydrogen. For instance, it's possible to have a 60% carbon capture rate and it still be considered blue hydrogen. Notwithstanding the uncertainty regarding a general definition for "low-carbon" hydrogen, several blue hydrogen projects have a carbon capture rate of between 90% and 95%. Therefore, blue hydrogen that achieves a very low lifecycle carbon footprint is a viable and important low carbon energy source.

Some countries have started introducing carbon intensity thresholds for low-carbon hydrogen, including the European CertifHy scheme and Australia's Guarantee of Origin scheme.

A globally accepted, clear framework to classify low-carbon hydrogen is required to boost the credibility and business case of low-carbon hydrogen producers and ensure that Australia's future hydrogen exports are accepted in importing countries and are able to compete in a market where the assessment of the carbon footprint is globally standardised.

GHD maintains it is vital that any potential low carbon hydrogen project is very carefully configured and analysed to confirm that it genuinely achieves very substantial lifecycle decarbonisation. From its own analysis it has confirmed that it is possible and practical to do so. Particular attention is also required. More detail about this will be provided in Part II.

What are the main obstacles to green hydrogen being produced at scale and what advantages does blue hydrogen currently have compared with the green alternative?

Green hydrogen is likely to dominate for small scale domestic requirements and in the long term at larger scale. However, in the short and medium term, blue hydrogen is a necessary step to reduce greenhouse gas emissions quickly at large scale. There are three important reasons why blue hydrogen should be considered a viable low-carbon energy source.

The Cost of Electricity

While there are cases for larger electrolysers and economies of scale to minimise the cost of green hydrogen, the single most significant cost contributor is the cost of electricity. We need to break down the variables that contribute to the cost of electricity and realise that if those variables do not come down in price over the next few years, green hydrogen will remain several times more expensive than the incumbent hydrocarbon fuels and also blue hydrogen.

Competition for Renewable Electricity

The production of blue hydrogen does not rely on renewable sources of electricity, although it can be incorporated to further reduce the carbon intensity of a blue hydrogen supply chain. Even with the most ambitious deployment of renewable electricity and the necessary grid firming and electrical transmission infrastructure, it will take decades to substantially transition from the current state where approximately 80% of our total energy needs are met by fossil fuels. More decarbonisation is achieved by using renewable power to decarbonise current power systems and to electrify as much of the other energy demands, rather than by using renewable electricity to produce hydrogen. Nevertheless, it is important that we produce significant volumes of low carbon hydrogen in order to decarbonise some of the hard to abate sectors where direct electrification is not practical. Being able to produce low carbon hydrogen from a source that does not compete for significant renewable power helps to de-risk the global path to net zero.

Mature Technology for production at scale

Much of the expertise and infrastructure required for blue hydrogen is already in place. The coal and gas industries are both mature with well-established supply chains. Access to enough coal or gas to sustain blue hydrogen production in any potential location will be a routine process, and investment in the required CCS solutions has never been higher. The blue hydrogen technologies at scale are mature and facilitate the decarbonisation of fuel at large scale. Green hydrogen technology is also mature but at comparatively small scale. Currently, large scale green deployment would be achieved through vast replication of an essentially small scale technology.

To this end cumulative emissions can be significantly reduced if blue hydrogen is also deployed compared with only deploying green hydrogen.

In your view, is it simply a case of blue first, green second?

Green hydrogen will undoubtedly play a significant role in our future energy system. Although blue hydrogen has higher lifecycle emissions than fully green hydrogen, it is unlikely that we can meet the decarbonisation goal timelines without blue hydrogen as part of the energy mix.

We need to be realistic about our transition to green hydrogen and sustainability. As blue hydrogen is commercially available at scale, rapidly deployable and still the cheaper fuel source, it can pave the way for future supply chains, a hydrogen economy, and the progression of regulatory standards and policies.

