New Energy Quarterly

Powering Movement

November 2024

Hamilton Locke

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Editorial

As the world collectively accelerates toward a cleaner, more sustainable future, the role of transportation in reducing carbon emissions has become pivotal. As governments, industries, and consumers increasingly recognise the need to transition towards net-zero, the transport sector is undergoing a profound transformation. In Australia, this shift is not merely a regulatory obligation but also a pivotal opportunity to reshape the nation's transport systems in ways that are cleaner, more efficient, and aligned with global climate goals.

In this New Energy Quarterly, we bring together a range of perspectives, insights, and analyses on how electric vehicles (**EVs**), hydrogen fuel cells, hydrogen derivatives, biofuels and other alternative energy sources are reshaping Australia's transport sector. From road to rail and sea to air, the articles in this issue tackle key challenges and opportunities that will define the future of mobility.

Our first article covers a broad range of solutions required to meet the net-zero targets across different transport modes. While EVs have gained significant attention in passenger transport, other sectors, such as aviation and maritime, require more tailored solutions, such as sustainable fuels and hydrogen.

At the heart of this transformation is the evolution of Australia's EV market. Next up, we explore the rapid growth of EV adoption in Australia, driven by government incentives, falling battery costs, and a shifting consumer mindset. Despite being slower to embrace EVs than some of its global counterparts, Australia is now on the cusp of significant change. The next decade is set to be a defining period for the nation's EVs.

Building on this, the third article examines the use of EVs as bi-directional charging units, a concept that holds enormous potential. By enabling EVs to supply power back to the grid, Australians could better manage their energy use, especially during peak demand. The rise of bi-directional charging technology marks a new phase in how we think about energy distribution and storage.

However, the widespread adoption of EVs brings with it new challenges, particularly around the need for charging infrastructure. Our fourth article dives into the investments and innovations needed to ensure that Australia has the capacity to support a growing fleet of EVs. The current network of chargers remains limited. As the market grows, so must the infrastructure to accommodate it, and the development of fast and ultra-fast charging stations will play a crucial role.

Vehicle efficiency standards are another critical component in reducing emissions and ensuring Australia meets its climate goals. Our fifth article examines Australia's long and arduous path to vehicle efficiency standards, which are due to be implemented in January 2025. It is hoped that implementing these standards will not only reduce emissions but also encourage manufacturers to innovate, driving competition and delivering better vehicles to consumers.

Investors are already taking note of the emerging opportunities within the EV sector. The sixth article offers an insightful analysis of investing in EVs in Australia, highlighting the financial and environmental incentives driving investment in this area.

Of course, as more EVs enter the market, questions about the challenges of recycling lithium-ion batteries become increasingly pertinent. The seventh article examines the environmental and logistical hurdles associated with recycling these batteries, from recovering valuable materials to minimising waste. It also touches on emerging technologies that aim to make battery recycling more efficient and sustainable.

The publication shifts gears in the eighth article, where we explore how hydrogen fuel cells compete with EVs. The article examines the pros and cons of both technologies, and whether hydrogen has a future alongside EVs in Australia's transport landscape.

The hydrogen versus electric debate continues in the ninth article. Road freight, with its reliance on heavy-duty vehicles, presents unique challenges for decarbonisation. The potential for electric trucks, hydrogen-powered heavy vehicles, and innovations in fuel efficiency offer possible pathways to reducing emissions in this sector. However, the transition will require substantial investment in both technology and infrastructure.

Continuing the theme, the tenth article investigates hydrogen versus electric trains, delving into how Australia's rail sector can decarbonise. With its vast rail network, the shift to zero-emission trains will be critical in meeting national climate goals, but the question remains: which technology will come out on top?

Finally, we look beyond land transport in our eleventh and twelfth articles where we delve into the aviation and maritime industries, two of the hardest sectors to decarbonise. In aviation, sustainable fuels, electric aircraft, and hybrid technologies are in development, while the shipping industry is looking at biofuels, hydrogen, and ammonia to reduce its carbon footprint.

Together, these articles offer a comprehensive overview of the transportation challenges and opportunities facing Australia. As the country continues its journey towards decarbonisation, the conversation around EVs, hydrogen fuel cells, and alternative fuels will only grow more urgent.

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Watt's Happened at Hamilton Locke

Matt Baumgurtel; Jo Ruitenberg; Marni Riley; William Ryan; Ally Frizelle; and Lachlan Stagoll attended both days of the All Energy Australia Conference in Melbourne.

Read our key takeaways from Day 1 **here** and Day 2 **here.**

The Hamilton Locke New Energy team attended the Clean Energy Summit 2024.

Read our key takeaways **here** for Day 1 and **here** for Day 2.

Kusum K C from the Hamilton Locke Sydney New Energy team attended Day 1 of the AWRE - Australasian Waste & Recycling Expo.

Read our key takeaways **here.**

The Hamilton Locke New Energy team attended the Large-Scale Renewable Generation and Storage Summit hosted by the Smart Energy Council.

Read our key takeaways **here.**

Adriaan van der Merwe and Will Ryan hosted the New Energy Associates Network (NEAN) fireside chat with Dr Madeline Taylor.

Read our key takeaways **here.**

Jo Ruitenberg, Matt Baumgurtel and Ally Frizelle attended the Clean Energy Investor Conference hosted by the Clean Energy Investor Group in Melbourne.

Read our key takeaway **here.**

The Hamilton Locke New Energy team was delighted to attend Unlocking QLD's Potential: The Vital Role of Green Electrons in Advancing Green Molecule Projects, hosted by the **Australian Institute of Energy** on the role of alternative fuels to power the transition to renewable energy, key challenges and considerations for the future.

Read our key takeaways **here.**

The Hamilton Locke New Energy Team: Matt Baumgurtel; Amelia Prokuda; Adriaan van der Merwe; Marni Riley; Megan Chau; and Kusum K C attended RiverCity Renewables Women in Energy which emphasised the need to be conscious of our gender biases and create a flexible work environment to nurture and support all genders.

The 3rd Annual Hydrogen Connect Summit was a roaring success. The event was capped off by the lively 'H2 Debate in the pub' in which our very own Matt Baumgurtel was on the winning team, confirming that Hydrogen will make us happy!

Read our key takeaways from the summit **here.**

Adriaan van der Merwe is pictured presenting on Connecting Continents: What Africa and Australia can teach each other about new energy.

Read our key takeaways from the conference **here.**

Matt Baumgurtel and David Wan attended the Australian Hydrogen Research Conference in Perth.

Read our key takeaways **here** for Day 1, **here** for Day 2 and **here** for Day 3.

Matt Baumgurtel; Tricia Moloney; Adriaan van der Merwe; David O'Carroll; William Ryan; Perri Robinson; and Chiara Ciulli attended the annual networking event co-hosted by Hamilton Locke and Energy Vault in Melbourne.

Market Insights

On 11 October 2024, the Clean Energy Regulator released a consultation paper inviting feedback in relation to the new Unit and Certificate Registry which will replace the Australian National Registry of Emissions Units as the main registry for participation in the Australia carbon market.

Read more

On 30 September 2024, the Queensland Government's updated version of State Code 23: Wind farm development came into effect, following community consultation and review of the existing Code and the associated Planning Guidance. Wind farm development applications will now be assessed against this new Code.

Read more

The AEMC released a draft rule on 26 September 2024, proposing to formalise AEMO's role in managing cyber security risks in the National Electricity Market. Feedback is invited by 7 November 2024 to refine these responsibilities.

Read more

On 25 September 2024, AEMO released a draft report amending the Inertia Requirements Methodology to ensure grid stability in the National Electricity Market. Starting December 2024, new requirements will guide Transmission Network Service Providers (**TNSPs**) and assets like generators and battery storage to support inertia, with TNSPs mandated to procure inertia by December 2027.

Read more

On 13 September 2024, the Australian Government released its 2024 National Hydrogen Strategy and its vision for a "clean, innovative, safe and competitive hydrogen industry that benefits Australia's communities and economy, enables our net zero transition, and positions us as a global hydrogen leader".

Read more

On 12 September 2024, the Future Made in Australia (Guarantee of Origin) Bill 2024 was introduced into Parliament by the Department of Climate Change, Energy, the Environment and Water (**DCCEEW**). This marks a pivotal step in Australia's clean energy transition, establishing a framework to track and verify low-emissions products and creating an enduring certification mechanism for renewable electricity.

Read more

On 2 September 2024, the Australian Energy Market Operator (**AEMO**) released a public consultation report on the technical requirements for the connection of 200kW to 5MW distributed energy resources to the National Energy Market.

Read more

On 22 July 2024, Western Australia signed a Renewable Energy Transformation Agreement with the Federal Government and opened registration for the first Capital Investment Scheme Tender in the state.

Read more

On 4 July 2024, the long-anticipated Future Made in Australia Bill 2024 was introduced by the Australian Government. The Bill enforces the Government's commitment to invest $22.7 billion in the Future Made in Australia package, which was announced under the 2024-25 Federal Budget.

Read more

On 28 June 2024, the Treasury released a consultation paper seeking feedback on the Hydrogen Production Tax Incentive introduced under the 2024-25 Budget as part of the Future Made in Australia package. This incentive aims to accelerate Australia's hydrogen industry by offering a refundable tax offset to eligible producers of renewable hydrogen. On 12 July 2024, the consultation period closed.

Read more

On 26 June 2024, AEMO release the 2024 Integrated System Plan (**ISP**) for the National Electricity Market (**NEM**). This is AEMO's latest investment roadmap for the transition of the NEM, with a clear plan for essential infrastructure to meet future energy needs.

Read more

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Market Recognition

Hamilton Locke Continues to Top National ECM and M&A Rankings!
Hamilton Locke has received top rankings in the 2024 Australian ECM and M&A rankings recently released in LSEG and Mergermarket for its work advising on deals for issuers and lead managers for the first half of 2024.

Read more

Hamilton Locke's recognition in the 2024 IFLR1000 guide
A number of Hamilton Locke's practices and lawyers have been included in this year's ranking in the IFLR1000 guide, including Matt Baumgurtel as Highly Regarded; Margot King as Notable Practitioner; and David O'Carroll as Rising Star. The Hamilton Locke Projects team has also ranked as Tier 4, reflecting Hamilton Locke's continued commitment to delivering exceptional work for its clients.

Read more

Lexology In-Depth Renewable Energy Law in Australia
The Hamilton Locke New Energy team contributed to the latest edition of Lexology In-Depth Renewable Energy Law in Australia.

Read more

Mondaq's Spring 2024 Thought Leadership Award
Matt Baumgurtel named as the winner for Energy and Natural Resources in Mondaq's Spring 2024 Thought Leadership Awards.

Read more

Lexology Recognises Matt Baumgurtel as a Leading Legal Influencer in Infrastructure for Q3 2024
New Energy Partner and Lead Matt Baumgurtel has been recognised by Lexology as a Leading Author in their Q3 2024 Legal Influencers for *Infrastructure in Australasia*. This prestigious acknowledgment highlights our team's commitment to delivering insightful and practical legal analysis that informs and supports our clients and the broader community. Being named a Legal Influencer reflects our dedication to providing valuable perspectives that help navigate the evolving infrastructure landscape.

Read more

Hamilton Locke Shortlisted for Legal Advisory of the Year and M&A Deal of the Year at 2024 Energy Storage Investment Awards
Hamilton Locke is honoured to be shortlisted for *Legal Advisory of the Year* and *M&A Deal of the Year* in the first-ever Energy Storage Investment Awards by Tamarindo. These nominations reflect a year of impactful work on pioneering energy storage and renewable projects that drive Australia's energy transition forward. We are grateful to Tamarindo for this recognition and look forward to celebrating with our industry peers on 3 December 2024.

Read more

New Energy Senior Associate William Ryan Shortlisted for Rising Star of the Year
We are thrilled to announce that New Energy Senior Associate William Ryan has been shortlisted for *Rising Star of the Year* at Tamarindo's inaugural Energy Storage Investment Awards. This prestigious category celebrates professionals with 5-10 years of experience who are achieving outstanding results and driving innovation within the energy storage sector. Will's recognition highlights his dedication and impactful contributions to advancing the industry.

Read more

Australasian Lawyer and NZ Lawyer Feature Hamilton Locke as a Law Firm of the Year
Hamilton Locke is delighted to be recognised as one of the best law firms in Australia in the *Law Firms of the Year* report, released by Australasian Lawyer and NZ Lawyer. Their report compiles crucial market indications such as financial performance, client growth, diversity and recruitment to assemble a list of the top 30 Australian and New Zealand based firms. The selection underlines the impressive performance of Hamilton Locke in the past 18 months and reflects

Read more

New Energy Partner and Lead Matt Baumgurtel Named a Dealmaker of the Year
Australian Lawyer and NZ Lawyer's inaugural Dealmakers of the Year list celebrates the top 25 dealmakers from Australia and New Zealand's legal profession, chosen based on quantity, quality, importance and innovation of their deal involvements. We are thrilled to see Matt recognised for his ongoing dedication to the sector!

Read more

Hamilton Locke recognised in the 2025 Edition of Best Lawyers in Australia
Hamilton Locke has once again been recognised in the 17th edition of The Best Lawyers in Australia Report, Best Lawyers: Lawyer of the Year Awards and Best Lawyers: One to Watch list. Our partners have been recognised across 17 practice areas.

Read more

Client Choice Awards 2024
Hamilton Locke was named a winner in the Client Choice Awards 2024 in the category 'Most Innovative Law & Related Services Firm'.

Read more

Partner of the Year Awards
Matt Baumgurtel and Jo Ruitenberg are named finalists in Lawyers Weekly's 2024 Partner of the Year Awards.

Read more

New Starters at Hamilton Locke

Partner
Gaynor Tracey
Madeleine Kulakauskas

Special Counsel
Chris Deeble

Senior Associate
Amy Whyte

Lawyer
Lachlan Chapman
Bernice Lum
Lachlan Stagoll
Jackson Price
Molly Kemp
Chanse Soth
Minji Kim

Consultant
Anna Mouat
Tim McAlpine-Scott
Daiki Yamagami

Graduate
Tom Lewsey

Paralegal
Nidhi Prakash
Rachael Chow
Lachlan Murrell
Lily Clements-Markham
Grace Mudge
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Jasper Wong
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Watt's Next? Sustainable Fuels

SPOTLIGHT

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What was your journey to becoming a lawyer?

I studied law and finance at university in Brisbane. At first, I didn't intend to practice law but I enjoyed the law subjects so much more than finance, I quickly changed my mind. I worked part-time during university but was fortunate to obtain a part-time paralegal role at a Brisbane firm in my penultimate year of university. My first project was cataloguing a giant room full of documents for discovery, it took months. After graduating, I completed a graduate clerkship at the same firm. I did rotations in planning and environment and major projects, and I never looked back. During my career, I have made some wonderful friendships with colleagues and clients. I have also had the opportunity to work on a variety of interesting, challenging and rewarding projects.

Tell us about your specialisation (include information on what excites you about current market developments)

I specialise in environmental and planning law. I work with different types of clients to resolve environmental and approvals issues that arise during all phases of the life of a project. This can range from providing strategic advice about the approvals pathway at the project inception stage right through to acting in litigation to secure the necessary planning and environmental approvals to facilitate a project. I also provide advice about infrastructure issues, land contamination and enforcement matters. The New Energy team hasn't paid me to say this but it goes without saying, I am excited by the work associated with the current renewable energy transition in Australia. There is so much opportunity in the space and some really fascinating projects being developed to diversify our energy sources. People in the renewable energy industry are collegiate, full of enthusiasm and always a pleasure to work with.

What are your career highlights?

Most recently, I acted for a sustainable waste management provider in successfully defending judicial review applications relating to a decision by the State Government to 'call in' the provider's development application for a large recycling park in Queensland. The proceedings were commenced by commercial competitors and local residents. They raised grounds of review including apprehended bias. It was hard fought and involved multiple parties. Even though the provider was successful in the proceeding, the State Government ultimately decided to only approve the project in part, so it was somewhat of an empty victory. Another highlight has been joining Hamilton Locke as a partner.

Why did you join Hamilton Locke?

Hamilton Locke's values (high performance, agility, leadership and openness) strongly resonate with me. I was impressed by the firm's fast growth and the calibre of lawyers who were joining. I was excited by the opportunity to work at a firm that was culture-led with a strategy that focused on championing people to collaborate and do their best work for clients. I am happy to say that Hamilton Locke genuinely 'walks the talk' and I have seen the difference it makes for our people and our clients.

RISING STAR

Ching Yee Tan

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

Looking back on my career, I am most proud of my ability to adapt and transition between roles in different jurisdictions and sectors. Navigating changes is not always easy but I relish the challenge (and opportunity) a change of scenery provides.

What do you enjoy about working in the legal industry?

