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Green Hydrogen: A Hype or a Solution to Australian Defence Force Energy Resilience?

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The defence sector globally faces persistent challenges in reducing emissions due to energy-intensive operations; however, opportunities exist to mitigate these impacts through energy demand management and the adoption of sustainable alternatives. Hydrogen has emerged as a promising option for Defence given its flexible production pathways and potential compatibility with existing fuel systems. However, current analyses often fail to explicitly integrate hydrogen within Australian Defence strategic frameworks, air power requirements and the unique vulnerabilities of northern bases. This paper addresses this gap by grounding the discussion in the Defence Net Zero Strategy and the Defence Future Energy Strategy, evaluating hydrogen's technological readiness and operational applicability, and assessing its potential to enhance energy resilience at remote northern air bases, including airbases of the Royal Australian Air Force in Darwin and Tindal. The paper provides a Defence-specific assessment of hydrogen's feasibility and identifies priority areas for research, trials and capability development to support future energy transitions.

1. Introduction

Energy resilience and security are crucial to Australian Defence operations, ensuring that military capabilities remain operational even amid energy disruptions (Bateman & Bergin, 2020). Disruptions to energy supply in remote locations, such as northern bases, could significantly impact air operations, strategic deterrence and Australia's northern posture (Department of Defence, 2023). As the strategic environment in the Indo-Pacific intensifies, the Australian Defence Force (ADF) faces mounting pressure to ensure a secure and flexible energy supply while reducing dependence on vulnerable fuel logistics chains (Department of Defence, 2023). The Defence Future Energy Strategy and the Defence Net Zero Strategy explicitly highlight the need to diversify energy sources, integrate renewables and enhance energy security without compromising operational readiness (Department of Defence, 2024a, 2024b). In this context, hydrogen and hydrogen-derived fuels have been identified as promising candidates for future Defence energy systems. Defence is exploring and adopting renewable energy sources, such as solar, wind, hydrogen and sustainable biofuels, to reduce reliance on traditional fuels (Department of Defence, 2024a).

Renewable resources like solar and wind energy, while promising to reduce carbon footprints, face challenges in the ADF operational sector due to their intermittent nature and the logistical complexities of deploying them in remote or austere environments (Cole, 2022). Meeting the high and continuous power demands of Defence operations often requires substantial energy storage solutions, which can be costly and logistically burdensome (Palmer, 2009). These

limitations highlight the need for domestically generated hybrid energy systems that combine renewables with more stable and portable energy sources, such as hydrogen or sustainable fuels, to ensure operational reliability and resilience (Armstrong et al., 2016).

Low-carbon liquid fuels (LCLFs) offer promising alternatives to conventional fossil fuels, but their adoption entails specific risks and challenges (International Energy Agency, 2020). One significant concern is the scalability of production; ensuring a consistent, large-scale supply of LCLFs requires substantial investment in advanced infrastructure and in ensuring feedstock availability (CSIRO, 2024c). Additionally, some LCLFs, such as those derived from bio-based sources, could compete with food production or lead to land-use changes if not managed responsibly (CSIRO, 2023). Moreover, the lifecycle emissions of some LCLFs can vary depending on the production process, potentially undermining their environmental advantages if not carefully monitored (Khan et al., 2023).

Hydrogen has therefore gained significant attention as a transformative energy solution that can help reduce Defence's dependence on conventional, fossil-based fuels while supporting broader sustainability targets. Hydrogen can be produced locally, offering a solution to the logistical challenges associated with traditional fuel supply chains, especially in remote or austere environments where access to conventional energy sources may be limited or compromised (Van Renssen, 2020). Furthermore, hydrogen fuel cells offer a quiet, efficient and low-emission power source, making them ideal for stealth operations and environmentally sensitive missions (Balat, 2008). Hydrogen's potential

to enhance base-level resilience through local production and hybrid microgrid integration is noted in the Defence Science and Technology Group's emerging technology assessments (Defence Science and Technology Group, 2022).