Stay tuned for Part II of this New Energy Expert Insights as we look into the specifics of blue hydrogen emissions and how blue hydrogen is already well placed to facilitate the transition to a green hydrogen future.

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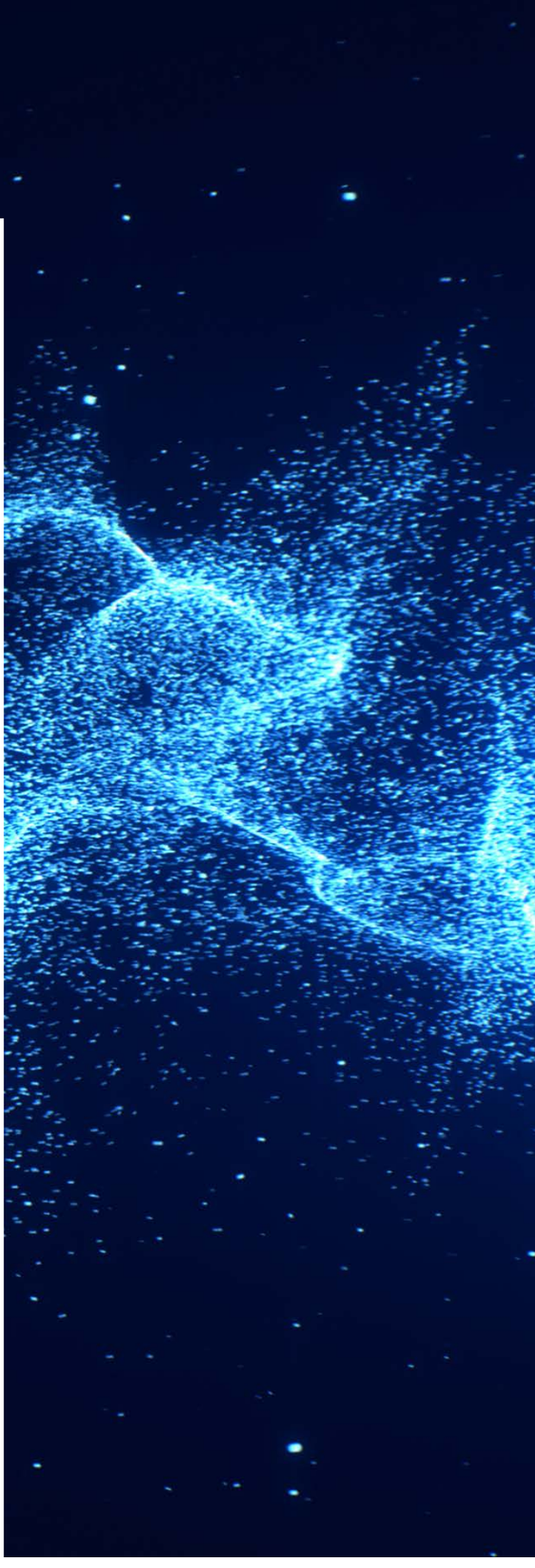

Fuelling the Fleets

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A report by the Australia Institute shows that Australia relies on The Australia Institute reports that Australia is reliant on imports for 91% of its fuel consumption, which means that the country's fuel supply is exposed to international price fluctuations and supply chain constraints.[i]

Under the Long-Term Emissions Reduction Plan to achieve net zero emissions by 2050, the Australian Government introduced the $250 million Future Fuels Fund to provide co-investment for innovative charging and refuelling infrastructure projects. The Fund is supplemented by the 2021 Future Fuels and Vehicles Strategy which aims to encourage the uptake of electric, hydrogen, biofueled or hybrid vehicles.

Electric

As noted in our article Driving it Home: How Australia Can Make the Switch to Electric Vehicles, various stakeholders are working towards a smooth transition to electric-fuelled vehicles (EVs). This includes the development of critical infrastructure, financial incentives and other policy instruments at both the State and Federal level.