Nothing beats the rush of getting transactions across the line against all odds! On a day to day basis, I enjoy solving problems and helping clients navigate complex issues while aligning their legal obligations with their broader business goals. Being a front end, real estate lawyer is particularly satisfying for me as the environment is often collaborative and the results are physically tangible.

What do you enjoy most about Hamilton Locke?

While most firms will say they value the development of their people, few go to the lengths that Hamilton Locke does with the DaVinci program amongst the initiatives. I am also impressed by the firm's emphasis on a cultivating a collaborative culture free from unnecessarily reverential hierarchical constraints common in big law.

In your opinion, how does HPX Group empower communities?

By committing to the holistic well-being of its people and fostering a supportive environment, HPX enables its people to thrive and make positive contributions both in the workplace and the wider community.

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

I will be undertaking a pottery course at TAFE this year. I see it as an outlet for creativity, an opportunity to work with my hands and disengage from the intellectual stresses of work.

Favourite movie and why?

I don't have the attention span for movies but will happily finish entire seasons of TV shows in a weekend. Current favourites are Succession and The Gentlemen.

Favourite cuisine/meal?

Hands down the best cuisine in the world is Malaysian and no one can convince me otherwise (I may be biased).

Watt is ARENA Funding?

Program	Summary	Funding available	Closing Date
Hydrogen Headstart Round 2	Hydrogen Headstart Round 2 was announced in the May 2024 Federal Budget. The Program will provide up to $2 billion of revenue to support large-scale renewable hydrogen production projects. Further information on Hydrogen Headstart Round 2 will be made available in the second half of 2024.[1]	AUD $2 billion	In development. Applicants can register their interest to get updates on information about Hydrogen Headstart Round 2 when it becomes available.
Battery Breakthrough Initiative	The Battery Breakthrough Initiative was announced in the May 2024 Federal Budget. The program will provide $523.2 million to promote the development of battery manufacturing capabilities in Australia.	AUD $523.2 million	In development. Applicants can register their interest to get updates on information about Battery Breakthrough Initiative when it becomes available.
Solar Sunshot	The Solar Sunshot program will support Australia's photovoltaic (**PV**) manufacturing capabilities. The program aims to support innovative manufacturing facilities in Australia across the solar PV supply chain. The solar PV supply chain includes polysilicon production, production of ingots, wafers, solar PV cells and solar module assembly. The program may also support complementary aspects of the solar PV supply chain such as solar glass, module frames, deployment technology and other innovation or manufacturing elements required for solar deployment.[2]	AUD $1 billion	Ongoing. Round 1 funding launched in August 2024, with Round 1A Expression of Interest due on 10 December 2024 and Round 1A Full Applications due on 30 April 2025.
Advancing Renewables Program (ARP)	The ARP awards grants to a range of projects that seek to: • optimise the transition to renewable electricity; • commercialise clean hydrogen; and • support the transition to low emission metals.	Up to AUD $50 million	Ongoing.
Powering the Regions Industrial Transformation Stream	The Industrial Transformation Stream seeks to support existing industrial facilities, and new clean energy developments, in regional areas to reduce their emissions, in line with Australia's 2030 targets and in support of reaching net zero by 2050.	AUD $400 million	Ongoing.
National Industrial Transformation Program	A range of technology solutions targeting industrial emissions abatement may be supported, from electrification and energy efficiency to fuel switching and zero emissions vehicles. Enabling technologies such as energy storage, demand management and critical infrastructure supporting onsite decarbonisation will also be considered. Projects can range from studies to scale demonstration and deployment.	AUD $40 million	Ongoing.
Regional Microgrids Program (RMP)	The Regional Microgrids Program (**RMP**) aims to support the development and deployment of renewable energy microgrids across regional Australia that contribute to the Program Outcomes. Funding has been allocated across two Streams under the Program, each with its own Outcomes: 1. **Stream A – Regional Australia Microgrid Pilots** – to fund Projects that contribute to the innovation and/or acceleration of developing and deploying equipment that enables the coordinated use of distributed renewable energy technologies, improving the resilience and reliability of electricity supply in regional areas and addressing barriers to deployment of microgrid solutions. 2. **Stream B – First Nations Community Microgrids** – to fund Projects that contribute to the provision of cleaner, cost effective and reliable energy in First Nations Communities and empowering these Communities to participate in electricity supply arrangements and the development of energy infrastructure.	Total AUD $125 million Stream A - $50 million Stream B - $75 million	19 December 2025.
Driving the Nation Program	The Program is focused on accelerating the uptake of Zero Emission Vehicles (**ZEVs**). ZEVs include Battery Electric Vehicles, Hydrogen Fuel Cell Vehicles and biofuel vehicles. The Program has various focus areas that will be funded (**Focus Areas**). On 9 November 2024, ARENA allocated an additional $36 million towards three focus areas aiming to support demonstration and deployment of heavy vehicles, charging solutions and other innovation supporting uptake of Battery Electric Vehicles.[3]	AUD $500 million	Ongoing.
Clean Energy Innovation Fund (CEIF)	Seeks to fund emerging Australian technologies and businesses to speed the nation's transition to a renewable economy.	Up to $200 million[4]	Ongoing.

[1]Australian Renewable Energy Agency, *Hydrogen Headstart Round 2* (Web Page) <https://arena.gov.au/funding/hydrogen-headstart-round2/>.

[2]Australian Renewable Energy Agency, *Solar Sunshot* (Web Page) <https://arena.gov.au/funding/solar-sunshot/>.

[3]Australian Renewable Energy Agency, Driving the Nation (Web Page) <https://arena.gov.au/funding/driving-the-nation-program-2/>

[4]Clean Energy Finance Corporation Investment Mandate Direction 2023 subsection 16(1).

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Fuelling the Future: Australia's Path to Net Zero Transportation

Authors: Matt Baumgurtel, David O'Carroll

The transport sector is a significant contributor to the nation's emissions at 21 per cent,[1] accounting for 3.8 tonnes of CO2 per capita (excluding aviation).[2] Against this backdrop, CO2 emissions from the transport sector must fall by more than 3 per cent per year until 2030 to ensure that Australia is on track to meet its Net Zero target.[3]

In this article, we explore the best fuel for each mode of transport, drawing on consumer and investor sources of anxiety: cost, range, and infrastructure challenges.

Cars and Light Commercial Vehicles (LCVs)

Electric Batteries in Cars

In 2023 it was reported that cars and LCVs are responsible for 60 per cent of emissions in the Australian transport sector and 10 per cent of emissions overall.[4] Consumer concerns regarding range and cost have stimulated efforts at both federal and state government levels to encourage the uptake of electric vehicles (**EVs**) by offering AUD$3000 rebates,[5] as well as an AUD$171 million investment in EV charging facilities over four years as part of the NSW Electric Vehicle Strategy,[6] and an AUD$500 million commitment as part of the National Electric Vehicle Strategy.[7]

The 2024-25 Federal Budget (the **Budget**) committed to provide AUD$154.5 million over six years commencing on 1 January 2025, plus AUD$12.6 million annually thereafter, to implement a New Vehicle Efficiency Standard (**NVES**), compliant with the New Vehicle Efficiency Standard Act 2024. The NVES is aimed at enhancing fuel-efficient vehicle options to lower transport emissions.

The Budget funding includes AUD$84.5 million over five years to establish a regulatory body for administering the NVES, which includes gathering comparable data with international counterparts. The Budget also allocates AUD$60 million over four years for electric vehicle charging infrastructure.[8]

The uptake of EVs is well-positioned to foster investor confidence in the production and supply of charging facilities to be rolled out at a national level.

Driving Green or Grey?

Despite the rapid charging speed of hydrogen vehicles, Toyota's Carbon Policy Manager, Andrew Willis, admits hydrogen "infrastructure is limited" and is therefore "holding up wider adoption".[9] With a keen emphasis on achieving Net Zero targets, the amount of electricity required for hydrolysis presents inefficiencies in hydrogen production. Moreover, a staggering 96 per cent of the hydrogen production is categorised as grey hydrogen.[10] Despite the cost advantage of grey hydrogen at approximately AUD$1-2 per kg, compared to green hydrogen at approximately AUD$5-7 per kg, grey hydrogen relies on fossil fuel sources, thus undermining Net Zero targets.

The Budget aims to achieve this through the introduction of the Hydrogen Production Tax Incentive (**HPTI**). The HPTI promises refundable tax credits of AUD$2 per kg of renewable hydrogen produced at qualifying facilities from 1 July 2027 to 30 June 2040. These credits will be available for up to ten years for projects that secure final investment decisions by 2030.

Further information is available in our recent article Hydrogen on the Horizon: Unpacking Australia's New Hydrogen Production Tax Incentive.

Overall, strong Federal infrastructure support resulting in increased investor and consumer confidence positions EVs as a more pragmatic option compared to hydrogen cars and LCVs.

Heavy Duty Trucks

The International Council of Clean Transportation claimed that a switch to battery-electric trucks could save up to 63 per cent greenhouse gas emissions over the vehicle's lifecycle, with a further 84 per cent reduction when solely using renewable energy.[11] The use of battery electric trucks has sparked government interest. In 2023, the Australian Renewable Energy Agency (**ARENA**) granted AUD$20 million to Team Global Express for the purchase of 36 medium and 24 light battery electric trucks, and AUD$20.5 million to support financing battery electric trucks purchased through the Clean Energy Finance Corporation and Taurus Motor Finance agreement.[12]

More recently, the Budget has allocated an investment of AUD$115 million in a battery electric bus depot under the Zero Emission Bus Transition Strategy that will introduce 1,200 new electric buses by 2028.[13]

ARENA has also allocated an additional $36million through the Driving the Nation Program towards three focus areas aiming to support demonstration and deployment of battery electric trucks, charging solutions and other innovation. This brings available funding to the take up of battery electric trucks in the logistics and delivery sectors to $100 million.[14]

Why Don't We Make the Switch?

While EV batteries provide a compelling solution to reducing emissions, the size and weight of the battery used in trucks is problematic to handle, ship, and poses significant fire risks. Specialist training and co-ordination across the supply chain on an inter-state basis must be achieved to make this a feasible option.

The Budget allocated AUD$523.2 million through the Battery Breakthrough Initiative. This will be administered by ARENA to advance battery manufacturing capabilities in Australia through targeted production incentives. An additional AUD$20.3 million will support the Building Future Battery Capabilities to scale up and improve standards within value chains to enhance battery manufacturing for the transport sector, including heavy vehicles.[15]

Despite Federal and State commitments to invest in EV charging infrastructure, 'range anxiety' from truck drivers and owners remains. The lack of charging points in remote areas across long journeys makes the switch to EV batteries a less favourable option. If consumer and investor confidence is restored, the Electric Vehicle Council predict that 100 per cent of the national fleet will be electric by 2040 meaning that ample energy generation for EVs would be required to avoid severe grid impacts.[16]

Power Without the Bulk

Although hydrogen is unlikely to be a good fit for cars and LCVs, the combination of its rapid fuelling time and similar range to fossil fuel offers a superior solution for trucks when compared to EVs. Additionally, the AUD$80 million investment in hydrogen refuelling networks on key freight routes could promote a similar "turnkey" service to that seen in South Korea.[17] This approach bridges gaps in the supply chain by manufacturers also guaranteeing a network of green hydrogen refuelling stations across standardised routes, as well as promoting job opportunities and investment in remote areas.

Based on this, hydrogen is poised to emerge as the preferred solution over EV batteries in trucks, due to the lack of weight restrictions and perceived consumer range anxiety.

Trains

Much like trucks, trains are likely to encounter challenges related to the size and weight of batteries, as well as experiencing lengthy charging times and causing subsequent grid impacts. However, the fixed rail routes and existing infrastructure could be more easily

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tapped into to make recharging EV batteries a problem of the past. Germany rolled out a hydrogen fuelled trainline in 2018 and has experienced great success that was quickly offset by the excessive manufacturing and running costs. Going forward, Germany will be replacing the remaining diesel trains with electric battery trains, not hydrogen.[18]

Recent industry consultations on the Australian Railway Association's forthcoming rollingstock decarbonisation critical path have identified that energy supply will be a critical factor in determining the commercial viability of these new technologies.[19] Ultimately, despite the success of hydrogen trains, the lower cost and competitive efficiencies of electrical battery powered trains are likely to attract better consumer and investor confidence.

Shipping

Shipping accounts for around 3% of global CO2 emissions but continues to face challenges in transitioning to alternative fuels such as hydrogen, ammonia, or other biofuels.[20] The Danish shipping giant, Maersk has begun to make the move to greener fuels, but an industry wide transition would require a regulatory overhaul and a harmonised approach from shipping developers and manufacturers.

Electric batteries are an unlikely contender for the shipping sector due to the lengthy re-charging times. However, Australia is well-equipped to supply and transport ammonia and hydrogen, particularly since the AUD$30 million partnership between Singapore and Australia to create a 'green shipping corridor' by 2050.[21]

Ammonia has also been hailed as a potential long-term near net zero shipping fuel with fewer barriers to market entry. Although much of our existing exposure to ammonia has not been as a shipping fuel, the International Code of the Construction and Equipment of Ships Carrying Liquefied gases in Bulk codifies the requirements of ammonia as shipping fuel.[22] As well as toxicity to humans and wildlife, the low density of ammonia,[23] compared to hydrogen, would require it to be stored at higher volumes, reducing the capacity to carry cargo resulting in reduced profit margins. Like hydrogen, the availability of green ammonia is limited, and whilst regular ammonia does not produce CO2, it does produce N2O,[24] a more potent alternative.

The large-scale uptake of green hydrogen will need to be backed by large investments to facilitate the specialist storage containers which are at temperatures of around −253°C. The key challenge is large scale production and shipping manufacturers who are likely to turn to additional fuel sources, such as biofuel, until hydrogen can be produced and stored at a sufficient scale to meet demand. The Australian landscape lends itself well to the mass production of biofuels and many ship engines would not require substantial refits to utilise them.[25]

To meet the demands for shipping fuel, multiple sources of low-carbon variants, such as biofuel, will be pursued alongside hydrogen until supply is at a sufficient scale to meet demand.

Aviation

A Smooth Take Off...

Much like shipping, the shift to hydrogen fuelled aircraft would require strong financial outlays, such as government incentives and public and private investment in the supply and storage of hydrogen.

To enable a complete overhaul, many aviation giants have committed to the development of hydrogen-compatible fleets. Airbus has announced that they could be taking flight as early as 2035[26] and Boeing around 2050.[27] The development of hydrogen aircraft has sparked global interest and significant investment from the likes of Japan with an impressive 4 trillion JPY (AUD$39.2 billion) public-private investment partnership.[28] Increased market entrants will promote competitive pricing and accelerate technological developments, such as the production and storage of hydrogen.

One Size Won't Fit All

As part of the Federal Government's Jet Zero Council, Qantas suggested in their recent report that government Sustainable Aviation Fuel (**SAF**) mandates should be implemented to reach production targets of 5 per cent by 2030 and 28 per cent by 2040, as well as providing a AUD$1.5 million grant to de-risk investment opportunities.[29] Head of Sustainability, Andrew Parker, believes that this strategy will strengthen Australia's fuel independence and create economic security.[30] Additionally, long term contracts with fuel providers could play a vital role in meeting targets, such as the Delta and Neste partnership who have committed to replacing 10 per cent of traditional jet fuel by 2030.[31]

The Budget includes several initiatives to advance the domestic low carbon liquid fuels industry, including SAF. AUD$18.5 million is allocated over four years to develop a fuel certification scheme. An additional AUD$1.5 million over two years will fund an analysis of the costs and benefits of demand-side measures for sustainable fuels.[32]

At this stage, no single feedstock would produce a sufficient volume of fuel to enable a direct transition to SAF and whilst both hydrogen and biofuel production are being slowed by infrastructure challenges, commercial and cross-border partnerships are likely to increase investor appeal and enable large scale production.

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Charging Forward: The Evolution of Australia's EV Market

Authors: Matt Baumgurtel, Adriaan van der Merwe, Megan Chau and Kusum KC

The Australian Government is undertaking a national approach to increase the uptake of Electric Vehicles (**EVs**) through the National Electric Vehicle Strategy (**NEVS**) to meet decarbonisation targets in Australia's Net Zero Plan. The three key objectives of the strategy are to "increase the supply of affordable and accessible EVs, establish the resources, systems and infrastructure to enable rapid EV update and encourage increased EV demand".[1]

Earlier this year, the Albanese government introduced a New Vehicle Efficiency Standard that is expected to give consumers a greater range of fuel-efficient cars that produce low to zero emissions to choose from. To support this initiative the government has also launched the 'Modern, Cheaper-to-Run Cars' campaign to raise consumer awareness about the benefits of EVs.