One of the significant advantages of hydrogen is its capacity for long-term energy storage, which can be integrated with renewable energy systems (Armaroli & Balzani, 2011). By leveraging hydrogen, Defence can store surplus renewable energy from sources such as solar and wind, ensuring a stable and reliable power supply even during periods of low generation. This adaptability not only enhances operational resilience but also contributes to the national shift toward a more sustainable energy future by supporting the continuous supply of energy even when renewable sources are intermittent.

As hydrogen technologies continue to mature, Defence is well positioned to lead in the adoption and integration of clean energy solutions. The development of hydrogen infrastructure, including production, storage and distribution, will help advance these technologies across industries and provide a model for broader societal adoption, particularly in sectors that require resilient, low-emission energy solutions (CSIRO, 2024a). Ultimately, hydrogen's versatility and potential to provide a sustainable, resilient energy supply make it a crucial element in Defence's strategy to future-proof its energy needs. Whether used in ground vehicles, for remote power generation at bases or in fuel cells for various military applications, hydrogen provides a clean and efficient power source (Tillett, 2022).

However, the applicability of hydrogen to Defence – particularly air power – remains underexamined. While hydrogen shows promise for ground operations, distributed energy systems and base power generation, uncertainties remain regarding its scalability, technological readiness and integration with mission-critical systems. Given the strategic importance and unique vulnerabilities of northern air bases, early assessment and targeted trials are essential. This paper evaluates the feasibility and limitations of hydrogen-based technologies for Defence energy resilience. It assesses whether hydrogen represents a viable and scalable solution for the ADF's operational needs or remains a promising but still-developing alternative energy concept.

2. Emerging hydrogen technologies in the clean energy transition

Due to its adaptability, hydrogen can be transported in various forms, including natural gas or liquefied ammonia, both of which offer higher volumetric energy content (Van Renssen, 2020). This flexibility makes hydrogen a compelling option for sectors requiring reliable, transportable energy.

Hydrogen is categorised based on its production process, which impacts its environmental footprint. These categories include blue, grey, turquoise and green hydrogen, each representing different levels of sustainability (Newborough & Cooley, 2020). Grey hydrogen, the most common form, is produced from fossil fuels and emits significant carbon dioxide (CO₂). Blue hydrogen also relies on fossil fuels but incorporates carbon capture and storage

to mitigate emissions. Turquoise hydrogen is produced through methane pyrolysis, generating solid carbon as a by-product rather than CO₂.

Green hydrogen, however, stands out as the most environmentally friendly option. Produced using renewable electricity, such as wind or solar power, green hydrogen emits no greenhouse gases during its production process (Oliveira et al., 2021). This characteristic makes it particularly valuable for decarbonisation efforts as it can help reduce emissions across sectors such as industry, transport and Defence. For the Defence sector, which relies heavily on energy-intensive operations, green hydrogen offers a potential path to lower emissions while maintaining operational effectiveness.

Given its need for reliable energy in often remote or high-stakes environments, the ADF requires solutions that not only meet energy demands but also support sustainability goals. Traditional fuel sources, while effective, carry high environmental costs and vulnerabilities, such as dependence on imported fuels (Coyne, 2024). Green hydrogen offers a way to mitigate these issues, providing a clean and potentially domestic energy source.

Green hydrogen's advantages go beyond low emissions. Its production can be integrated with renewable sources such as solar or wind, enabling flexible generation across diverse environments. For the ADF, this flexibility could mean energy independence in remote locations and the ability to reduce its carbon footprint during operations. The adaptability of green hydrogen, coupled with Australia's rich renewable resources, makes it an attractive option for Defence applications.

However, despite its potential, green hydrogen faces significant challenges. The production, storage and transportation infrastructure required for hydrogen fuel is still developing and often costly (Mazloomi & Gomes, 2012). Additionally, hydrogen's low energy density and volatility pose technical challenges, requiring advances in safe, efficient storage methods (Younas et al., 2022). For the ADF, adopting green hydrogen at scale would necessitate substantial investment in new infrastructure and technology.