The private sector is heavily invested in this transition. For example, Janus Electric recently unveiled what it claims to be Australia's first electric prime mover fleet comprised of four heavy haulage vehicles. The key feature of the company's technology is its ability to take existing vehicles and convert them into EVs as opposed to purchasing new vehicles. This circumvents the high upfront purchase price of EVs.

In Victoria, Volgren released two fully electric buses for the Department of Transport and bus operator, Kinetic. A further 34 buses will be rolled out over the next three years. Kinetic has also contracted with the Melbourne Bus Franchise (MBF) to replace more than half of its fleet with low or zero-emission models.

The New South Wales government recently committed $219 million to achieve an 8,000-strong, zero emission public bus fleet by 2047. This would lead to a 78% reduction of Transport for NSW's current emissions.[ii]

Hydrogen

Another key focus area of the Future Fuels and Vehicles Strategy is the commercialisation of hydrogen as a transport fuel. To achieve this goal, the program will support projects developing renewable hydrogen transport solutions, particularly fuel cell electric vehicles (FCEV) which operate using a fuel cell powered by hydrogen.

For example, Emerald Coaches, based in Queensland, recently committed to convert 120 vehicles from diesel fuel to hydrogen fuel by 2040 at an estimated cost of $100 million.

Substantial progress is also being made to scale up the production and supply of renewable hydrogen as a source of fuel. Hydrogen Fuels Australia intends to develop Australia's first modular hydrogen production and integrated FCEV refuelling operation in Truganina, Victoria. Projected to become operational in the third quarter of this year, the site will initially produce 60-90kgs of green hydrogen from its own solar array, enough to fuel up to 3 vehicles per day. Eventually, the plan is to scale up the site to supply up to 3,000kg of hydrogen daily, with capacity to refuel 100+ vehicles per day.

Biofuels

Liquid fuels (including biofuels) are one of the more commonly used fuels in the heavy freight, shipping and aviation industries due to its high-density energy and ease of storage and transportation compared to electricity and hydrogen. Furthermore, biofuels can more easily be substituted for traditional fuels. Many vehicles designed to run on conventional diesel, for example, will have no problem running on biodiesel alternatives without the need to convert the vehicle.

Biofuels however have high manufacturing and energy costs, and the focus of future developments will be on making biofuels more cost-effective and economically viable. Pilot programs are underway to produce the next generation of commercial biofuels, including the Northern Oil Advanced Biofuels Laboratory project and the Oceania Biofuels renewable diesel and sustainable aviation fuel biorefinery in Gladstone, Queensland.

Funding

To support the above, the Australian Renewable Energy Agency (ARENA) recently launched Round 2 of the Future Fuels Program with $127.9 million in funding to support commercial fleets to shift to zero emissions vehicle technology by 2026.

The Clean Energy Finance Corporation offers additional funding to clean energy projects on behalf of the Australian government, having invested over $450 million in projects and funds aimed to reduce emissions in the transport sector. The Corporation also partners with external organisations to facilitate co-financed projects.

Funding at the State-level is also available, such as the Hydrogen Industry Development Fund in Queensland that contributed to the Emerald Coaches hydrogen project mentioned above. In New South Wales, the Electric Vehicle Strategy offers a cash rebate of $3,000 on 25,000 eligible vehicles to encourage the greater uptake of EVs.

Western Australia has allocated $60 million to accelerate the use of zero emission vehicles in the 2022-23 State Budget. This funding includes:

- A $3,500 rebate for Western Australians if they purchase an electric or hydrogen fuel-cell vehicle; and
- $22.5 million towards charging infrastructure.

The Future

Australia has a renewed focus on securing readily available sources of fuel for its domestic transport needs – specifically via electricity, hydrogen and biofuels. While the transition to renewable fuels is a work in progress, an increase in the number of renewable energy projects, available funding and other incentives for both developers and consumers means there has never been a better time to 'fuel' a more sustainable transportation industry in Australia.