Most states and territories have also developed their own strategies to increase the uptake of EVs as outlined in the table below:[2]

State/ Territory	Initiative	Aim	Status
ACT	Zero Emissions Vehicles Strategy 2022-30[3]	80-90 per cent of new light vehicle sales to be zero emissions vehicles by 2030. Phase out internal combustion engine vehicles by 2035.	As of August 2024, 9,193 zero emission vehicles (**ZEVs**) were registered in the ACT.[4] This number is expected to grow as the ACT introduces and maintains multiple financial schemes further incentivising the uptake of EVs as follows: 1. No motor vehicle duty is payable for new and used ZEVs purchased after 1 August 2022, reinforced by further amendments to the *Duties Act 1999* (ACT) in 2024.[5] 2. From 1 July 2024, the method for calculating vehicle registration fees for light vehicles changed from a weight-based system to an emissions-based system. The effect is that cheaper registration fees apply for low to zero emission vehicles compared to higher emission vehicles within the same weight range.[6]
NSW	Electric Vehicle Strategy[7]	EV sales to account for 52 per cent of new car sales by 2030-31 and a majority of total car sales by 2035.	In 2023, NSW saw a 9 per cent growth in EV sales, bringing the total proportion of EVs in the NSW market to just under 10 per cent.[8] Pending further information to be released in the 2024 report, it is anticipated that EV sales will continue to grow. NSW recently announced $73.5 million in grants to promote the rollout of essential public charging infrastructure, encouraging the continued uptake of EVs by consumers and local businesses.[9]
	Net Zero Manufacturing Initiative[10]	Develop local manufacturing capacity for renewables and components for the renewable sector.	Applications have closed for each of the funding streams available under the Net Zero Manufacturing Initiative with all application outcomes to be notified by late 2024.[11]
NT	Electric Vehicle Strategy and Implementation Plan 2021 – 2026[12]	Increase the number of government fleet EVs by 20 year-on-year, totalling 200 vehicles by 2030. Encourage EV uptake by removing registration fees and reducing stamp duty for the next five years.	As of 31 August 2024, a total of 123 EVs are registered in the NT government fleet,[13] well on track to meet its 200 EV target by 2030. To incentivise EV uptake, the NT government will grant free registration and stamp duty concessions up to $1,500 for eligible plug-in electric vehicles until 30 June 2027.[14] Following this incentive, the NT more than tripled its EV sales in 2023 compared to 2022.[15]
QLD	Zero Emission Vehicle Strategy 2022-2032[16]	Increase EV sales to 50 per cent of new passenger vehicle sales by 2030 and 100 per cent by 2036. 100 per cent of eligible QLD Government passenger fleet vehicles to be zero emission vehicles by 2026.	In July 2024, 8.5 per cent of total Queensland's new passenger vehicle sales were zero emission.[17] Further uptake was achieved under the ZEV Rebate Scheme.[18] Offering rebates of up to $6,000, the scheme boosted EV car registrations by fourfold to 46,000 vehicles by 31 July 2024 before the scheme closed on 2 September 2024.[19] Uptake of EVs in regional Queensland rose to 3,000.[20]
	Zero Emissions Vehicle Action Plan 2022-2024[21]		

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TAS	Tasmanian Government Motor Vehicle Allocation and Use Policy[22]	100 per cent of eligible government passenger fleet vehicles to be zero emission vehicles by 2030.	This policy was implemented in July 2024 and is yet to see significant traction.
	Energy Saver Loan Scheme[23]	Encourage investment in EV charging infrastructure by providing zero-interest loans, between $500 and $10,000 over three years, to individuals, small businesses and community organisations.	The Tasmanian Government is extending funding under its broader *No Interest Loan Scheme* to provide for a further 2,000 loans per year.[24]
	Electric Vehicle Rebate[25]	Encourage EV uptake by funding a $2,000 rebate for new or second-hand EVs that are new to Tasmania.	There remain 21 rebates available as of 2 September 2024.[26]
VIC	Zero Emissions Vehicle Roadmap[27]	400 VicFleet vehicles to be replaced by ZEVs by 2023.	More than 100 ZEVs were ordered for the 2022 financial year.[28]
		Install EV charging stations across regional Victoria by 2024.	Multiple charging stations have been installed across regional Victoria. A map of Victorian EV charging stations is available here.[29]
		All new public bus purchases to be ZEVs from 2025.	In 2022, the government implemented a Zero Emissions Bus Trial.[30] In 2024, as part of this trial, 27 electric buses are scheduled to operate from a new electric bus depot in Melbourne's north-east.[31]
		Increase EV sales to 50 per cent of all light vehicle sales by 2030.	EVs accounted for 7.5 per cent of Victorian vehicle sales in 2023.[32]
WA	State Electric Vehicle Strategy for Western Australia[33]	Encourage EV uptake, with 25 per cent of all new light and small passenger, and small and medium SUV, government fleet vehicles to be EVs by 2025/26.	As of 2023, at least 22.4% of total WA Government fleet vehicles are EVs.[34]
		Develop EV infrastructure, including an EV charging network from Perth to Kununurra.	The Perth to Kununurra EV network is currently under construction, with a majority of planned EV charging locations now constructed.[35] A map of WA EV charging stations is available here.

** The information in the table is accurate as of September 2024.*

Looking to the Future

Imminent changes to Australian standards on bi-directional EV charging and looming elections in the Australian Capital Territory, Queensland, Western Australia, Tasmanian, and the Commonwealth promise to initiate renewed discourse and EV policy both at the state and federal level.

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Leading the Charge: The Growth of EVs in Australia and Worldwide

Authors: Matt Baumgurtel, David O'Carroll and Megan Chau

In our previous Quarterly, we discussed the growth of battery powered electric vehicles (**EVs**) in Australia and the potential for EVs to operate as an effective and consumer-friendly distributed energy resource. Since then, measures have been taken to formally implement a new vehicle efficiency standard in Australian legislation and navigate the use of Vehicle-to-Grid (**V2G**) technology. On an international scale, a report has been released by the International Energy Agency (**IEA**) confirming EV uptake will continue to grow worldwide in 2024.[1]

Growth of EVs and the New Vehicle Efficiency Standards

Forecasts by the Australian Energy Market Operator (**AEMO**) show that underlying residential energy consumption is due to increase by 31 per cent over the next decade, amounting to approximately 75 TWh worth of energy being consumed by 2033.[2] The substantial spike in energy consumption is largely attributed to the growth of residential dwellings and specifically, the transition from vehicles with traditional internal combustion engines to electric ones – in other words, EVs.

In Australia, EVs have gained popularity over the years, due in large part to a nationwide commitment to achieving a net zero emission economy by 2050.[3] This has resulted in more emerging policies incentivising EV uptake – most recently, the proposed vehicle efficiency standards (**VES**).[4]

The VES aim to impose carbon emission targets across the fleet of vehicles that a supplier may source and sell in the country. At the end of each year, the number of vehicles brought into the market and the carbon emissions generated by each vehicle supplied are tallied up against the relevant emissions target. For each gram of CO2 per kilometre falling below the target, the supplier will be issued one credit or 'unit' which may be used or sold to other suppliers to offset high emissions. Alternatively, if the tally results in a figure higher than the relevant target, the supplier will be given two years to match or fall below the target by earning or trading units with other suppliers.

The emissions target will decrease each year, such that suppliers will either have to bring across more EVs in the first instance or sell more EVs to offset the high emission vehicles they may be selling in parallel in order to comply with the stricter target.

Key provisions of the VES include:

1. **Revised Emission Targets** – the VES propose the following emissions targets:[5]

Year	Type 1 Vehicles (grams / kilometre)	Type 2 Vehicle (grams / kilometre)
2025	141	210
2026	117	180
2027	92	150
2028	68	122
2029	58	110

   Type 1 Vehicles broadly refer to passenger or household / domestic-use vehicles and Type 2 Vehicles broadly refer to commercial (light to medium goods) vehicles or heavy off-road passenger vehicles.

   These revised targets closely reflect the standards proposed to be implemented in the United States (**U.S.**) earlier this year and bring Australia closer to the comparatively stricter European Union targets.[6]

2. **New Vehicle Categorisations** – the VES recategorise a limited number of 4WD-model vehicles, such as the Toyota Landcruiser and Nissan Patrol, from passenger car (Type 1) to light commercial (Type 2) vehicles. This is done in recognition of the higher minimum power requirements for these vehicles to operate due to their size and build, and to ensure such vehicles can realistically comply with the VES.
3. **Time for Implementation** – following consultation with the industry, the VES are planned to commence on 1 January 2025. However, the credit and penalty scheme will only come into effect from 1 July 2025, allowing time for suppliers and manufacturers to process and ensure compliance with the new standards.

The proposed VES are currently before parliament for consideration in the New Vehicle Efficiency Standard Bill 2024.

Looking Ahead

In our previous article, we covered the Realising Electric Vehicle-to-Grid Services Project (**REVS Project**) led by Energeia in 2020, which looked into the operation, economic value and potential opportunities for EVs in Australia. The REVS Project found that V2G technology had the potential to earn owners thousands of dollars per vehicle by providing energy for grid events in the Frequency Control Ancillary Services (**FCAS**) market, with strong potential for growth if more powerful chargers were used. Further, since V2G vehicles were rarely called upon to provide FCAS services and, when called on, were only required to provide a small amount of energy, there is a low risk of excessive power draining and premature battery degradation in these vehicles.

The Australian National University will prepare a RoadMap for V2G based on the trial data from the REVS Project.

From an international perspective, the IEA recently published the Global EV Outlook 2024 report, giving insight on the global uptake of EVs. In this report, the IEA predicts up to 17 million EVs may be sold in 2024, equating to more than one in five cars sold worldwide.

While these numbers are promising, the report flags production cost, affordability and the roll-out of public charging infrastructure as key issues to address to ensure there is a continued appetite for EVs. However, in response to these issues, the IEA also found that a strong year-on-year sales growth has attracted almost USD 500 billion in investments into the global EV and battery manufacturing industry. As a result, key EV suppliers, being the U.S., China and a number of European countries, are now moving towards mass-market production to meet the increasing demand. As competition for the supply of EVs intensifies, it is expected that EVs will become more affordable to better appeal to consumers.

Conclusion

Now, more than ever, the appetite for EVs is at an all-time high. As a low emission vehicle, EVs support Australia's commitments to achieving a net zero emission economy. With extensive social, financial and regulatory backing on a domestic and international level, EVs are becoming more affordable and accessible for both commercial suppliers and consumers. For the world to achieve a future with net zero emissions, it is clear that EVs will play a pivotal part.

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The Future of EV Charging Infrastructure in Australia

Authors: Matt Baumgurtel, David O'Carroll and David Wan

As we move towards a world of electrified transport, the decarbonised future not only relies on the uptake of electric vehicles (**EVs**) themselves, but equally on the essential infrastructure supporting them – EV charging infrastructure.

We explore the increasing demand for EV charging infrastructure, the relevant governmental funding programs on the federal and state levels, and the regulatory requirements for businesses rolling out EV charging infrastructure.

Outlook of EV charging infrastructure

The rapid growth of EVs will drastically increase the demand for EV charging infrastructure. As of the end of 2023, there are more than 180,000 EVs in Australia.[1] Though EVs currently represent less than 1 per cent of the total passenger vehicle fleet in Australia, the number of EVs is expected to skyrocket to around 2.5 million within the next 10 years.[2] The range of current EV models are well-equipped to meet the daily travel needs of most people commuting between home and work.[3] In Australia, only 10 per cent of cars travel more than 100km each day.

Most EV charging in Australia is expected to occur in private homes, with at-home charging to provide 95 per cent of the charging needs for roughly 70 per cent of the Australian population that reside in detached dwellings.[4] Nevertheless, a significant proportion of EV users will rely heavily on public chargers, including on-street, shopping centres, public car parks and apartment blocks.

To service this demand, Australia needs to increase its public charging capacity by eight-fold, requiring 27,500 new public EV chargers by 2033.[5]

Australia has already been accelerating the rollout of EV charging infrastructure. In 2023, Australia saw a 75 per cent increase in the number of public EV charging locations, from 464 by the end of 2022 to 812 by the end of 2023.[6] Notably, NSW is leading with the most significant increase in charging locations, adding 52 fast charging and 28 ultrafast charging locations in 2023.[7]

Funding program highlights

In the Federal Budget for FY 2024-25, the Australian Government will provide $154.5 million to implement the recently introduced New Vehicle Efficiency Standard. This includes $60 million over four years from 2024 to support the installation of EV charging infrastructure at automotive dealerships and workshops across the country. More information on the 2024 Federal Budget can be found in our *New Energy Insights: The 2024 Federal Budget – What it means for Clean Energy.*

To address the increasing demand for charging infrastructure, governmental funding programs have been implemented on the federal and state levels,[8] including:

1. **Federal level:** Driving the Nation – National EV Charging Network

   In April 2023, the Federal Government announced funding of $39.3 million to help deliver 117 EV chargers on key national highway routes across Australia, at an average interval of 150 kms and connecting all capital cities. This initiative aims to enhance charging infrastructure in rural and regional areas, closing the gaps and known black spots in Australia's fast charging network.

2. **State level:** NSW fast charging grants (Round 3)

   With applications closing by 3 October 2024, the fast charging grants round 3 has up to $54 million in funding available. The EV fast charging grants program aims to add approximately 280 fast and ultra-fast charging stations across NSW. This will ensure that fast charging stations are no more than 5 km apart in metropolitan areas and no more than 100 km apart on major roads and highways across NSW.

3. **State level:** NSW EV fleets incentive

   The EV fleets incentive is a payment scheme that helps eligible organisations procure battery electric vehicles and smart chargers. The $8 million competitive bid funding opens on 24 July 2024 and closed on 17 September. The $7 million kick-start funding opens on 24 July 2024 and closes when allocated funds are exhausted.

4. **State level:** NSW Kerbside Charging Program

   In July 2023, the NSW Government launched a $3 million kerbside charging grants funding round to support the installation of at least 150 EV chargers at kerbside locations, targeting EV drivers who lack off-street parking. With a total budget of $10 million, the program offers funding for charge point operators and councils, covering up to 80 per cent of installation, equipment costs and software subscriptions. Round 2 of the NSW kerbside charging grants are open with $4.5 million in funding available, with applications closing by 9 December 2024.

5. **State level:** NSW Destination Charging Grants (Round 2)

   In November 2023, the NSW Government launched the second round of the Destination Charging Grants to bolster EV confidence among residents and tourists in regional NSW. The $10 million funding round encourages small to medium regional tourism businesses and councils to install at least 1,500 EV charge points, making it easier for EV owners to travel to and within regional areas. Applications closed on Friday, 2 August 2024.

Regulatory requirements for businesses rolling out EV charging infrastructure

Businesses in the EV charging infrastructure market need to navigate a complex landscape of regulatory requirements, which vary based on the location of the EV charging infrastructure. These locations include on-street, at destinations (e.g. at a supermarket, carpark or workplace) or en-route (e.g. service station or charging points on highways).

Depending on the location of the EV charging infrastructure, businesses rolling out EV charging infrastructure may be subject to:[9]

1. Retailer authorisation (or exemption) by the Australian Energy Regulator (**AER**) for the sale of electricity under the *National Energy Retail Law* and *National Energy Retail Rules*;
2. Network service provider registration with the Australian Energy Market Operator (**AEMO**) for an electricity distribution network or an exemption from the AER under the *National Electricity Law* and *National Electricity Rules*; and
3. Customer registration with the AEMO for buying and selling energy in the wholesale electricity market.

In addition, there may be state-specific licensing requirements. For example, in Victoria, a licence from the Essential Service Commission (**ESC**) is required for the sale or supply of electricity. In South Australia, operators of EV charging stations can have a fixed term exemption from the requirement of holding a distribution licence.[10]

Furthermore, businesses also need to consider relevant safety regulations, as well as the *National Construction Code*, which now contains requirements for EV charging infrastructure in carparks associated with certain building classes.[11]

EVs: The future is bright

As Australia marches towards a future of electrified transport, it is critical to support the uptake of EVs with a rapid deployment of EV charging infrastructure. The combined efforts of federal and state funding programs are paving the way for a seamless transition. Meanwhile, businesses must familiarise themselves with the regulatory requirements in entering the EV infrastructure market.

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Investing in the Electric Vehicle Revolution

Authors: Matt Baumgurtel, Hannah Jones, Conor Bates, Sally Yang and Alexander St John

The electric vehicle (**EV**) revolution is rapidly changing the transportation industry, creating a wave of investment opportunities in all areas across the lifecycle of the EV. Such opportunities extend beyond car retailers to a complex ecosystem that includes new technologies, critical minerals and the infrastructure needed to keep EVs running.