2.1. Direct air capture and carbon sequestration

Direct air capture (DAC) and carbon sequestration (CS) are complementary technologies that enhance the sustainability of green hydrogen production by mitigating carbon emissions across the energy supply chain (Lau et al., 2021; G. Li & Yao, 2024). Both methods aim to capture and store CO₂, though they differ in mechanisms and application contexts. DAC involves the direct removal of CO₂ from the atmosphere using chemical or physical processes (McQueen et al., 2021). The captured CO₂ can then be permanently stored underground or repurposed for industrial applications. In the context of green hydrogen production, DAC can offset residual emissions arising from electrolysis or other energy-intensive processes, particularly when the renewable energy supply is not entirely carbon-free (Kim et al., 2025).

When paired with green hydrogen production, DAC can support carbon-neutral energy systems by capturing CO₂

emissions and either storing them permanently underground or using them for beneficial purposes, such as enhanced oil recovery or synthetic fuel production (Lau et al., 2021; G. Li & Yao, 2024). This ensures that even minor emissions from hydrogen production are counterbalanced, enhancing the overall sustainability of hydrogen as an energy vector and supporting broader climate mitigation objectives.

DAC projects are increasingly moving from pilot studies to larger demonstration and commercial-scale facilities. In Australia, the Airthena DAC demonstrator, supported through the Government's Carbon Capture Technologies Program, employs adsorption-based capture technology at pilot scale (Department of Climate Change, Energy, the Environment and Water, 2024a). Globally, Climeworks Hinwil plant in Switzerland, the world's first commercial DAC facility, has been operating since 2017, capturing approximately 900 tonnes of CO₂ annually for agricultural use, while the Mammoth plant in Iceland now captures tens of thousands of tonnes of CO₂ per year using modular DAC units paired with geological storage (Climeworks, 2025). Additional projects, such as the STRATOS facility in Texas developed by 1PointFive and the Trinity Campus integrated DAC test facility in the Permian Basin, illustrate the expansion of DAC deployment toward climate-relevant scales, capturing hundreds of thousands of tonnes of CO₂ annually and testing integration with energy and industrial systems (Bekkering, 2025; McEwen, 2025). These global demonstrations provide insights into integrating DAC with renewable energy and hydrogen production pathways, which could inform future Defence energy resilience initiatives.

CS complements DAC by capturing CO₂ from specific sources, such as industrial facilities or energy generation systems, and storing it in geological formations or in long-term carbon sinks, such as soils and forests (Gibbins & Chalmers, 2008; Rosa & Mazzotti, 2022). While green hydrogen is produced from renewable energy, infrastructure and operational processes – including electrolyser manufacture and transport – can still generate CO₂ (Tao et al., 2022). CS can mitigate these emissions, making hydrogen production cleaner and more compatible with Defence or industrial decarbonisation goals. Furthermore, CS is particularly relevant in hybrid hydrogen production models, such as blue hydrogen, in which natural gas or coal is partially used in hydrogen production. Capturing CO₂ emissions from steam methane reforming or high-temperature electrolysis helps reduce the overall process's carbon intensity (AlHumaidan et al., 2023; Yu et al., 2021).

Integrating DAC and CS across large-scale hydrogen production systems enhances the sustainability and carbon-neutral potential of green hydrogen infrastructure (Ogden, 2003). As renewable energy becomes more widespread, employing these technologies to offset emissions from energy production and storage can support long-term operational resilience, particularly in regions where natural sequestration options are limited or unfeasible (Krevor et al., 2023). Collectively, DAC and CS provide a strategic approach to ensuring that hydrogen production not only meets energy demand but also contributes meaningfully to carbon mit-

igation and broader decarbonisation efforts, with implications for Defence and national energy security.

2.2. Key differences in how DAC and CS support green hydrogen

Carbon source. DAC captures CO₂ directly from the atmosphere, making it a more flexible and broadly applicable solution that can offset emissions across the entire hydrogen production process. CS typically captures CO₂ from specific sources, such as power plants or industrial emissions, and stores it in geological formations or through biological processes.

Implementation. DAC systems are more technological and industrial in nature, requiring energy input for the capture process and typically relying on renewable energy sources to be truly green. In contrast, CS can be integrated with existing industries, such as fossil fuel power plants or natural gas infrastructure, where captured CO₂ can be stored or utilised in industrial processes.