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Herbie goes electric – Expediting Australia's EV uptake

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Driven your car lately? The routine grocery shop, drop-offs for after-school activities and road trips have all become noticeably pricier. Driving our modern-day "Herbie" has become considerably more expensive since the famous Volkswagen beetle graced our screens in the 1968 classic 'The Love Bug'.

The start of 2022 has seen Australians empty their wallets and pay record prices for petrol - a symptom of the fluctuating imbalance in the supply and demand of oil, and further exacerbated by the recent geopolitical developments in Ukraine and the Middle East.

However, what if Herbie could be reloaded and made more affordable? Currently, the transition to electrification and minimising the impact of excessive fuel prices in Australia is facing a number of barriers. While the previous Federal Government stepped in briefly to ease some of the pricing pressures of filling up a tank, our gradually increasing reliance on imported fuel remains problematic. The Australia Institute delved into the Australian fuel market in their fuel reliance report in April and uncovered Australia's hefty dependence on imported oil.

The report showed that Australia currently relies on overseas imports for around 91% of petrol. Although hardly surprising, it is alarming to think that we are a singular global event or emergency away from a fuel crisis. While we have established a firm commitment to return to compliance with the International Energy Agency's 90-day minimum stock requirement, as of January 2022, Australia only has 68 days' worth of liquid fuel stored.

Domestically, just two local oil refineries are still in operation – Ampol in Brisbane and Viva Energy in Geelong. A budgeted investment of $2.3 billion in fuel security proved a temporary fix for the oil refineries, but the lack of substantive funding for the transition to electric vehicles (EVs) remains a major issue.

To minimise this exposure to overseas volatility, it seems more important than ever for the Government to commit to backing the uptake of EVs in Australia.

Are we behind the 8 ball?

In May 2022, 94,483 new cars were sold in Australia,[1] but only 925 were all-electric. Despite steady improvement from the prior month, the percentage sold in Australia flailed in comparison to other developed economies in Europe such as Germany, the Netherlands, and Denmark who averaged between 25-85% of new cars sold being all-electric.

To put this into context, as early as 2009, Europe imposed a CO_2 emission performance standard. And as of 2020, manufacturing companies are limited to an average emission of 95 grams of carbon dioxide per kilometre.

These standards make EVs cost-competitive in most European countries and other countries such as India, China, Japan, and the US which also have similar standards. However, Australia falls into the 20% of countries where manufacturers are not required to meet such standards, making it difficult for EVs to penetrate the consumer market.[2]

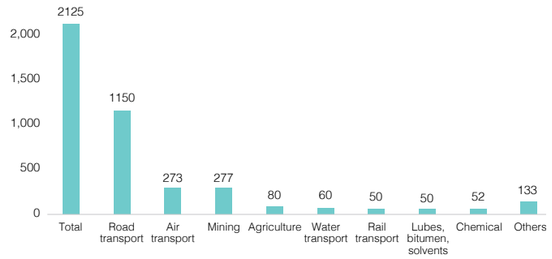
The benefits of electrification

The benefits of transitioning to electrification are clear. If EV charging can be managed efficiently, specifically outside peak electricity demand periods, it can help create a more consistent electricity network demand profile. This will have a significant impact in helping EV owners avoid higher-cost charging periods and aid the integration of both small and large-scale renewable energy systems into the electricity grid.[3]

Most Australians recognise the energy security benefits of EV uptake, with 45% of the population stating that one of the biggest benefits of an EV uptake would be the reduced dependence on foreign oil.[4] The sudden increase in EV uptake globally over the past 25 years can be attributed to solar becoming the cheapest form of power and lighter lithium-ion batteries becoming affordable, sustainable and practical enough for EV manufacturers to gain a foothold in the market.[5] We have already witnessed the potential of electric mobility with e-scooters now commonplace in all the major CBDs in Australia, providing an efficient and convenient commute for short trips.