Current types of EVs in the market

There are currently four types of EVs[1] and over 70 models available in the Australian market:[2]

1. **Battery electric vehicles (BEVs):** EVs solely powered by electricity that produce no tailpipe emissions.[3] BEVs are also known as 'plug-in' EVs as they use an external electrical charging outlet to charge their battery.
2. **Plug-in hybrid electric vehicles (PHEVs):** vehicles powered by a combination of liquid fuel and electricity. They can be charged with electricity using a plug but also contain an internal combustion engine that uses liquid fuel.
3. **Fuel cell electric vehicles (FCEVs):** vehicles that use a fuel cell to power their electric motors. The fuel cell may also be used in combination with a battery or supercapacitator. FCEVs are typically fuelled by hydrogen and usually provide greater range than BEVs. One example is H2X Global, an Australian automotive company that specialises in FCEVs and fuel cell electric generators.
4. **Non-plug-in hybrid EVs (HEVs):** the electricity generated by the HEV's braking system is used to recharge the battery instead of using an external plug to charge the vehicle. This is called 'regenerative braking' and is also used in the other types of EVs mentioned above.

The uptake of EVs in Australia has been relatively slow compared to other developed countries due to certain limitations such as the number of charging stations and range of car models.[4] However, the number of EVs in Australia is expected to grow as further infrastructure is rolled out and cheaper EV models enter the market.

Key investment opportunities

Key investment opportunities in the EV revolution include:

1. **Battery Technology:** Battery technology is a critical factor shaping the EV market as it influences the range, performance and cost of the EV.[5] Investors are closely monitoring developments in battery chemistry, manufacturing processes and recycling technologies as breakthroughs in this area and this could dramatically impact the competitive market of EVs. Companies involved in battery production, as well as those developing innovative battery technologies, are attracting significant investment interest.[6]
2. **Charging Infrastructure:** The expansion of charging infrastructure is essential to support the widespread adoption of EVs. As the demand for EVs grows, this presents ideal investment opportunities for companies involved in the deployment of charging stations, fast-charging technologies and smart grid solutions.
3. **Automotive Manufacturers:** EVs are estimated to reach 40 per cent of global car sales by 2030, up from only making around 3 per cent of global car sales back in 2020.[7] Traditional market leaders in the EV manufacturing space such as Tesla are facing growing competition from traditional automakers in addition to new entrants.[8]
4. **Supply Chain:** The shift towards electrification is driving demand for key materials used in EV batteries such as lithium, cobalt and nickel. The International Energy Agency (**IEA**) estimates that there will be over 40x growth in lithium demand by 2040 and an anticipated lithium uptake of 180,000 metric tonnes by 2030.[9]

Government Initiatives in Australia

Australian Government

The Australian Government announced its National Electric Vehicle (**NEV**) strategy on 19 April 2023.[10] The strategy looks to increase the affordability of EVs, expand the national rollout of EV charging infrastructure and reduce Australia's transport emissions.[11]

The Australian Government has partnered with a number of businesses to implement its NEV Strategy.[12] On the 7th March 2024, the Clean Energy Finance Corporation announced it is investing up to $50 million with Angle Auto Finance with the aim of having 20,000 new EVs being utilised in Australia over the next 2 years.[13] The Australian Government also has a partnership with the NRMA to build 117 fast EV charging sites on national Australian highways.[14]

NSW Government

The NSW Government has also made commitments to increasing the uptake of EVs. The Government's commitments currently consist of plans and strategies such as the Net Zero Plan Stage 1: 2020 – 2030.[15]

Net Zero Plan Stage 1: 2020 – 2030

Stage 1 of the Net Zero Plan sets out how the NSW Government will deliver on its objective to reduce emissions from 2020 – 2030.[16] The Plan sets out how the Government's first priority is to provide a pathway to deploy proven emissions reduction technologies (which includes EVs) at scale over the next decade.[17] To do this, the NSW Government will reduce where possible certain barriers to entry for such technologies and also co-investments to ease the issue of high upfront capital costs in deploying such technologies.[18] Further, in encouragement of the update of EVs, the NSW Government will support amendments to the *National Construction Code* and NSW Building Sustainability Index (**BASIX**), to ensure new buildings are EV ready.[19]

Exploring investment opportunities in the EV revolution

Overall, the EV revolution presents a range of investment opportunities such as investment into automotive manufacturing, battery technologies and charging infrastructure. However, these investment opportunities will not be without their risks, as regulatory dynamics and competitive pressures will continue to influence the market in the years to come.

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Beyond the Charge: Three Key Challenges with Lithium-ion EV Batteries

Authors: Matt Baumgurtel, Adriaan van der Merwe, David O'Carroll, Megan Chau and Kusum KC

As the world transitions towards a more sustainable future, electric vehicles (**EVs**) have emerged as a key player in reducing emissions. Most of the EVs in the market today are powered by lithium-ion batteries which is a proven technology that has been in the market for decades in small consumer electronics.

Lithium-ion batteries are well-suited for use in EVs, as their high energy density allows for longer driving ranges and their long-life cycle ensures durability and cost-effectiveness. These features have increasingly enabled EVs to compete with internal combustion engine (**ICE**) vehicles in the market.

Extensive research and development (**R&D**) has also led to significant advancements in performance, safety, and affordability, further enhancing the appeal and competitiveness of EVs. There are, however, three key challenges associated with lithium-ion batteries:

1. thermal management;
2. limited availability of critical raw materials; and
3. recycling and disposal.

Thermal Management

One of the biggest risks with lithium-ion batteries is the potential for the batteries to overheat, resulting in fires and explosions. While EV fires are rare when compared to ICE vehicles,[1] they can be more dangerous and difficult to extinguish due to the size and high energy density of the battery.[2] The fires can reach temperatures of 400 degrees Celsius in seconds, release toxic gases and if there is thermal run off, potentially reignite hours, or even days, later.[3]

Emergency responders often lack the knowledge and resources necessary to effectively manage EV fires, making it even more challenging to handle such incidents when they occur. Emergency responders need to know the make, model and year of the EV to determine the best course of action to extinguish a battery fire using regular water-based extinguishers as they have limited access to lithium-ion gel extinguishers.[4]

R&D is required to address the safety and risk knowledge gaps linked to lithium-ion batteries and to develop best practices and standards. There are "currently no national standards addressing fire safety in Australia for built environments" which is deeply problematic given the increase in EVs and EV infrastructure installed in apartment complexes and shopping centres.[5] The recent EV fire at Sydney Airport where five cars were destroyed shows how quickly EV fires can spread in confined spaces and the resulting scale of damage compared to ICE vehicles.[6]

EV fire risk has been identified as a key consideration for state governments to address under the National Electric Vehicle Strategy (**NEVS**). Potential measures that have already been identified include prescribing safety requirements and introducing hazard prevention strategies.[7] Initiatives like the 'Modern, Cheaper-to-Run Cars' campaign that raise consumer awareness about the benefits of EVs, should also be expanded to educate consumers about the risk of EV fires and the appropriate actions to take in case of a fire.[8] However, battery safety is just one aspect of the challenge and must be addressed concurrently with developing strategies for managing the limited availability of critical minerals and battery recycling.

Limited availability of Critical Raw Materials

Lithium-ion batteries are comprised of finite resources such as lithium, cobalt, and nickel. The availability of such rare earth minerals poses a significant challenge for the production at scale of such batteries in the future. There is expected to be a six-fold increase in the adoption of EVs in Australia by 2030. Globally, the increase in passenger EV adoption is expected to lead to an eight-fold increase in the demand for lithium-ion batteries by 2050.[9]

The global acceleration in the adoption of EVs has been driven by decarbonisation strategies, the introduction of vehicle efficiency standards, and governments signalling they will be banning the sale of ICE vehicles by 2035. On 29 January 2024, Ethiopia became the first country to ban the import of ICE vehicles completely (effective immediately).[10]

While EVs are crucial for reducing carbon emissions, relying solely on them without addressing the limited availability of critical raw materials could lead to supply chain disruptions and present an energy security risk. The production and processing of critical minerals is currently concentrated in just a few countries. Notably, China holds 60 per cent of the world's manufacturing capacity for renewable technologies, and up to 70 per cent of critical mineral processing.[11]

Establishing a domestic battery manufacturing industry will allow producers and regulators to have greater oversight over operations and supply chains. This, in turn, makes it easier to produce higher-quality batteries and address modern slavery risks in supply chains.

Modern Slavery

Currently, there is significant global scrutiny regarding the risk of modern slavery in the critical mineral processing sector. This scrutiny stems from several reports and investigations highlighting exploitative labour practices, particularly in regions with weak labour laws and enforcement. Concerns include child labour, forced labour, and unsafe working conditions in mines and processing facilities.

Major corporations and governments are increasingly pressured to ensure their supply chains are free from such abuses. Regulatory measures, such as the *Modern Slavery Act 2018* (Cth), requires companies to report on the actions they are taking to eliminate modern slavery from their supply chains.

By developing a robust domestic battery manufacturing industry, Australia can set high standards for ethical sourcing and processing, thereby mitigating the risk of modern slavery. This approach not only enhances the quality and reputation of Australian-made batteries but also aligns with global efforts to promote sustainable and ethical production practices in the critical minerals industry.

Recycling

Even with strategies to manage critical resources, it is evident that global demand will exceed supply and batteries will need to be recycled for their critical minerals.[12] According to the recent CSIRO and FBICRC report, only 10 per cent (of a potential 95 per cent) of lithium-ion batteries were recycled in Australia in 2021.[13] The report also highlights that inadequate recycling could lead to a loss of value between $603 million to $3.1 billion by 2035.[14]

Australia does not currently have the technical capability to recycle lithium-ion batteries.[15] The Federal Government introduced a battery stewardship scheme in 2022 to create a national collection network, however only a small percentage of batteries collected under this scheme were exported for offshore processing, with the vast majority stored in warehouses or scrap yards which pose a fire and environmental contamination risk.[16]

Relying on offshore battery recycling also poses risks similar to those experienced when countries imposed bans on plastic waste exports to protect the environment and manage waste more sustainably. Nations with advanced battery recycling capabilities may restrict imports to prioritise their own environmental and economic needs. These restrictions can lead to supply shortages and increased costs for countries dependent on external recycling services.

For example, when China banned plastic waste imports in 2018, it disrupted global recycling markets and forced many countries to reevaluate their waste management strategies. Similarly, potential export bans on recycled battery materials could severely impact Australia's ability to access essential resources for battery production.

Scalability is already a key challenge in setting up a recycling industry in Australia due to a lack of feedstock. Further challenges include determining who should bear the cost of transport and navigating different transportation policies (which often have policy gaps for transporting defective and damaged batteries) that exists across jurisdictions. This has created apprehension in the industry about transporting batteries and added to the logistical and economic challenges.

However, in the short-term it will still be easier to set up a recycling industry compared to building a manufacturing industry as it can take 5 – 10 years to build a primary industry sector (especially if this includes exploration).[17]

Policies and Regulations

This again underscores the need for the Federal Government to make strategic decisions about supporting a battery industry in Australia and determining whether that includes battery recycling. To this end, the Federal Government released the *Critical Mineral Strategy 2023-2030* in June 2023, which aims to establish diverse and resilient supply chains, enhance domestic critical minerals processing, leverage these minerals to boost Australia's renewable energy capabilities, and generate economic opportunities for regional and First Nations communities.

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Additionally, in the 2024-25 Federal budget, the government committed $7.1 billion to support the refining and processing of critical minerals and allocated $549 million to develop a battery manufacturing industry under the 'Future Made in Australia' package. The Federal Government has also committed funding to explore and create detailed maps of critical mineral deposits.

The *National Battery Strategy* released in May 2024, outlines how the Federal Government will support the domestic battery industry as it grows and recognises the need to create a circular economy.

In relation to safety and recycling, regulations need to be harmonised across Australia to make it easier for stakeholders (including original equipment manufacturers (**OEMs**), emergency responders and transport operators) to follow best practices and make compliance and logistics easier.

Establishing clear policies and providing subsidies will be crucial to encourage new recycling operators to enter the market. Additionally, investing in ongoing R&D efforts will be important as it could lead to further efficiencies and cost improvements, enhancing the economic viability of recycling operators in the future.

Industry bodies like the Association for the Battery Recycling Industry (**ABRI**) also have an important role to play in bringing together various stakeholders, including "OEMs, battery repurposing companies, waste sector entities, government bodies, research institutions, and environmental groups, to promote the collection, recycling and safe disposal of all batteries."[18] This collaborative approach is expected to drive innovation and investment and will be crucial for addressing any challenges that may arise.

While challenges remain, the growth in demand for EVs and lithium-ion batteries present a unique opportunity for Australia to further enhance its position in the global renewable energy supply chains.

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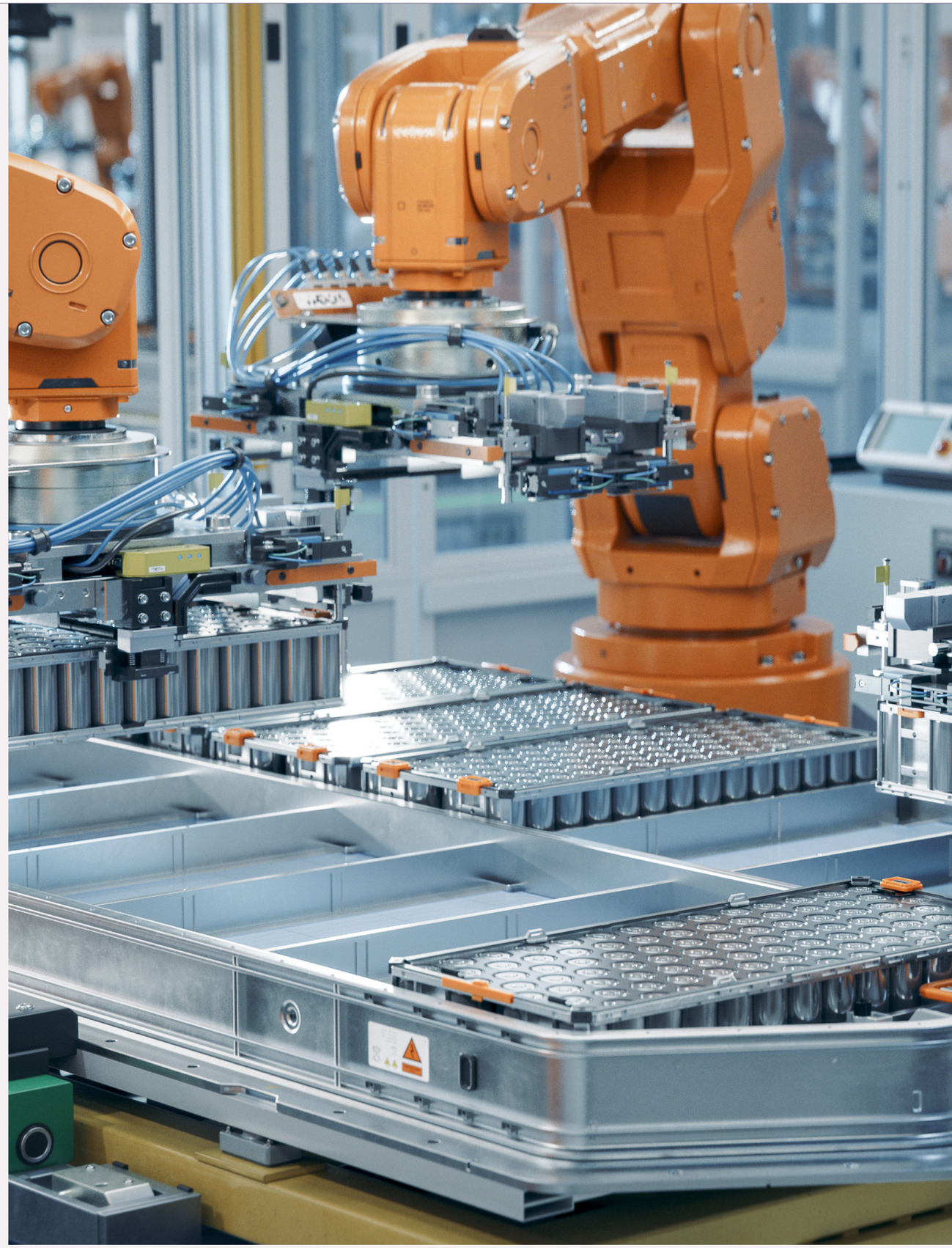


Can Hydrogen Fuel Cell Vehicles compete with Electric Vehicles in the Light Passenger Vehicle Market?

Authors: Matt Baumgurtel, William Ryan and Michael Liu

Transportation is the second largest source of global CO2 emissions (after energy generation), and in 2022 produced almost 8 gigatonnes of CO2.[1] Transport sector emissions are predominantly attributable to road transport vehicles, which produced 5.87 gigatonnes of CO2 in 2022.[2]

Accordingly, investment in green road transport vehicles – particularly light passenger vehicles – represents an important step in the global transition to net-zero emissions.