Geographical considerations. DAC can be deployed across diverse locations, making it an attractive option for hydrogen production facilities located far from natural sequestration sites. CS, on the other hand, is more site-specific and requires suitable geological formations for CO₂ storage, which limits its deployment in some regions.

Both DAC and CS are valuable technologies in enhancing the sustainability of green hydrogen production. DAC can play a pivotal role in offsetting residual emissions from hydrogen production, ensuring carbon neutrality, while CS can address emissions across a broader context, particularly those from infrastructure and transportation involved in hydrogen production. By integrating both technologies, green hydrogen can become an even more viable and effective solution for decarbonisation, supporting the transition to a cleaner, more resilient energy future across sectors such as Defence and industry.

3. Australian industrial growth in the green hydrogen sector

Australia has emerged as a key player in the global green hydrogen sector, driven by its abundant renewable energy resources, Government support, and increasing industrial interest. The country's commitment to decarbonisation, coupled with its vast potential for renewable energy production from solar, wind and hydro, positions it as a leader in developing green hydrogen technology and infrastructure (H. X. Li et al., 2020). Several factors contribute to Australia's industrial growth in the green hydrogen sector.

3.1. Renewable Energy Potential

Australia's vast landscapes, abundant sunshine and strong winds make it one of the world's most ideal locations for renewable energy production. The country is leveraging its natural resources to produce green hydrogen through electrolysis, in which renewable electricity from solar or wind power splits water into hydrogen and oxygen, with no carbon emissions (Sarker et al., 2023). The expansion

of renewable energy infrastructure is critical to driving the green hydrogen sector, and Australia is making significant investments to scale up renewable capacity. The potential for a renewable energy ‘superpower’ is a driving force behind the Government’s ambition to be a global leader in green hydrogen production.

3.2. Government support and policy initiatives

The Australian Government has recognised green hydrogen as a key component of its strategy to reduce carbon emissions and ensure energy resilience. In recent years, the Government has rolled out policies and strategies to accelerate the growth of the hydrogen sector. In 2024, Australia released the National Hydrogen Strategy 2024, which aims to make Australia a major global exporter of hydrogen by 2030 (Department of Climate Change, Energy, the Environment and Water, 2024e). This strategy focuses on supporting R&D, infrastructure development and policy frameworks to promote green hydrogen’s role in decarbonising sectors such as heavy industry, transportation and Defence. The Hydrogen Head Start program is a funding initiative introduced by the Australian Government to support the significant investment in hydrogen from global pipelines (Department of Climate Change, Energy, the Environment and Water, 2024c). The proposed Critical Minerals Production Tax Incentive and Hydrogen Production Tax Incentive are other Australian Government initiatives to enhance domestic hydrogen production (Australian Taxation Office, 2025). In addition to these initiatives, State governments are also contributing to this transition, especially the South Australian Government, which introduced the world’s first *Hydrogen and Renewable Energy Act 2023* with accompanying regulations (*Hydrogen and Renewable Energy Act 2023* [SA]).

Other Federal and State governments’ support includes funding for large-scale green hydrogen projects, including pilot programs and commercial-scale facilities that focus on local production and export opportunities. These initiatives are designed to stimulate investment, reduce production costs and drive innovation in the hydrogen industry.

3.3. Industrial investment and partnerships

Australia has seen a surge in investment from both domestic and international industries in the green hydrogen space. Major players in the energy sector, including large oil and gas companies, are actively exploring the production, storage and export of green hydrogen. Companies like Fortescue Future Industries, Woodside Energy and AGL Energy are pursuing large-scale green hydrogen projects across the country, aiming to capitalise on Australia’s competitive advantage in renewable energy resources (CSIRO, 2024b).

Partnerships between Australia and international markets are also contributing to growth. For example, Australia has entered into hydrogen export agreements with countries such as Japan, South Korea and Germany, eager to secure low-carbon energy sources to meet its net-zero commitments (International Energy Agency, 2022). These collaborations foster the development of a global green

hydrogen supply chain comprising production facilities, transport infrastructure and export ports (Panchenko et al., 2023).