Calls for a broader zero-emissions transport strategy on a national scale have been anticipated for years, as transport is Australia's third-largest source of carbon emissions. The transition to EVs will play a major role in raising Australia's climate ambitions and surpassing our target to cut emissions by 26-28% by 2030. Whilst EVs are more expensive up front in comparison to traditional internal combustion engine (ICE) vehicles, they will save $1,100 per year on average in avoided petrol costs (based on current prices).[6] If all vehicles in Australia were EVs, reliance on imported oil would fall by approximately 33%.

Australian consumption of refined petroleum products by sector, petajoules 2019-20



Source: Department of Industry, Science, Energy and Resources (2021) Australian Energy Update 2021, Table H3, https://www.energy.gov.au/publications/australian-energy-update-2021

What are we doing?

So far, much of the shift towards EVs has been done without much government assistance. As it stands, Federal Government policy has been ambitious but has lacked the targeted regulation and incentives needed to foster consumer enthusiasm for the EV market.

States and territories have incentivised the uptake of EVs and tried to make them more attractive to the modern-day buyer. The ACT has incorporated incentive-based benefits to those with wide-ranging incomes to increase the implementation of EVs. The main incentives are stamp duty exemptions for EV purchases, a zero-interest loan of up to A$15,000 for eligible households and two years of free registration.

A University of Canberra study questioned whether such incentives created a significant impact on the consumption of EVs. The study found that with a stamp duty exemption and a base EV price of $50,000, 9% of new vehicles sold in the next 5 years would be electric. Whilst this would only bring the proportion of electric cars on ACT roads to 1.6%, it would indicate a steady increase from the latest known proportion of 0.1% in 2019.[7]

NSW, QLD, and Victoria also offering incentives such as $3,000 rebates on the purchase prices. Such incentives helped increase EV sales by nearly 200% in 2021[8] and led to further initiatives to electrify other modes of transport such as buses. Recently, NSW committed to electrify its fleet of 8000 buses and power them with renewables by 2030.

Earlier this month, the NSW Government launched its Electric Vehicle Strategy with an investment of up to $595 million to be outlined in the next state budget to increase EV sales by 52% by 2030-31. Increasing accessibility to chargers, removal of stamp duty for EVs under $78,000 and providing the aforementioned rebates are a good start in driving initiatives to build consumer confidence and interest in EVs. Further collaboration between states and similar funding programs will be critical to furthering the transition towards cleaner transport.

How can we do better?

The Climate of Nation report carried out by the Australia Institute, showed that whilst a large majority of Australians support the further implementation of EV policies and strategies, 68% believe that the Federal Government ought to be doing more to increase EV uptake in Australia. The solution is no easy fix, although there are different implementation schemes which could aid governments' efforts to improve fuel supplies through the EV sector.

Studies have indicated that incentive-based policies will stimulate more interest in the uptake of EVs in lower-income households than in higher-income households as these were found to be more likely to switch to electrification regardless of incentives. One of the main barriers affecting EV uptake is affordability and a substantial amount of EV uptake success will rely on how quickly it can reach price parity with ICE vehicles. Introducing tax rebates for EVs and their charging stations will help to decrease reliance on foreign fuel. Funding should also be directed towards reducing Australia's petrol demand and creating fuel standards which have been successful overseas, particularly in Europe.

Australia doesn't yet have a concrete set of standards. If you have purchased a new car since 2008, you are likely to see a sticker on it indicating the fuel economy and emissions per kilometre. However, this is really the extent of our emissions mitigation efforts, with The Grattan Institute and both local heads of Volkswagen and Nissan voicing frustration with the lack of efforts to incentivize EVs in Australia and the lack of a competitive market in the absence of such standards. Without specific emission standards and no clear financial impetus to choose electric over ICE vehicles, manufacturers have not felt obligated to supply EVs to Australia in the volume required to truly accelerate the transition.