Industry have advanced two possible solutions: battery powered electric vehicles (**EVs**) and hydrogen fuel cell vehicles (**HFCVs**).[3]

Hydrogen Fuel Cell Vehicles

Much has been said about EVs. By contrast, HFCVs – being vehicles running on electricity produced from hydrogen fuel cells – are relatively unknown to the public.

Vehicle manufacturers, by contrast, are demonstrating interest in HFCVs and companies such as BMW, Honda, Hyundai, and Toyota have invested in this emerging technology.[4] For instance, BMW and Toyota announced a partnership in September 2024 to develop a hydrogen fuel cell powertrain technology which can be used in future car models from both companies.[5]

Despite these investments, the feasibility of hydrogen as a fuel source for road transport has been questioned, particularly in the context of light vehicles (as opposed to heavy vehicles). For example, the Grattan Institute has advised that investment in hydrogen powered light passenger vehicles is futile as EVs present a much more compelling economic case and already dominate market share.[6]

This raises the question of whether there is a place for hydrogen as a fuel source for any future mix of light passenger vehicle transport (or road transport more broadly).

The Advantages of Hydrogen Fuel Cell Technology

The key advantages of hydrogen fuel cell technology are that it allows for faster refuelling, greater range, and a lighter chassis than battery EVs.[7] These attributes make the technology a particularly attractive prospect for long-haul heavy freight transport in comparison to current EV technology, with the benefits of transporting greater payloads for longer distances and with shorter refuelling times. However, these comparative advantages are being challenged by advancements in EV technology, with improvements in battery capacity and the development of battery-swapping technology for heavy vehicles.[8]

The attributes of HFCVs may also be suitable for the provision of fleet vehicles to niche markets, such as bus, taxi, and security patrol fleets, where vehicles are required to be in constant operation.[9] This application is being explored in Australia through state government investment in hydrogen bus pilot programs[10] and car manufacturers trialling the introduction of light HFCVs through private leasing agreements.[11] Again, however, the viability of such programs will continue to be challenged into the future as electric bus prices fall.[12]

The Limitations of Hydrogen Fuel Cell Technology

The production and transportation of hydrogen for use in HFCVs is high and involves a multi-stage process requiring electrolysis, compression or liquefaction, storage, transportation, and the development of refuelling infrastructure.[13] Each of these stages requires significant energy input as well as other associated costs, resulting in an average cost of hydrogen gas between $7/kg and $16/kg.[14]

Accordingly, HFCV may remain financially unviable for manufacturers, with the long-term feasibility of these vehicles reliant on a marked fall in the price of hydrogen.[15] To match the affordability of driving an EV this figure would need to drop to $2/kg or below.[16]

Although the increasing deployment of renewable energy generation is likely to cause a longer-term fall in the cost of energy input for the production of hydrogen, this fall would also cause a decrease in the cost of running an EV. Although the deployment of EVs require significant infrastructural investment, this investment is arguably lesser than the infrastructural investment involved with HFCV deployment (including supply, storage, maintenance, and refuelling infrastructure).[17]

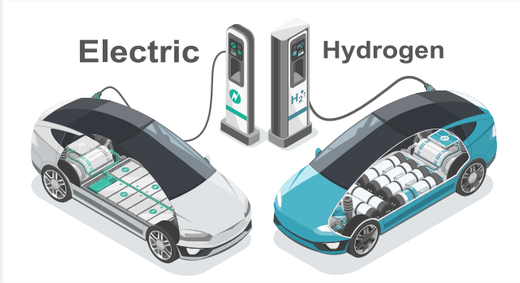
This is evidenced by the current standing of hydrogen fuel infrastructure in California, one of the leading investment hubs for such infrastructure globally. Despite significant funding by California to subsidise the development of hydrogen refuelling stations since 2008, targets for the number of new stations have been reducing and existing stations have suffered closures due to endemic maintenance issues.[18]

In addition to the disparity in existing infrastructure, the uptake in EVs versus HFCVs by consumers is also vastly disparate. In Australia, only six HFCVs were acquired by consumers in 2023, all through leasing agreements.[19] By comparison, more than 87,000 EVs were sold over the same period.[20] This variance in market share domestically is also reflective of the international market. Even California, a global leader in hydrogen refuelling infrastructure, saw consumers continue to favour EVs, with over 380,000 purchased in 2023, compared to only 3,143 HFCVs.[21]

Finally, for HFCVs to be truly 'green', the energy inputs required for hydrogen fuel must also be green. At present, a significant portion of hydrogen is produced from natural gas.[22] This, in addition to the energy requirements of compression, storage, and transport, means that HFCVs will not be a green method of transport until all inputs are sourced renewably. While EVs may also rely on a grid that is not sourced entirely from renewably generated electricity, the growth in renewable energy generation and distributed energy resources demonstrate that it is feasible for EVs to be entirely renewable energy generated.

What's next for HFCVs?

Although the evidence demonstrates challenges for the mass adoption of HFCVs in the light passenger vehicle market, HFCVs may nonetheless have a role to play in niche subsectors of the green road vehicle market (such as with long-haul transport and vehicle fleets). This position was touted in the Australian Government's National Hydrogen Strategy 2024, which identified hydrogen as a solution to transitioning to the long haul transport sector.[23]



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Diesel Dilemma: The Drive to Decarbonise Road Freight

Authors: Matt Baumgurtel, Adriaan van der Merwe, William Ryan, Conor Bates and Lana Knaggs

Australia stands at a critical juncture in its efforts to decarbonise the heavy-duty transport sector. We examine the potential path forward for decarbonising the road freight sector.

Transportation is a significant contributor to global CO2 emissions, responsible for about 24 per cent of total emissions in 2022. 35 per cent of direct CO2 emissions from road transport are attributed to trucks and buses, even though they represent fewer than 8 per cent of all vehicles (excluding two- and three-wheelers). To achieve net zero by 2050, road freight emissions need to be reduced by 15 per cent from 2022 to 2030, declining at roughly 2 per cent per year. It's time to take a closer look at diesel's domination and the future of sustainable heavy-duty transportation in Australia.

Key takeaways

1. **Diesel still rules:** Despite the push for greener options, diesel trucks dominate the market, making decarbonisation difficult.
2. **Hydrogen and electric on the horizon:** Hydrogen and electric trucks show promise but need major infrastructure upgrades before they go mainstream.
3. **Renewable diesel's quick fix:** Renewable diesel offers an immediate emissions solution, but cost and scale of production challenges are prominent.
4. **Australia's opportunity:** With the right investment, Australia may have the potential to become a renewable diesel powerhouse and lead the green trucking revolution.
5. **Collaboration is key:** To decarbonise, industry leaders, energy providers, and the government must work together.

Diesel domination

Diesel still dominates the road freight sector. For example, in the European Union (**EU**), only 0.6 per cent of trucks purchased in 2022 were electric, with 96.6 per cent running on diesel. Promisingly, the sale of electric trucks in the EU increased almost threefold in 2023 to account for more than 1.5 per cent of sale share. However, there is clearly still a long way to go to catch up on diesel. High energy requirements, short refuelling times, status quo bias, and long asset lifespans are contributing to diesel's market dominance and lend to the conclusion that the heavy-duty transport sector is one that is "hard-to-abate".

The emergence of hydrogen and electric trucks

Several sustainable options have been developed to address trucking emissions. More than 300 models of hydrogen and electric trucks are available globally. For instance, Hyundai introduced the world's first hydrogen heavy-duty truck in 2020, powered by a 190kW hydrogen fuel cell that provides a range of 400kms on a single charge. Refuelling takes only 8 to 20 minutes,[1] making it a promising fuel alternative for long-haul routes, especially in countries such as Australia where refuelling downtime is a critical factor.

However, hydrogen presents challenges, notably the space required for storage. Just one kilogram of atmospheric pressure hydrogen requires eleven cubic metres of space. Accordingly, hydrogen needs to be liquified or compressed for trucking use, requiring a lot of energy and expensive equipment, which has led to high costs and slowed its adoption.

Alternatively, electric trucks (**e-trucks**) are gaining traction as the dominant renewable alternative for road freight. When compared to diesel, e-trucks are generally cheaper to own and maintain. Combining this with carbon pricing and government incentives, they are a clean and affordable solution for the trucking industry. With ambitious policies such as the EU's CO2 standards for heavy-duty vehicles (which target a 90 per cent CO2 emissions reduction by 2040) and the United States's (**US**) heavy-duty emissions regulation, it is no surprise that e-truck sales are expected to continue to rise.[2]

Lagging infrastructural development

Although the uptake of hydrogen and electric battery trucks will grow over the coming decade,[3] widespread adoption will not be possible unless associate (and extensive) infrastructure is developed and deployed.[4]

McKinsey and the World Economic Forum together report that the technology required to charge an average 400kWh battery in 45 minutes could cost between €200,000 and €350,000 per charge point, while the capex for hydrogen fuelling stations can range from €2-€3 million for a 1,000kg/day station, depending on the output pressure.[5]

In time, these costs are expected to drop because of advances in technology and utilities of scale.[6] Harmonised standards to achieve maximum interoperability of charging infrastructure will be essential to enable the fast roll-out of charging infrastructure, mitigate risks for manufacturers, operators and importers, and allow technologies to benefit from economies of scale. To this end, the recognition by the EU and US of the adoption of the megawatt charging system by international standardisation organisations is an important development.[7]

In Australia, the deployment of interoperable charging infrastructure is being undertaken by companies like NewVolt Infrastructure Pty Ltd. Working alongside industry bodies, logistics operators, buyers and government authorities, NewVolt is developing a national network of shared charging infrastructure, exclusively for the electric trucking industry.

Another potential issue is that high-powered charging also creates issues for the electricity grid and so careful planning and investment will be required to accommodate this increased load. A potential mitigant to this risk may be to install co-located renewable energy sources and batteries to decrease stress on the local power grid. However, these solutions would require even greater capex.[8]

Might more diesel be the answer?

Renewable diesel, an advanced biofuel, may offer a pragmatic interim solution to reduce emissions while electric and hydrogen infrastructure is developed.

Unlike other biofuels like ethanol-blended petrol and biodiesel, renewable diesel is synthetically refined to directly replace petroleum diesel and is compatible with existing engines and infrastructure. It can reduce lifecycle greenhouse gas emissions by 60-80 per cent and tailpipe emissions by about 4 per cent (depending on the feedstock used),[9] making it a promising "drop-in" replacement fuel for the trucking industry which can be used by existing infrastructure and assets.

Renewable diesel is not without its own challenges. The cost of producing renewable diesel is estimated to be twice that of standard diesel.[10] Applying this situation to a price sensitive industry where fuel costs can account for between 17 to 30 per cent of a typical trucking operation's total expenses, it is clear that achieving economies of scale will be critical to renewable diesel becoming an economically viable option. In addition, the use of feedstocks for fuel that could otherwise be used for cooking and human nutrition raises serious social issues. Reuters reports that food and fuel markets are becoming so tightly connected that rises in demand for renewable diesel could trigger shortages of edible oils such as palm oil, an essential cooking medium for millions of people across Africa and Asia.

While renewable diesel production has "boomed" in the US,[11] no renewable diesel is currently produced in Australia.[12] However, CSIRO notes that Australia's large landmass, temperate climates, advanced farming practices, access to renewable feedstocks, established supply chains and renewable energy potential all point towards the conclusion that Australia may have a significant opportunity to develop a competitive domestic industry for renewable diesel.[13]

Testament to this, the Australian Government has identified low carbon liquid fuels (**LCLF**) as a priority sector as part of Future Made in Australia and is fast tracking support for the development of a LCLF industry.[14] With an initial focus on sustainable aviation fuel and renewable diesel, the government opened a public consultation and committed $1.5 million over 2 years from 2024-25 to undertake a regulatory impact analysis of the costs and benefits of introducing mandates or other demand-side measures for the LCLF industry. It will be intriguing to observe the industry feedback, and the results of the analysis, including whether the Australian Government will invest further to expand the domestic LCLF industry.

The future of sustainable heavy-duty transportation in Australia

Australia stands at a critical juncture in its efforts to decarbonise the heavy-duty transport sector. While diesel remains the dominant fuel, the emergence of hydrogen and electric trucks offers a promising path forward. The development of hydrogen and electric infrastructure will be essential for these technologies to gain traction. In the meantime, renewable diesel presents a viable short-term solution, though achieving cost-effective production and balancing socio-economic issues remains a significant hurdle.

With Australia's vast resources, including renewable feedstocks and advanced farming practices, the country has the potential to become a leader in renewable diesel production and green trucking technologies. By fostering collaboration between industry leaders, government bodies, and energy providers, Australia can both reduce its carbon footprint and set a global example for sustainable transport. The next decade will be crucial, and with the right investments, Australia can meet its emissions targets while advancing innovation and industry growth.

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Hydrogen Trains: Revolutionary or Overhyped?

Authors: Matt Baumgurtel, William Ryan and Sam Poulsen

Hydrogen trains (**HTs**) have emerged as a promising solution to decarbonising rail transport globally. Innovative technology and strong environmental credentials have attracted significant attention to HTs in Australia and abroad.

However, much of Australia's rail network covers vast distances between remote and dispersedly spread population centres – begging the question: are HTs fit for these conditions?

In this article, we explore some of the basic science behind HTs, their operational advantages for Australia's network, the challenges HTs face in scaling up operations in Australia, and what might come next for the nascent industry.

Hydrogen Trains: What are they?

Australia is on an ambitious path to reach net zero carbon emissions by 2050. Part of that journey will require decarbonising railway transport and replacing diesel locomotives with cleaner alternatives. HTs are fast becoming a promising solution to lift the environmental credentials of the industry. Using hydrogen as a fuel either within a combustion engine or to power a chemical reaction with oxygen in fuel cells, HTs can generate energy to power train motors.[1] Advantageously, HTs generate only water and heat as by-products and do not produce carbon emissions or air pollution.[2] Where feed hydrogen has been produced from clean energy sources such as wind and solar, HTs tend to have very low lifecycle emissions.[3]

Conversely, diesel engine trains (**DETs**) account for 60 per cent of the total direct and indirect emissions from the Australian national rail carbon footprint.[4] Although rail is the least emissions-intensive mode of passenger transport (according to the International Energy Agency),[5] DET emissions have, among other things, detrimental health consequences for Australians. The Australian Cancer Council has noted that 1.2 million Australians are exposed to diesel engine exhaust chemicals each year, and that people operating in transport are at higher risk of exposure.[6] DET chemicals increase the risk of operators developing long-term health problems, negatively impacting public health costs. These health outcomes are avoided with HTs.

So, despite their environmental and health-related benefits, why have HTs not taken off? Below, we explore some key challenges to HT implementation across Australia's rail network, and how those challenges might be addressed.

Challenges to Implementation

Use Cases: Where Hydrogen Trains Will Work, and Where They Won't

In the race to de-carbonise rolling stock, one of the largest producers of HTs in Germany has claimed HTs will almost always lose to battery-electric trains (**BETs**) in procurement tenders in Europe.[7] This is because railways in central Europe are usually close to stations with overhead charging lines that can charge BETs.[8] This logic might also be applied to Australia's urban railways which are typically close to charging stations in population centres around the country. HTs may not be appropriate on these railway networks, where BETs better suit existing charging infrastructure.

However, HTs are typically capable of travelling much greater distances than BETs. HTs may therefore find success in the vast Australian rail networks that cover greater distances than urban centre networks and do not have charging infrastructure available. Further, using BETs on remote rail networks would not be economical given limitations on load capacity of existing batteries.[9] Australia's dispersed population centres and remote communities such as mining outposts require trains that can travel routes spanning hundreds, if not thousands, of kilometres. Promisingly, HTs look set to meet these demands. One HT model has, for example, been demonstrated to travel nearly 3,000km without refuelling.[10] While this distance was likely due to optimised testing conditions, in 2022 another model was demonstrated to travel 1,175km without refuelling during the normal course of operation in Germany.[11]

Infrastructure

However, HT technology is complex and requires the support of specialised infrastructure. With specialisation comes cost, and this is particularly apparent in remote regions where infrastructure costs are typically higher than in urban regions.[12] HT re-fuelling stations, for example, are more complex than typical DET stations due to technical requirements of hydrogen storage at high-pressure or in cryogenic tanks.[13] This may mean that using HTs in certain applications such as remote mining, port or rail corridor locations are not immediately economical compared to DETs given the associated costs with setting up HT refuelling capabilities.[14] Accordingly, proponents of HTs must also focus on reducing the costs associated with HT re-fuelling infrastructure.

Promisingly, the outlook on investment in the HT industry appears positive. The Australian Renewable Energy Agency announced on 21 December 2023 that it had shortlisted six applicants for its AUD $2 billion Hydrogen Headstart Program (**Program**). The Program will support large scale-renewable hydrogen production projects across multiple states in Australia,[15] and is part of a broader $127 billion pipeline of announced hydrogen industry investment in Australia.[16] The Program puts Australia on a policy and strategic trajectory towards developing key infrastructure associated with HTs such as refuelling stations and will lay a solid foundation of investment to support this nascent industry. HT proponents may be able to capitalise on this investment to scale up HT use across Australia and into remote regions. In the 2024 Federal Budget, the Federal Government allocated a further $8 billion in funding to support the production of renewable hydrogen through tax incentives and programs including the Program.