3.4. Infrastructure development

Australia is advancing a substantial program of hydrogen-infrastructure development, reflecting its strategic ambition to position itself as a global leader in renewable hydrogen production, domestic utilisation and export. Significant investments are concentrated in designated ‘hydrogen hubs’, which aim to consolidate shared infrastructure for production, storage, distribution and export (Department of Climate Change, Energy, the Environment and Water, 2024b; Kar et al., 2023). The Port Bonython Hydrogen Hub in South Australia represents one of the most significant commitments, supported by federal and state funding, to establish an export-scale facility capable of accommodating large-volume shipments of hydrogen and ammonia (Department of Climate Change, Energy, the Environment and Water, 2023). In Western Australia, the Pilbara Hydrogen Hub is progressing toward the development of common-user infrastructure – including pipelines, port upgrades and storage facilities – intended to support industrial applications such as green steel and critical minerals processing (Net Zero Economy Authority, 2024). Complementing these export-oriented hubs, the Townsville Hydrogen Hub in Queensland is being developed to deliver renewable hydrogen for local transport and industrial uses, with capacity to scale towards export over time (Department of Climate Change, Energy, the Environment and Water, 2024d). Additional infrastructure is emerging through the Australian Government’s Regional Hydrogen Hubs Program, which funds planning and development across multiple sites, including Gladstone, Bell Bay, Kwinana and the Hunter region, enabling national coordination and reducing entry costs for industry users (Department of Climate Change, Energy, the Environment and Water, 2025).

At the domestic level, Australia is also deploying infrastructure that supports hydrogen integration into local energy systems. The Hydrogen Park Murray Valley (HyP Murray Valley) project on the New South Wales–Victoria border is constructing a 10 MW electrolyser to blend renewable hydrogen into the existing natural gas network, servicing more than 40,000 homes and businesses (Australian Gas Infrastructure Group, 2025). It marks one of the first large-scale applications of renewable hydrogen for household and commercial energy supply. In parallel, Australia is building hydrogen-refuelling infrastructure to stimulate demand in the transport sector (Department of Climate Change, Energy, the Environment and Water, 2025). The ACT Government, in collaboration with Hyundai, ActewAGL and Neoen Australia, established the country’s first public hydrogen refuelling station and procured a fleet of hydrogen fuel-cell vehicles to support its operation (CSIRO, 2025; Rattenbury, 2021). More recently, Viva Energy has opened Australia’s first publicly accessible commercial hydrogen-refuelling station in Geelong, supported by a 2.5 MW electrolyser capable of servicing heavy vehicles and complementing electric-vehicle charging facilities at the

same site (Viva Energy Australia, 2025). These investments demonstrate a deliberate national shift towards enabling hydrogen adoption across mobility, industry and distributed energy systems (Beech et al., 2024).

Collectively, these developments illustrate that Australia's hydrogen-infrastructure deployment is transitioning from isolated pilot studies to coordinated, large-scale implementation. While some significant projects have experienced delays or cancellations due to market challenges, the active construction of hubs, gas-blending facilities and refuelling networks signals maturing policy settings and stronger commercial momentum (Premier of Victoria, 2025). The coexistence of export-scale infrastructure and domestic-use projects underscores a dual-purpose national strategy: to integrate hydrogen within Australia's decarbonisation pathways while establishing the foundational assets required to compete in emerging global hydrogen markets.

3.5. Job creation and economic growth

The industrial growth of the green hydrogen sector is expected to create significant job opportunities in Australia. From research and development to the construction, operation and maintenance of hydrogen facilities, the green hydrogen industry offers a wide range of employment opportunities (Taylor, 2021). The Australian Government has identified hydrogen as a key area for economic diversification, particularly in regions that rely heavily on fossil fuel industries. Green hydrogen offers a sustainable alternative that can create jobs, boost regional economies and help Australia transition to a low-carbon future without sacrificing economic growth.

4. Challenges for Defence adoption of hydrogen

In the light of recent advancements in Australia's hydrogen sector, integrating hydrogen within the ADF presents substantial opportunities alongside significant challenges that must be strategically addressed to realise its full operational and sustainability potential.