Targeted government policy is also essential. On the campaign trail, the newly elected Labor Government promised a range of strategies to expedite the use of EVs across Australia. Such proposals included discounts to make EVs more affordable and pledging a new $500 million 'drive the nation' fund, with the specific purpose of allowing the Commonwealth to co-invest in EV chargers. These proposals are a positive first step, and the Federal Government is encouraged to fulfil its promises and to capitalise on the many opportunities that an EV revolution presents.

It is imperative, now more than ever, to focus efforts on transitioning from ICE vehicles and integrating more EVs into our everyday mobility. There's no better time than now to turn Herbie electric.

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Hydrogen as a Transport Fuel

Published: July 2022

Hydrogen is fast becoming a viable fuel for heavy-duty transport in Australia. With projects now underway to construct a network of refueling infrastructure in multiple states, we explore the barriers to establishing hydrogen as a commercial fuel.

Hydrogen vs Petrol

Hydrogen is not governed by a unified regulatory framework. Whilst Australia's federal and state governments are supportive of developing a national hydrogen industry, the current approach is for each state and territory to create its own set of hydrogen policies. This leads to inconsistencies in the requirements to develop hydrogen projects, as well as a divergence in how the type of hydrogen (such as green or blue) is determined. These types of misalignments create unnecessary hurdles to cross-border hydrogen coordination.

However, inconsistencies can be overcome, as is evident from the Hume Hydrogen Highway project which aims to build a renewable hydrogen refueling network across three states along Australia's eastern seaboard.

A 2018 study by ARENA and the University of Queensland identified safety as a key concern when it came to the public perception of hydrogen, and adequate safety tests were deemed an 'extremely important' factor for the participants to feel comfortable with the introduction of hydrogen-fueled vehicles.

To resolve these safety concerns, the study proposed introducing hydrogen-fueled public transport. This would allow consumers to become familiar with new technology and infrastructure, before making hydrogen fuel available for private use. Such initiatives are underway, with Queensland planning to introduce a fleet of 120 hydrogen fuel cell buses by 2040. Victoria will also soon start a $20 million Zero Emissions Bus Trial which will roll out two hydrogen fuel cell buses for use in school and public transport services in its western suburbs.

The cost of hydrogen was the next concern identified in the ARENA study, with some participants believing that the higher cost of hydrogen fuel and vehicles may be a turn-off for consumers. However, this concern was off-set by arguments that the cost of petrol would only increase in future, leading to hydrogen being a cheaper long-term option.

Storing and Transporting Hydrogen

Hydrogen can be stored as a gas or a liquid, but its unique properties (such as having the highest energy per mass of any fuel and a boiling point of -252.9°C) call for specific safety requirements. Storing hydrogen as a gas means using large-volume, high-pressure tanks, while storing it as a liquid has the additional requirement of using cryogenic temperatures to prevent boiling.

These properties require specific infrastructure to ensure that hydrogen can be supplied and stored in quick, easy and safe ways at refuelling stations.

One option is to physically deliver stores of hydrogen to refuelling stations, but due to hydrogen's volatility and strict storage requirements, there are only a few established transport methods. One method is road transport using cryogenic liquid tanker trucks or gaseous tube trailers. Hydrogen can also be transported via pipelines which utilise a mix of metering stations, control valves, gates and storage facilities to directly 'funnel' hydrogen from the point of production to the point of use.

To address the transport challenge, Toyota Motors recently developed a new hydrogen storage module which utilises high pressure hydrogen tank technology to store up to 18.7kg of hydrogen for use in automobiles, with the potential to be developed for use by railways, shipping and fuel cell generators.

Electrolysers at Petrol Stations

An alternative to transporting hydrogen to refuelling stations would be to produce it on site by way of an electrolyser.

An electrolyser produces hydrogen through the process of electrolysis. By taking in water and converting it to its component parts – hydrogen and oxygen – the electrolyser releases oxygen but retains and stores hydrogen for future use.