Safety

Hydrogen-related disasters, including the 1937 Hindenburg Blimp fire and the 2011 explosion at the Fukushima nuclear power plant have instilled public reluctance to accept hydrogen as a future fuel technology.[17] This reluctance has fed into perceptions around the safety of HTs. In our previous article, we noted that hydrogen properties call for specific safety requirements and infrastructure to ensure hydrogen can be transported, stored and delivered safely. Hydrogen safety issues usually fit into two categories, materials-related issues (e.g., components cannot withstand the high-pressure storage), and handling-related issues (e.g., human error).[18] Addressing these issues suitably will be relevant to the successful uptake of hydrogen use in rail contexts. However, with appropriate industry standards and education these concerns are likely to fade as HT innovation continues. Key to this change will be HT proponents making use of large public schemes available such as the Program to invest in certification and safety measures.

What's Next?

The Australian Federal Government released its National Rail Procurement and Manufacturing Strategy in November 2023 (**Strategy**). The Strategy forms part of a National Rail Manufacturing Plan (**Plan**) and outlines the Government's commitment to "simplify procurement, harmonise standards across states and territories, increase innovation, and improve skills and capabilities in the rail manufacturing sector".[19] The Government's Strategy, Plan and Program individually and collectively indicate a policy and strategic shift towards supporting the hydrogen and railway industries with the development of innovative and decarbonising technologies. Further, these policies may pave the way for future proponents of HTs to invest in and support this nascent industry.

While some concerns must be addressed before HTs become commonplace, HTs are on track to change the rail industry in Australia. HT environmental credentials and applications for long-haul routes position HTs as attractive to governments, investors and consumers alike.

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Decarbonising Aviation: The Flight Plan to a Low Carbon Future

Authors: Matt Baumgurtel, William Ryan, Conor Bates and Sam Poulsen

The aviation industry has connected Australians to the world since the early 20th century. In many ways, however, the environment has footed the bill for the industry's progress – although signs of change are taking off. We explore recent industry trends, challenges and opportunities available to the aviation industry to meet decarbonisation targets, plus delve into the new technologies revolutionising aviation.

Recent industry announcements

Despite the national trend towards emissions reduction, Australia's aviation emissions continue to increase.[1] Although aviation is considered a 'hard-to-abate' emissions sector, the Australian Government is committed to assisting the industry reach net zero. For example, the Australian Jet Zero Council (**Council**) was announced in June 2023. The Council brings together a cross-section of aviation industry stakeholders to:[2]

1. lead efforts to achieve net zero aviation;
2. advise the Government on sustainable aviation matters including adopting sustainable aviation fuel (**SAF**), measures to reduce emissions and ways of securing our supply chains; and
3. support industry decarbonisation efforts.

Relatedly, in September 2023, the Government released its Aviation Green Paper (**Green Paper**). The Green Paper outlines the Government's policy direction for the aviation sector up to 2050, including its focus on sustainability.[3]

These commitments demonstrate the increased governmental focus on decarbonising the Australian aviation industry, including supporting the Government's wider legislated targets of Australia reaching net zero by 2050.

The Government's Aviation White Paper (**White Paper**) is expected to be released in late 2024. The White Paper will complement the Green Paper and set the long-term policies to guide the next generation of growth and innovation in the aviation sector.[4] The first listed priority of the White Paper is to maximise the aviation sector's contribution to achieving net zero carbon emissions, including through SAF and emerging technologies.[5] Additionally, the Government has announced the Emerging Aviation Technology Partnerships Program, which will fund and support development of innovative aviation technologies including low and zero emissions propulsion systems.[6]

New technologies transforming the industry

The majority of industry emissions stem from operating planes. Airlines must reduce these emissions to facilitate the industry's net-zero transition.[7]

A number of solutions have been put forward to reduce emissions, as follows.

Hydrogen powered aircraft

The advantages of hydrogen as a transport fuel is well documented. Hydrogen technologies are attractive to airlines because they have the major benefit of producing only water and heat as the byproduct of energy production and so are emissions and air-pollutant free.

However, hydrogen-powered aviation depends on complex technology and associated infrastructure (as discussed in our previous article). As an example, hydrogen-powered aviation infrastructure involves establishing bespoke refuelling stations as well as deploying parking stands which can accommodate different sized aircraft.

Further, upgrading airports globally with uniform hydrogen-supporting infrastructure is a key barrier preventing hydrogen powered aircraft from becoming commonplace on long-haul routes. Unpredictability in routes, emergency landings, and changes to schedules (among other things) mean that airlines require ubiquitous infrastructure to operate and service their fleets.

By contrast, it is more probable that hydrogen planes will be deployed for short-haul applications within Australia. The domestic aviation industry has already demonstrated an interest. For example, Australian airline Regional Express recently partnered with Dovetail Electric Aviation to trial aircraft fitted with hydrogen-electric engine technology.[8] Further, Stralis Aero, a Queensland-based organisation, is developing retrofitted hydrogen fuel cell engines on smaller planes.[9]

Government support has been encouraging. Recent initiatives including the Hydrogen Headstart Program may assist the Australian aviation industry to develop the supporting infrastructure required to get the hydrogen planes off the ground.[10]

Electric powered aircraft

Electric powered aircraft are propelled by a battery system that replaces fuel-powered piston and turbine engines.[11] Similar to hydrogen-powered planes, this technology is likely to be more relevant to domestic flights than long-haul flights. Trialling battery electric planes in commuter, regional and short-range environments will be fundamental in developing more energy efficient, climate-friendly and cost-effective larger aircraft. This sentiment is supported by recent announcements in the Green Paper which indicate electric aircraft will be limited to routes less than 500km due to battery energy density limitations. However, not to diminish the importance of these aircraft, Dovetail Electric Aviation has received AUD $3 million in funding from the Australian Government to convert turbine-powered planes into electric-powered aircraft.[12] This investment and others like it suggest the Government is supportive of bringing electric planes to market for short-range flights.

Sustainable aviation fuel

SAF is likely the key to unlocking the aviation industry's net zero ambitions. SAF (which describes non-petroleum feedstock) can:

1. reduce CO2 emissions by up to 80 per cent;
2. be produced from a variety of waste products;[13]
3. integrate easily with existing aircraft engines;
4. provide superior range to other technologies; and
5. be easily scaled.[14]

These advantages make SAF a strong contender to dominate a net zero aviation industry.[15]

Government support for SAF

In support of SAF uptake, in 2023, the Commonwealth Scientific and Industrial Research Organisation (**CSIRO**) released the Sustainable Aviation Fuel Roadmap (**Roadmap**). The CSIRO suggests that Australia is in a prime position to develop a domestic SAF industry, identifies opportunities to produce and scale production, and highlights the challenges this nascent industry will face.[16] These findings are important, given that SAF currently accounts for just 0.2 per cent of global jet fuel use.[17] However, the proportion of SAF in global jet fuel supply is expected to increase rapidly. Already, the contribution of SAF is triple that produced in 2022, and it is expected to triple once again in 2024 to 1.875 billion litres.[18]

To read more on the opportunity to invest in the Australian SAF industry, see our expert insights series with John Sheehy and Rodrigo Arias of Pottinger.

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Industry support of SAF

Promisingly, the industry has started to invest in the infrastructure required to support SAF in Australia. Boeing and Wagner have commenced the design and construction of Australia's first steady supply of SAF in Queensland.[19] and LanzaJet and Jet Zero have committed to a novel licence and engineering agreement to convert bioethanol into SAF.[20] Further, domestic carriers including Qantas and Virgin Australia have committed to utilising more SAF in their operations. Specifically, Qantas is targeting 10 per cent of its fleet to be powered by SAF by 2030.[21]

These commitments are important given the 'green premium' that SAF currently demands, being two to four times the cost of standard jet fuel.[22] Since fuel represents 30-40 per cent of an airline's cost base, the green premium will heavily impact airlines' bottom lines.[23] However, economies of scale and appropriate government support are likely to reduce this cost over time. This trajectory, coupled with SAF's ability to integrate with existing technology, is likely to make SAF the favourite of airlines and manufacturers.

The road ahead for sustainable aviation

The path to decarbonising Australia's aviation industry is challenging but promising. Government initiatives, such as the Australian Jet Zero Council and the Aviation Green Paper, reflect a strong commitment to achieving net-zero aviation by 2050. Emerging technologies, including hydrogen and electric-powered aircraft, offer innovative solutions, particularly for short-haul flights. However, the infrastructure and technological limitations of these alternatives mean their full potential is still up in the air.

SAF stands out as the most viable near-term solution, capable of significantly reducing emissions while integrating with existing aircraft and infrastructure. Although SAF currently comes with a 'green premium,' increasing investments and scaling production should lower costs, making it an essential tool in reducing the aviation industry's carbon footprint. As the industry navigates these new opportunities and challenges, ongoing government support, coupled with advancements in technology, will be crucial to realising a sustainable future for aviation.

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[2]Australian Jet Zero council (Web Page) <https://www.infrastructure.gov.au/infrastructure-transport-vehicles/aviation/australian-jet-zero-council>.

[3]Aviation Green Paper (n 1).

[4]Aviation White Paper <https://www.infrastructure.gov.au/infrastructure-transport-vehicles/aviation/aviation-white-paper>.

[5]Ibid.

[6]Aviation Green Paper (n 1) 89.

[7]Other changes which are not discussed in this article include the adoption of more advanced plane materials such as carbon fibre, on-ground operational and maintenance improvements, and carbon offsetting (Ibid 76).

[8]Ibid 89.

[9]Ibid.

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[13]Net Zero 2050: Sustainable Aviation Fuels (Web Page) <https://www.iata.org/en/iata-repository/pressroom/fact-sheets/fact-sheet—alternative-fuels/> 1.

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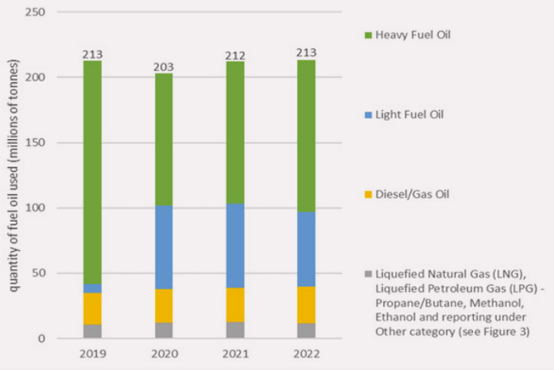
The Future of Alternative Marine Fuels for Sustainable Shipping

Authors: Matt Baumgurtel, Adriaan van der Merwe, Megan Chau and Eamonn Carpenter

The maritime industry is on a journey to decarbonise. Currently accounting for approximately 3 per cent of the world's total CO2 emissions, the shipping sector is facing mounting societal and regulatory pressure to transition to more sustainable practices.[1]

In this article, we explore the types of traditional and alternative marine fuels, give an overview of the changing attitudes towards alternative fuels and highlight the changes in the regulatory landscape.

Currently, the most common marine fuels are Heavy Fuel Oil (**HFO**), Light Fuel Oil and Diesel / Gas Oil (together, **Traditional Marine Fuels**) (see below).[2]



These Traditional Marine Fuels emit around 1 gigatonne of greenhouse gas (**GHG**) emissions per year, including sulphur oxides (**SOx**) and nitrogen oxides (**NOx**), which account for approximately 2.5 per cent of global GHG emissions annually.[3]

The International Maritime Organization (**IMO**) has set a goal of achieving net-zero emissions by approximately 2050, with a short-term goal of having zero, or near-zero, GHG emission technologies, fuels, or energy sources making up at least 5 per cent of the fuel mix.[4] Accordingly, there are a number of alternative marine fuels which are being pursued as low-GHG alternatives (**Alternative Marine Fuels**).

Types of Alternative Marine Fuels

Ammonia

Ammonia is a mix of nitrogen and hydrogen, which does not emit any CO2 during combustion. Ammonia has half the energy density of Traditional Marine Fuels (though higher than hydrogen) and is highly toxic, flammable, and corrosive, which necessitates specialised storage and handling.[5] However, green-ammonia production should scale with the continued uptake of renewable energy and additional benefits from the existing infrastructure resulting from its use in agriculture.

Liquefied Natural Gas

Liquefied Natural Gas (**LNG**) is natural gas cooled to a liquid state, making it more compact for storage and transport. As a marine fuel, LNG offers significant environmental advantages, including lower emissions of SOx and NOx, compared to traditional HFO.[6] However, LNG is still a fossil fuel and sits between the potential future fuels like ammonia, hydrogen or methanol, and Traditional Marine Fuels. As a result, it is seen as a bridging fuel that can help achieve emission reduction targets while the use of Alternative Marine Fuels are being scaled up.[7]

Biofuels

Biofuels, which are derived from organic materials such as plant oils, animal fats and recycled cooking oils, present an alternative to fossil fuels for the maritime sector. Biofuels can significantly reduce greenhouse gas emissions, with some biofuels offering up to an 80 per cent reduction in GHG emissions compared to conventional fuels.[8] However, the sustainability of biofuels depends on the ability to preserve their source. For example, using crops for fuel can compete with priority for food production and lead to deforestation. Additionally, the maritime sector is in direct competition with the uptake of sustainable aviation fuel (**SAF**).[9] SAF is produced from the same cooking oils and animal fat waste used to create marine biofuels. Although SAF has higher production costs than marine biofuels, the aviation industry's margins are better suited to absorbing or passing on the costs, meaning the aviation industry is likely to absorb a majority of supply moving forward.[10]

Hydrogen

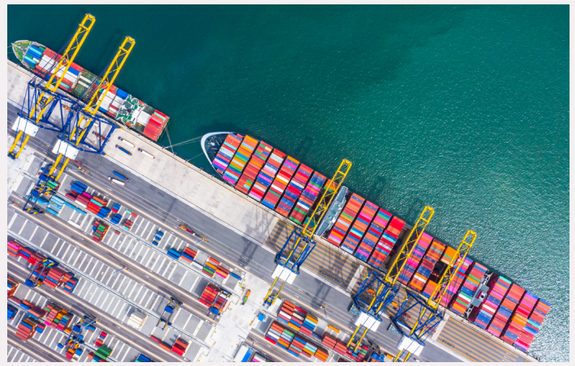
Hydrogen is a 'zero-emission fuel', making it a highly attractive option for the maritime industry's decarbonisation. Hydrogen combustion produces very little NOx, no SOx and no carbon dioxide (**CO2**) emissions. However, it is one of the least energy dense fuel sources by volume (raising operating expense concerns) despite having high energy content by weight.[11] Hydrogen storage and handling also pose significant challenges, requiring advanced storage solutions such as cryogenic tanks, and the conversion of hydrogen via compression, liquefaction, or chemical compounding.[12] There is no one size fits all solution to storage, as no single storage method is capable of housing high density energy without expending large amounts of energy to safely store that energy.[13] As a result shipowners are facing high capital expenditure costs associated with transitioning to hydrogen including costs associated with fitting and maintaining the required storage and engines for hydrogen use, as well as production, conversion and training-related costs.

Methanol

Methanol, a liquid at ambient temperatures, offers a practical alternative marine fuel due to its ease of storage and handling. It can be produced from various feedstocks, including natural gas, biomass, and even CO2. Methanol combustion results in lower emissions of SOx, NOx, and particulate matter compared to Traditional Marine Fuels. However, methanol has a lower energy density than HFO, necessitating larger storage volumes on ships. Additionally, methanol production is extremely limited.[14]

Changing attitudes – Decarbonisation efforts

In 2023, the Global Centre for Maritime Decarbonisation and Boston Consulting Group conducted an industry survey with 128 shipowners and operators who collectively owned or operated over 14,000 merchant vessels.[15] While 73 per cent viewed getting to net-zero operations as a strategic priority, the lack of commercial incentives and low economic viability of these fuels have been identified as one of the leading challenges for adoption.[16] Specifically, Alternative Marine Fuels require investment from shipowners to build, or retrofit, their vessels to use such fuels,[17] attract a premium over conventional fuels, require higher-skilled labour to operate and have a lower energy density.[18]



Regulations supporting the transition

The IMO's goal of achieving net-zero emissions by approximately 2050 are supported by the following climate policies:

1. **US Inflation Reduction Act** – the US Inflation Reduction Act incentivises developers and investors to produce Alternative Maritime Fuels through providing tax credits for the production of clean hydrogen, and additional credits for carbon sequestration.[19]
2. **EU Emissions Trading System** – the EU Emissions Trading System acts as a cap-and-trade program which now applies to the maritime and aviation industries. It requires companies to purchase allowances (a right to emit a certain amount of GHGs) if their vessels travel within the EU.[20] This program, over time, will increase the price of these allowances which incentives vessel owners to transition to Alternative Marine Fuels.[21]
3. **FuelEU Maritime Regulation** – the FuelEU Maritime regulation (entering into force in 2025) sets GHG emissions intensity requirements on the energy used by ships over 5000 gross tonnage trading in the EU, targeting a 2 per cent decrease in GHG by 2025, and an 80 per cent decrease by 2050.[22] Notably, this target does not just cover CO2 emissions, but undertakes a full lifecycle assessment of the fuels used onboard, from well-to-wake.[23]
4. **FuelEU pooling mechanisms** – the FuelEU pooling mechanism under the Fuel EU Maritime Regulation allows for vessel in compliance with the set annual GHG targets to share any extra allowance or surplus GHG emission with other vessels. In this sense, overachieving vessels are able to monetise on compliance – or fleet owners may take a broader view of their fleet's compliance in line with the policy. However, there is not currently a government run marketplace for the surplus.[24]

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What does the future hold?