4.1. Operational relevance to air power

Hydrogen's primary contribution to air power operations lies in ground-based energy support systems rather than direct replacement of conventional aviation fuels. Key applications include hydrogen-powered microgrids for critical airfield systems, backup power for command-and-control nodes, electrification of ground support equipment, and integration into distributed energy systems for runway and hangar operations. These applications align with Defence objectives to enhance operational resilience while maintaining sortie generation and platform performance (Department of Defence, 2024a). Nonetheless, uncertainties remain regarding the integration of hydrogen systems with existing operational infrastructure, the readiness of fuel-cell technologies for high-demand scenarios and the scalability required for continuous air operations in remote or austere environments.

4.2. Hydrogen and northern base resilience

Northern airbases of the Royal Australian Air Force (RAAF), such as RAAF Darwin and RAAF Tindal, exemplify strategic locations where hydrogen integration could strengthen operational resilience. Their geographic isolation increases vulnerability to disruptions in fuel supply, while exposure to climate-induced stresses exacerbates energy insecurity. Deploying co-located hydrogen production facilities – powered by solar, wind or hybrid systems – could reduce reliance on long-haul fuel convoys, enhance redundancy in critical systems, support distributed and hardened energy architectures, and increase operational autonomy during contingencies. These outcomes are consistent with strategic priorities articulated in the National Defence: Defence Strategic Review 2023 (Department of Defence, 2023).

Despite its potential, the implementation of green hydrogen in Defence faces several critical barriers: high production costs, particularly in the early stages, present substantial economic challenges. Technical limitations related to hydrogen storage, transport and integration with legacy infrastructure remain key hurdles (Panchenko et al., 2023). Moreover, operational considerations – including safety, handling protocols and environmental factors in northern and remote locations – require comprehensive mitigation strategies (Kar et al., 2023). Overcoming these challenges will necessitate coordinated investment in technological innovation, infrastructure development, workforce training, and ongoing trials to ensure operational compatibility and energy resilience across Defence facilities.

5. Conclusion

Green hydrogen presents a strategic opportunity to enhance energy resilience and operational effectiveness within the ADF. Its adoption could reduce reliance on fossil fuels, strengthen energy security and contribute to Defence's sustainability objectives. However, large-scale implementation is currently constrained by high production costs, technical limitations in storage and transportation, and the need for extensive infrastructure development (Department of Defence, 2024a, 2024b). Despite these challenges, hydrogen's versatility – particularly in supporting ground-based operations, distributed energy systems and northern base resilience – highlights its potential to play a transformative role in future Defence energy systems. Realising these benefits will require targeted research, investment in innovative technologies, and structured trials to ensure operational compatibility and energy reliability across Defence facilities.

The future integration of green hydrogen into the ADF depends on addressing technological and economic barriers through coordinated policy, strategic capability development and international collaboration. Sustained investment in infrastructure, workforce capability and logistics innovation will be critical to reducing costs, improving efficiency and enabling safe, large-scale deployment. If these challenges are effectively managed, green hydrogen could significantly reduce Defence's carbon footprint, enhance

operational energy security, and support resilient operations in remote and strategic locations. Ultimately, the role of hydrogen in the ADF's energy strategy will depend on continued innovation, evidence-based trials, and the alignment of technological capabilities with Defence operational requirements.