Some projects to construct hydrogen refuelling stations include an electrolyser as a key part of the plan. For example, Viva Energy recently announced its $43.3 million plan to build a public hydrogen refuelling station at its Geelong refinery site, which includes the construction of a 2MW electrolyser. The site will be operational by 2023/24 and, once complete, should have capacity to refill 10 trucks every 1.5 hours.

Electrolysers may also be used to retrofit existing petrol stations to become hydrogen production facilities. However, since electrolysers run on electrical energy, a prerequisite would be to upgrade the electricity network in Australia.

In 2021 Toyota Australia announced plans to construct a hydrogen production facility and refuelling station out of its decommissioned car factory in Altona, Melbourne. With funding from ARENA, this facility incorporates a 200kW electrolyser, 84kW personal solar array, 100kW battery and stationary fuel cell to generate electricity to power the site. The project has been dubbed by Toyota as an 'early-stage testing ground' for the further development of hydrogen technology.

Conclusion

It is clear that hydrogen fuel has the potential for mainstream use in Australia. The advances in safety, convenience and utility of hydrogen through the development of storage modules and electrolysers will ensure that hydrogen will be viewed as a viable alternative source of fuel in Australia.

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Matt has over 17 years' experience, particularly focused in the energy sector. Matt's has considerable expertise in project development, construction, financing, joint ventures, and mergers and acquisitions transactions. He specialises in legal advice throughout the energy and infrastructure lifecycle, and acts for investors, developers, and constructors of solar, thermal, wind, hydrogen, electricity transmission, waste to energy and energy storage projects in Australia and the APAC region.

Matt's expertise also includes drafting and negotiating project and finance agreements, EPC and O&M agreements, connection and access agreements, and power purchase agreements. Matt also has extensive experience managing non-recourse project financing, including parallel bank negotiations, due diligence and transaction documentation.

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Andrew leverages his attention to detail and collaborative nature to cultivate strong relationships with his colleagues and clients, working together to deliver optimal outcomes. Andrew has practised as a projects lawyer in both Sydney and Dubai, and has been expanding his skillset in the energy space since his return to Sydney in 2021.

Andrew has a passion for navigating complex issues, particularly in the renewable energy space. He specialises in renewable energy projects including wind, solar, energy storage, waste-to-energy and hydrogen. Andrew has experience working on a variety of contracts, including EPCs, O&Ms and PPAs.

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As an energy, infrastructure and resources specialist, David has a passion for law and looking at problems with a logical and strategic lens, using his extensive knowledge and skills of the market to find positive outcomes for clients.

David has expertise in energy, infrastructure and resources, as well as project development and construction. In particular, David's expertise includes drafting and negotiating project agreements, EPC and O&M agreements, connection agreements and other construction contracts (including D&C and construct only contracts).

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Cedric has over 7 years' experience in the energy sector. Cedric has considerable expertise in project development, construction, financing, energy related transactions and general commercial transactions. He specialises in advising clients involved in the energy lifecycle and has acted for solar, wind and energy storage investors and developers, as well as energy off takers, such as crypto minors and data centre providers. Cedric also has vast expertise in advising electricity retailers. He was previously the Young Energy Professionals' co-chair of the Australian Institute of Energy.

Cedric's expertise includes negotiating and drafting on-market and off-market power purchase agreements, finance agreements, and grant and bank financing arrangements.

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Adriaan is a problem-solver with a passion for finding creative, people-oriented solutions for his clients. He is passionate about leaving the world better than we found it, which aligns perfectly with his role in our New Energy team. Adriaan began practising as an energy and projects lawyer in Africa, before expanding his skill set by practising construction law in Sydney.

Adriaan advises the public and private sector on infrastructure development, power projects, construction, regulatory matters and energy related disputes. He has extensive experience in advising on the technologies of wind, solar PV, CSP, landfill, biomass, gas, coal, nuclear and hydro. Adriaan's other work includes transmission, distribution and procurement related assignments.

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