The shipping sector is being driven by both penalties and incentives to adopt Alternative Marine Fuels. This combination of regulatory pressure, and growing understanding and investment into the production and storage of biofuels, methanol and hydrogen derivative products will continue to propel the shipping sector to transition away from Traditional Marine fuels. The challenges facing shipowners are notable and the apprehension is warranted. However, as the transition continues shipowners will need to determine (perhaps irrespective of the commercial viability) when, not if, they will adopt more widespread use of Alternative Marine Fuels.

The Hamilton Locke team advises across the energy project life cycle – from project development, grid connection, financing, construction, including the buying and selling of development and operating projects. For more information, please contact Hamilton Locke New Energy Partner Matt Baumgurtel.

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New Energy Expert Insights

Ready for take-off – Investment in Australian Sustainable Aviation Fuel with John Sheehy and Rodrigo Arias Lopez – Pottinger

In this edition of New Energy Expert Insights, we sat down with John Sheehy, CEO of Pottinger and Rodrigo Arias Lopez, Executive Director at Pottinger, to discuss the investment outlook of sustainable Aviation fuel in Australia.

John Sheehy is the CEO of Pottinger. He has advised private and public sector clients in relation to strategy, M&A, risk, innovation and management in over 40 countries, spanning six continents, with a combined value of over $50 billion.

Rodrigo Arias Lopez is an Executive Director at Pottinger. He has deep experience in corporate finance and capital markets having worked in Europe, the Americas and Australia. He advises both private and public clients across multiple industries on corporate strategy, M&A and capital raising.

Pottinger is an independent advisor to leading companies, state and federal governments, industry associations and growth stage companies on M&A, capital raising, corporate strategy and public policy. Pottinger was recently selected to advise on the Sugar Plus Industry Roadmap as part of the Queensland Government's plans to further the biofuels industry, including Sustainable Aviation Fuel (**SAF**).[1]

Tell us about the opportunities for investors in the adoption of SAF?

There will be many opportunities for investors, with different risk-reward profiles, to get involved in the SAF industry.

These include:

1. **real assets:** some investors might choose to invest directly into agricultural land and the feedstock required to produce SAF. This investment opportunity is capital intensive and is likely to be most attractive for incumbent, well capitalised agricultural and/or real estate specialists;
2. **early stage:** the domestic SAF industry currently requires funding for SAF pilot plants. These equity cheques will be modest but require investors which have the right kind of risk appetite for technology and commercialisation risk. Venture capital and private equity investors will be logical participants
3. **medium term:** as SAF facilities scale and technologies mature, investment opportunities will become larger as the funding of bigger production facilities becomes the focus. This will require both equity and debt funding and will involve larger institutional investors such as infrastructure fund managers and climate/transition fund managers; and
4. **long term:** as the asset class matures and resembles more well established renewable energy projects with long-term, inflation-protected offtake agreements, we will see more project-level financing and institutional infrastructure investors/LPs including project finance.

Are you seeing capital being deployed into SAF at scale?

Capital deployment is still relatively modest and largely driven by equity co-commitments by joint venture partners under cooperation agreements to develop pilot facilities.

Before capital can be deployed at scale, businesses need to demonstrate that the underlying technology works. A common measure of technological maturity is NASA's Technology Readiness Level (**TRL**). The TRL scale is a globally accepted benchmarking tool for tracking progress and supporting the development of a specific technology rated on a scale from one-nine; a project or technology with a TRL level one represents early stage research. Meanwhile, TRL level nine means deployment of technology at scale on a commercial basis.[2]

There are multiple technological approaches to the production of SAF. Current SAF technologies vary in terms of maturity. In Australia, we are yet to see any project reach full commercial scale.

What are the prominent SAF technologies?

SAF production technologies can be grouped based on the type of feedstock used. Mainstream examples include:

1. **HEFA** (**hydroprocessed esters and fatty acids**) which uses fats, oils and greases;
2. **ATJ** (**alcohol to jet**) which uses carbohydrate-rich crops such as sugarcane and agricultural residues to produce ethanol and then kerosene; and
3. **Power to liquid**, which uses captured CO2 and hydrogen.

Is there a preferred SAF technology, or is there space for multiple SAF technologies?

If you look at the volume of SAF required, technologies and feedstocks will not be mutually exclusive. Multiple technologies and multiple feedstocks will be required in order to meet local and global demand.

When compared with the cost of producing jet fuel from fossil fuels, SAF production is still uneconomical (SAF costs anywhere between 2x and 4x per litre of fuel). This can largely be attributed to a lack of economies of scale. Among mainstream technologies, power to liquid is the costliest of the options.

We expect the price gap between fossil-fuel based jet fuel and SAF to materially narrow over time as fossil fuels are phased out, and carbon taxes and green fuel mandates are implemented.

While there will be movement on both sides of the equation to bring the production costs of SAF in line with jet fuel in the next 10-20 years, we need to bridge the gap faster.

What is the role of Government, and how can it incentivise best practice?

The Government needs to go in early when no one else will.

Two things needed from the government in the near term are:

1. active funding of businesses to create pilot projects (for around AUD$5-50 million) to finish feasibility studies and get the pilots off the ground; and
2. supporting demand: One way to do that is to make sure that airlines are mandated to use a certain percentage of SAF produced, as well as requiring a fuel mix (as is the case in many other jurisdictions).

How can we accelerate SAF uptake?

Long Term Capital

While near-term subsidies are crucial to get the wheels turning, we also require capital providers with a long term investment horizon. Project returns will be attractive over time, but not all investors have the ability to place truly long term bets. Government can accelerate SAF uptake by acting as a long term equity partner to project sponsors.

Fierce Collaboration

Work is being done at different levels of SAF to foster that fierce level of collaboration. For example, the sugar industry has its own long-term strategic roadmap, "SugarPlus",[3] which determines its role in the bioeconomy.

How are transactions being structured to ensure adequate risk allocation?

We are looking at how to bring people, skills and capital together.

We are doing this through a prolific use of unincorporated and incorporated joint ventures or cooperation agreements (**JV**). JVs are an effective tool to support consortium members or JV partners to share risks and rewards, as well as foster this fierce collaboration before the large amounts of capital start to flow.

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How are SAF developers and manufacturers ensuring that the fuel is sustainable?

We must think about the CO2 footprint of the operation.

Three key considerations are:

1. **responsible power sourcing**: there is an abundance of renewable energy in Australia. Renewables are a very appropriate way of looking at how to power these facilities. This can be done through on-site generation or power purchase arrangements;[4]
2. **processing of emissions:** we must look at the potential for carbon capture and storage; and
3. **ecological conservation:** as an example, land under cane is often high value and follows the coastline, there are a lot of ecological considerations to be taken into account.

Creating SAF in an eco-friendly way is essential and must be incorporated into government policy considerations.

How does SAF tie in with the broader Eco-Infrastructure conversation?

'Eco-Infrastructure' is a term we use at Pottinger that relates to the transition to environmentally-focused projects that can, over time, take on the attributes of the infrastructure asset class. By this, we mean long dated offtake contracts as well as inflation-linked revenues that present low risk with moderate returns. SAF-related assets and infrastructure will become a new infrastructure-like asset class in the near-term.

Closing remarks

Australia has access to all the right factors to become a global leader in SAF production. We have a large land mass, the right feedstocks, a highly skilled labour force and huge pools of institutional capital which support the business case for the development of the industry. We have two major airlines and a huge amount of air travel per capita which alone support a local business case.

The Hamilton Locke team advises across the energy project life cycle – from project development, grid connection, financing, and construction, including the buying and selling of development and operating projects. For more information, please contact Matt Baumgurtel.

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New Energy Expert Insights

Embracing the risks of the EV Revolution - Mia Barnard and Mike Erskine of GHD

In this edition of New Energy Expert Insights, we sat down with industry experts, Mia Barnard and Mike Erskine of GHD to consider the opportunities and risks that asset owners are likely to face during the transition to electric vehicles (EVs).

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

GHD has been recognised for their global contributions through the Zero Emission Vehicles Climate Change Business Journal Award in 2022 which involved a Fleet Net Zero study to optimise logistic, financial, environmental and energy efficiencies.

What are some of the risks that the energy transition is presenting to owners of assets such as residential and commercial buildings, shopping centres, parking lots, and airports?

Safety

Many of the risks associated with the conventional fossil fuel system will move from petrol stations into high urban density places such as car parks. EVs contain varying sizes of Lithium-ion Batteries (LiBs), which changes the fire risk profile associated with the vehicles in the car parks.

While the probability of an EV catching fire is lower (about 80x lower[1]) than an internal combustion engine vehicle (ICEV) fire, the consequences can be more severe due to thermal runaway and the increased difficulty in extinguishing fires compared to ICEV fires. This changes the risk profile for asset owners.

Infrastructure Compatibility

Asset owners who install infrastructure for charging EVs will need to assess the energy demand associated with this, which may require upgrades to electrical infrastructure and increases in local energy network capacity. We need to address this challenge by building and renovating existing buildings with forward thinking approaches.

Risk must be systematically embraced and turned into pragmatic solutions through design. Builders and developers must adhere to robust minimum standards now that look very clearly into the lens of the future. If builders and developers operate on the edge of the current law and not much more, there are problems that could manifest in 10 - 20 years' time.

We can learn lessons from events like the 2017 Grenfell disaster in the UK for example, where a devastating fire started by a refrigerator tragically killed 72 people as the building exterior was made of flammable cladding. It will become increasingly important to have a safety case approach for large buildings. With the increased fuel load from EVs within high urban density buildings, we need to implement much more mature risk management processes.

Building standards and existing buildings must now embrace infrastructure compatibility for technology that will continue to develop over the coming decades. These buildings will stand for the next 50 years during one of the biggest transitions that society has ever made (within a very short time) and a failure to address electrical, fire and safety risks appropriately could be devastating.

Why would an asset owner be willing to take these risks?

Transport makes up about 19 per cent of Australia's emissions and passenger and light vehicles (including light delivery vehicles used by logistics companies) make up 60 per cent of Australia's emissions. EVs are a technology that people can access today, to reduce emissions. This makes them low hanging fruit for government to actively promote in Australia, even though the technology is ahead of current regulation.

Embracing a technology that is ahead of current regulation comes with risks. For example, if 200 per cent more energy is going into the buildings, 200 per cent more energy must come out - Einstein got it right! This means that 200 per cent more ventilation is required, and we are not seeing this in the regulations.

The transition to EVs is happening, and asset owners which don't take on the new and different risks associated with providing EV charging may risk losing a competitive advantage. Whether asset owners provide charging or not, EVs will be coming to their premises, and it is important to embrace, prepare for, and protect yourself from this future with a formalised risk assessment process that goes beyond current regulations.

How can asset owners assess and manage these risks, and what strategies can mitigate these risks effectively?

Knowledge is the biggest factor. Asset owners can't claim that they didn't know that there is a change happening so there is a burden on them to be informed and risk aware. Asset owners need to understand what the transition means to their asset and what the impact will be. An informed asset owner will understand when the threshold of action is and have a financial and business resilience plan to respond to those action points.

GHD applies a range of quantitative and semi-quantitative risk scenarios and approaches that we utilise from oil and gas which have the leading edge because of the energy intensity. In addition, aviation and rail have techniques that we utilise to reduce risks down to what we call 'so far as is reasonably practicable'. With any process it's the quality of input, data and assumptions that drive the process to give the quality of output of thinking for these plans.

Do you consider government interventions (such as the National Construction Code (NCC) mandate measures to support the future installation of EV charging for at least 10 per cent EV charging car spaces in new developments) to be valuable in driving EV uptake, or do you think there will be appetite for voluntary uptake among asset owners?

The Tug-of-War: Compliance and Convenience

If an asset owner complies with the strict 10 per cent, they must ask themselves whether they will comply with the 10 per cent and no more, if they try and provide a charge point for every car in the car park, or something in between? For example, as more consumers switch to EVs as the government are incentivising them to, asset owners for residential buildings must accept that this is what tenants are going to expect.

It is important to consider that with the range of EVs and average travel patterns in our large towns and cities, a high proportion of users would only need to charge their vehicle once or twice a week, and would have other public charging options available to them. To balance cost-effective infrastructure with customer expectations, it will be important to consider the role of shared charging facilities in residential premises.

It is a choice between complying with the mandatory rules, or whether asset owners go beyond this to ensure that all tenants are provided with the convenience of being able to use the facilities when they want in individual allocated parking spaces.

The Balancing Act: Innovation and Legal Oversight

Government mandates such as this (the **NCC**) indicate to asset owners that there will be developments around the provision of EV chargers but right now, there is a lack of clarity on how exactly that will unfold. This requires asset owners to begin preparing for future changes long before they have been realised.

This is also seen in the context of assets with long life spans such as rail infrastructure with rolling stock. Many owners are presented with difficult and expensive decisions as most of the stock will need to be replaced within the next seven years, but many of the desirable technologies are not market ready. They are presented with two choices:

1. extend the life of the asset a little bit longer and wait for the technology; or
2. make decisions now that will be effective up until 2050-2060.

As the supply of EV chargers increases, might tighter regulation be needed to protect asset owners and users from low quality installations?

Asset owners need to ensure that they find safe ways to meet mandatory targets, while balancing other drivers such as profitability.

They also might find creative solutions to meet regulatory requirements without making large investments by looking at their environmental, social and governance (**ESG**) approach, and reducing the number of parking spaces available in their developments and using the space for something completely different. This would also offer emission reduction benefits by supporting a shift to wider sustainable transport patterns. In doing so, asset owners could meet ESG targets whilst avoiding capital outlays for EV charging infrastructure.

Conclusion

The energy transition presents significant challenges for asset owners across sectors, particularly in navigating safety risks, infrastructure compatibility, and evolving regulations. The shift towards EVs demands greater attention to fire safety, ventilation, and power requirements, which exceed current regulatory frameworks.

Asset owners must proactively embrace these changes, not only to mitigate risks but also to maintain their competitive edge. As the demand for EV charging infrastructure grows, balancing compliance with legal mandates and ensuring the safety and integrity of installations becomes crucial. Government interventions, while helpful, must be supplemented by forward-thinking strategies from asset owners, who should adopt robust risk management processes and invest in resilient, future-proof infrastructure.

The Hamilton Locke team advises across the energy project life cycle – from project development, grid connection, financing, and construction, including the buying and selling of development and operating projects. For more information, please contact Matt Baumgurtel.

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(Consultant, admitted in Ireland, not admitted in Australia)

[1]Source: Parliament of New South Wales, Joint Standing Committee on Road Safety (Sept 2024), Electric and hybrid vehicle batteries

New Energy Expert Insights

Community Engagement for Better New Energy Projects with Amy Kean and Luke Osborne – Stride Renewables

Authors: Matt Baumgurtel and William Ryan

In this edition of New Energy Expert Insights, we sit down with Amy Kean and Luke Osborne, Partners at Stride Renewables, to discuss their experiences with community engagement in New Energy developments.

Amy Kean has over 20 years of experience in energy markets across the public and private sectors, nationally and internationally. Amy is the Chair of the NSW Decarbonisation Innovation Hub and the Electrification and Energy Systems Network. Prior to establishing Stride, Amy was the NSW Government Renewable Energy Advocate.

Luke Osborne is a business leader with a diverse, multidisciplinary background and 20 years' experience in the renewable energy industry. He has an MBA, is a Fellow of Engineers Australia, and has a technical background overlaid with decades of commercial and management experience. He was a part of the founding team and the Chief Operating Officer of two market-leading companies: Windlab Systems and Reposit Power.

Stride Renewables is a boutique advisory firm specialising in New Energy. With a team of experts in government policy, development, and stakeholder engagement, Stride helps businesses secure contracts, navigate government policy and social licence, and develop cost-efficient projects.

What is the role of community engagement in building projects more efficiently?

If done right, community engagement coupled with co-designed shared benefits can build trust for a project, minimise planning delays and lead to quicker and smoother development. By proactively involving key community stakeholders, developers can mitigate the risk of scope creep and related cost blowouts caused by conflicts and opposition, particularly in the planning process.

At what stage in the project lifecycle should developers engage with the community? Additionally, is there a risk of community consultation fatigue if engagement efforts are not strategically managed?

Community engagement often gets criticism for starting too early, with some suggesting it should wait until project plans are more developed. However, involving the community at the outset is the best approach.

Early engagement allows developers to understand the social context and stakeholders who are important to the project, gathering ideas from a local audience, building trust, and gaining initial support. Neighbours and landowners are key players, so it's important to connect with them right from the start.

Although early engagement can be tough – since projects are under public scrutiny before they are fully defined – it's critical to listen and establish relationships, ideally in-person and convenient to them. Time spent in kitchen table conversations – especially prioritising those most directly affected, like landowners, Traditional Owners and neighbours – is never wasted and has arguably saved many projects. However hard it is, it's better to be honest about not having all the answers than to remain silent, which can breed rumours and misconceptions.

Delaying or avoiding engagement to prevent community fatigue or to await more concrete designs can lead to bigger problems down the line. Missing out on valuable input or overlooking risks can be a setback. Postponing engagement can also risk people feeling left out, becoming suspicious, and negative and inaccurate perceptions may take hold.

"Once trust is eroded it's hard to regain. That's why timely and thoughtful community engagement is crucial for the success of infrastructure projects."

Early conversations should focus on understanding local needs and concerns, ideally by working together to shape the project. This teamwork allows for feedback and adjustments, making the project more relevant and fostering trust.

Could you provide examples of innovative approaches to community engagement that developers might adopt to ensure that the concerns of local communities are effectively heard and addressed?

Early and on-ground engagement and co-designed shared benefit initiatives were success factors for both the Blind Creek Solar Farm and Coonooer Bridge Wind Farm projects.

Stride helped develop Blind Creek Solar Farm, which won the 2022 Clean Energy Council Community Engagement Award for its social licence, pioneering solar farm benefit sharing scheme and agrisolar initiatives. The project consulted early with nearby landowners, First Nations, local Councils and community to design a shared-benefit model tailored to identified needs. The developers led regular in-person individual conversations, community open days and online information sessions (during COVID lockdowns) and were pro-active in local media on the project. The project received 37 supportive public submissions and only 3 public objections in the NSW planning assessment process.

Luke pioneered community co-ownership combined with a rent proximity model for Coonooer Bridge Wind Farm in Victoria, which also received a Clean Energy Council Community Engagement Award. The project had an unprecedented quick planning approval, reducing development costs. The first of its kind at the time, these approaches paved the way for best practice shared benefit models in the industry.

The Blind Creek Solar Farm project, located near Bungendore, NSW. Image courtesy of Stride and Blind Creek Solar Farm Project.

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How can developers engage with communities in a way that is meaningful and moves beyond tokenistic or 'box ticking' gestures?

Early-stage funding initiatives are excellent in supporting short-term needs and activities. However, building trust is also about investing in genuine engagement, responsive project design as well as co-designing legacy benefits over the construction and decades of project operation.

Stride takes a more nuanced approach to engagement, following a thorough consideration of the social context, site and stakeholder mapping. This includes:

- Prioritising in-person and on-ground engagement with the key stakeholders directly involved with the project (landowners, Traditional Owners and neighbours) in the early stages.
- Leading discussions with the proposed benefits of the project, and an open approach to listening and learning.
- Subsequent tailored engagement with those not directly involved, such as the community advocates, elected officials, local Council, and residents. We always advise verbal and in-person interactions over email to avoid superficial touchpoints, matters getting lost in translation, and issues escalating.

The approach relies on early internal financial decisions around shared benefits and who may receive these, with a view to co-designing the benefits along the way. Stride has a proven shared benefit model which supports this.

For the Blind Creek Solar Farm project, as an example, we identified and engaged several stakeholder groups as a priority within a 6.5km radius directly affected by the project, obtaining their views and developing a shared benefit scheme: the local eco-living community, immediate neighbours, and more distant residents. Broad engagement took many forms over the 18-month period, both individually and in groups, and heavily focussed on in-person and verbal communications. There was a deliberate early media release to be transparent and earn community trust from the outset. It was intentionally different to common industry practice of keeping a low profile and signing non-disclosure agreements.

The outcome: Over 100 people were involved in outreach activities and they welcomed the early and honest face-to-face interactions, as well as COVID-safe opportunities to learn about the project and provide feedback. At the time, Blind Creek was also proudly the first solar farm with a Community Shared Benefit Scheme, sharing $3.5 million in financial benefits directly with neighbours and the broader community. This aligns with a vision of sustainable agriculture, environmental restoration, and community building, including $1.25 million to the local swimming pool.

Stride helped develop Blind Creek Solar Farm in consultation with nearby landowners, First Nations, local Councils and community. Image courtesy of Stride and Blind Creek Solar Farm Project.

What is your perspective on the current dialogue between communities, governments and developers regarding project proposals?

The dialogue between communities, governments and developers regarding New Energy project proposals has become increasingly intricate and contentious.

Over the past 20 years, while the industry has gained substantial knowledge, rapid scaling has resulted in poorly managed projects becoming increasingly common. Expectedly, community outrage has increased, especially in regional areas earmarked for numerous project proposals and concerns around cumulative impacts.

In NSW, we are also seeing local governments actively ensuring they benefit directly from local projects, unfortunately sometimes without meaningful social licence outcomes. State Government review of projects has also escalated. In NSW, 59 per cent of solar and wind projects are currently being reviewed by the Independent Planning Commission (triggered by more than 50 public objections received in the assessment process irrespective of location), reflecting the lack of social licence in the industry broadly.

"There is a trend towards legislating community engagement, however, mandatory benchmarks should not compromise taking a tailored approach to engaging with each community."

Beyond compliance regimes, the Australian Government is now also rewarding meaningful efforts on gaining social licence. Projects competing for government support via renewables tenders like NSW Renewable Energy Zone Access Rights and the Federal Capacity Investment Scheme must now demonstrate community and First Nations engagement credentials and acceptance. This is resulting in renewed and amplified focus in these areas for developers intending to win government funding and underwriting.

How can governments and developers engage with First Nations people in a meaningful way? Are recent examples of First Nations equity involvement in projects likely to become mainstream?

Through the NSW Energy Roadmap and the Federal Capacity Investment Scheme, State and Federal governments are encouraging developers to share economic benefits with First Nations communities in ways which haven't been done before, aiming to enable economic empowerment. For this to happen, it is crucial for the developers (and the industry more broadly) to deeply understand the legislation at play (such as Native Title) as well as the local context, including the history, hierarchy, and dynamics of the Traditional Owners, governing bodies and other indigenous groups. Just as with any community, there are complexities and sensitivities that need to be managed carefully to build trust.

First Nations communities typically require time to build trust. Engaging with these communities in person and allowing sufficient time for meaningful interactions are essential steps. It's also important to consider whether the consulted parties have (and/or require) the resources to fully participate in engagement processes, as they are often under-resourced.

Equity involvement is one option within a suite of shared benefit opportunities available for First Nation's communities and needs to be carefully considered within the local context, project financials and via engagement with the key stakeholders.

While equity might seem straightforward, it can be complex to administer and may not always yield the expected results. Instead, there may be other effective ways to support communities, such as funding for local initiatives (ranger programs, youth or childcare centres), healthcare support, training and apprenticeship programs, or rent payments to local organisations to acknowledge the connection to Country on project sites.

What can Australia learn from other countries in respect of First Nations engagement?

"Australia can gain valuable insights from international examples of First Nations engagement, but it's important to recognise that each country's approach is influenced by its unique legal, tax, and community support systems, and importantly the capability of local groups."

Direct comparisons are not always straightforward due to these differences.

In Canada, successful projects have often stemmed from strong equity partnerships by involving Indigenous communities in local projects, such as through employment and educational schemes. However, these models may not be easily transferable to Australia due to differing tax systems and the differing nature of community governance. For example, in Australia, large-scale projects involving more than 50 people can face challenges in terms of bankability and financial viability.

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New Zealand offers another example where benefits are sometimes distributed through co-operative ownership models, rather than individual ownership. This approach has provided long-term benefits to indigenous communities by linking homeownership to cooperative structures and may be particularly beneficial where communities have a limited number of homeowners.

What do you foresee as the most significant trends that will occur in the community engagement space over the next five to ten years?

Our industry must re-learn to engage with communities in a tailored, effective manner. A similar paradigm-shift occurred in the early 2010s. Simultaneously, we expect governments will continue to be heavily involved in the new energy transition in regulating such engagement.

Specifically, we believe that agri-renewables ('agrivoltaics') are poised for significant growth. With increased stakes and a faster pace, developers who have a better grasp of community engagement in this sector will advance at a faster pace.

Given the higher stakes now, it's crucial that the industry's approach to community engagement transforms to ensure the success of projects and the New Energy transition.

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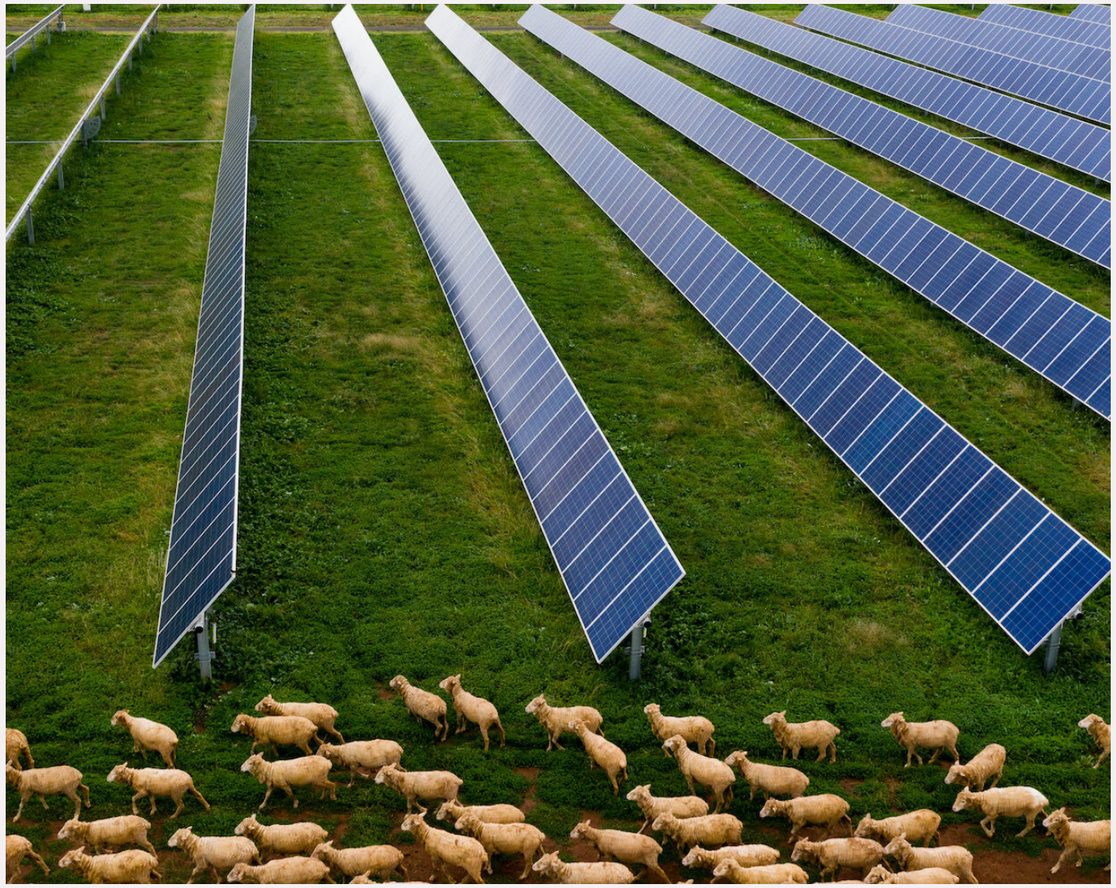
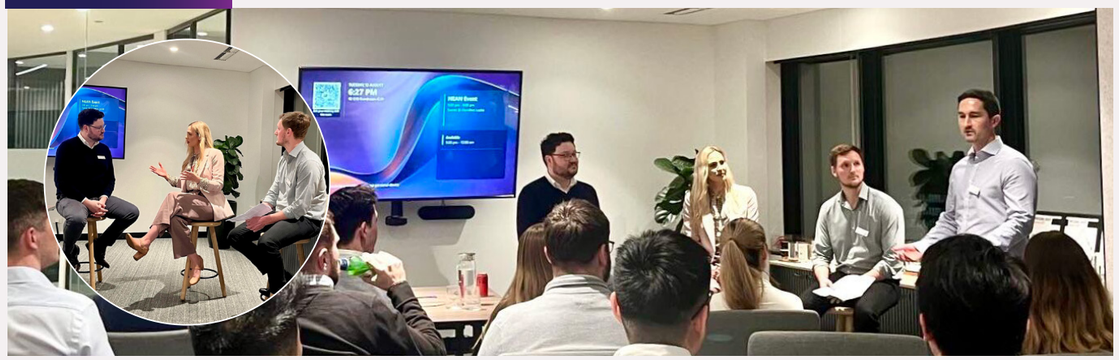


Stride helped develop Blind Creek Solar Farm in consultation with nearby landowners, First Nations, local Councils and community. Image courtesy of Stride and Blind Creek Solar Farm Project.

New Energy Associates Network - NEAN: Fireside Chat on the Intersection of Distributed Energy Resources and Agrivoltaics.

NEAN is a network for New Energy industry professionals from graduate to senior associate level, aimed at building connections and sharing industry knowledge among members. NEAN seeks to foster and grow relationships between industry stakeholders at the earlier stages of their careers.

Recent Events



On 12 August 2024, Dr. Madeline Taylor sat down for a fireside chat on the intersection of Distributed Energy Resources (**DER**) and agrivoltaics with New Energy experts, Special Counsel Adriaan van der Merwe and Senior Associate William Ryan.

It was great to see so many minds eager to discuss the current state of play in the adoption of agrivoltaics in Australia, the symbiotic relationship between solar and farming, insights from global approaches and the importance of social contract (between landowners, developers and government) for the wide adoption and integration of DER.

While other countries like Japan, Germany, and the US are more progressed with agrivoltaics, Australia still lacks the necessary research and advisory support to drive its adoption. There is also a significant gap in understanding the ecological impact of agrivoltaics in arid environments. Dr. Madeline Taylor's ongoing research on the 'Australian Agrivoltaics Regulation Model' will play a crucial role in shaping our understanding of what broader adoption of agrivoltaics in Australia could look like.

We asked Dr. Madeline Taylor what she would like to see the government do to accelerate the adoption of DER. She emphasised the need for the Australian government to introduce an agricultural decarbonisation policy and urged the government to be bold, advocating for a regulatory sandbox to foster and support innovation.

Inaugural NEAN Pub Social!

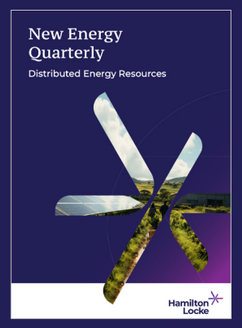
On 15 October, the New Energy Associates Network came together for our first-ever pub social at the Edinburgh Castle, and it could not have been better! The relaxed setting made for great conversations, laughs, and a true sense of community.

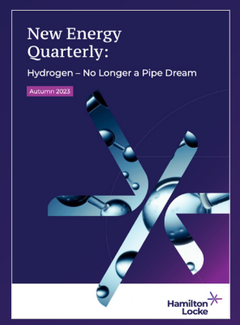
Thank you to everyone who joined. It was great to connect, share insights, and strengthen relationships with such an inspiring group of peers in the New Energy sector.

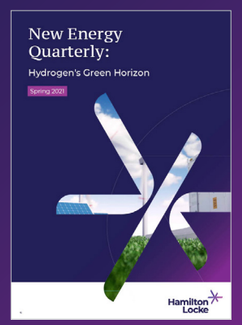
We're looking forward to the next one already and hope to see you all at the upcoming NEAN fireside chat! Details to come shortly.

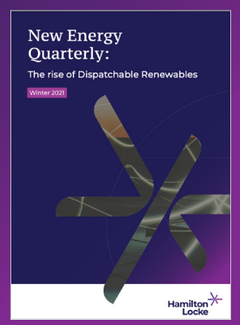
Want to be added to the mailing list for the next NEAN event? Please reach out to David O'Carroll.

New Energy Quarterlies









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