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References

- AlHumaidan, F. S., Absi Halabi, M., Rana, M. S., & Vinoba, M. (2023). Blue hydrogen: Current status and future technologies. *Energy Conversion and Management*, 283, 116840. <https://doi.org/10.1016/j.enconman.2023.116840>
- Armaroli, N., & Balzani, V. (2011). The hydrogen issue. *ChemSusChem*, 4(1), 21–36. <https://doi.org/10.1002/cssc.201000182>
- Armstrong, R. C., Wolfram, C., De Jong, K. P., Gross, R., Lewis, N. S., Boardman, B., & Ramana, M. V. (2016). The frontiers of energy. *Nature Energy*, 1(1), 1–8. <https://doi.org/10.1038/nenergy.2015.20>
- Australian Gas Infrastructure Group. (2025). *Hydrogen Park Murray Valley: Lessons Learned Report – June 2025*. <https://arena.gov.au/assets/2025/06/AGIG-HyP-Murray-Valley-AGIG-Lessons-Learned-Report-June-2025.pdf>
- Australian Taxation Office. (2025). *Critical Minerals and Hydrogen Production Tax Incentives*. Australian Government. <https://www.ato.gov.au/about-ato/new-legislation/in-detail/businesses/hydrogen-production-and-critical-minerals-tax-incentives>
- Balat, M. (2008). Potential importance of hydrogen as a future solution to environmental and transportation problems. *International Journal of Hydrogen Energy*, 33(15), 4013–4029. <https://doi.org/10.1016/j.ijhydene.2008.05.047>
- Bateman, S., & Bergin, A. (2020). Naval, national security and defence issues from climate change. In J. McDonald, J. McGee, & R. Barnes (Eds.), *Research Handbook on Climate Change, Oceans and Coasts* (pp. 409–424). Edward Elgar Publishing. <https://doi.org/10.4337/9781788112239.00030>
- Beech, J., Chia, T. L., & Moore, R. (2024). *Market and Technology Report Edition 1 –Infrastructure: – New Energies Service Station Project*. Viva Energy Australia. <https://arena.gov.au/assets/2024/06/Viva---New-Energies-Service-Station-Geelong-Demonstration-Project---Market-and-Technology-Report-1.pdf>
- Bekker, B. (2025). *The 5 Best Direct Air Capture Carbon Credit Projects of 2026*. Regreener. <https://www.regreener.earth/blog/the-5-best-direct-air-capture-carbon-credit-projects-of-2026>
- Climeworks. (2025). *Climeworks makes history with world's first commercial direct air capture plant*. <https://climeworks.com/press-release/today-climeworks-is-unveiling-its-proudest-achievement>
- Cole, B. (2022). Decreasing Reliance on Fossil Fuels to Increase Defence Capability. *Air/Space*, 2. <https://airpower.airforce.gov.au/sites/default/files/2022-12/Decreasing%20Reliance%20On%20Fossil%20Fuels%20To%20Increase%20Defence%20Capability.pdf>
- Coyne, J. (2024). *The urgent need for a strategic overhaul in Australia's Defence approach to fuel resilience*. The Strategist. <https://www.aspistrategist.org.au/the-urgent-need-for-a-strategic-overhaul-in-australias-defence-approach-to-fuel-resilience/>
- CSIRO. (2023). *Sustainable Aviation Fuel Roadmap*. Australian Government. <https://doi.org/10.25919/7dd3-fn74>
- CSIRO. (2024a). *National Hydrogen Roadmap: Pathways to an economically sustainable hydrogen industry in Australia*. Australian Government. <https://www.csiro.au/en/research/environmental-impacts/fuels/hydrogen/hydrogen-roadmap>
- CSIRO. (2024b). *National hydrogen roadmap update: Australia's hydrogen industry development*. Australian Government. <https://www.csiro.au/en/research/environmental-impacts/fuels/hydrogen/hydrogen-roadmap>
- CSIRO. (2024c). *Sustainable Aviation Fuel: State of Play 2024 – One year on from the Australian SAF Roadmap, November 2024*. Australian Government. <https://www.csiro.au/en/news/all/articles/2024/november/saf-state-of-play-report>
- CSIRO. (2025). *Canberra Hydrogen Refuelling Station*. Australian Government. <https://research.csiro.au/hyresource/canberra-hydrogen-refuelling-station/>
- Defence Science and Technology Group. (2022). *Emerging technology assessments*. Australian Government.
- Department of Climate Change, Energy, the Environment and Water. (2023). *\$70m for South Australia's Port Bonython Hydrogen Hub*. Australian Government. <https://www.dccew.gov.au/about/news/sa-bonython-hydrogen-hub>
- Department of Climate Change, Energy, the Environment and Water. (2024a). *Carbon Capture Technologies Program grant recipients announced*. Australian Government. <https://www.dccew.gov.au/about/news/carbon-capture-technologies-program-grant-recipients-announced>
- Department of Climate Change, Energy, the Environment and Water. (2024b). *Construction begins on Hydrogen Park Murray Valley*. Australian Government. <https://www.dccew.gov.au/about/news/construction-begins-hydrogen-park-murray-valley>
- Department of Climate Change, Energy, the Environment and Water. (2024c). *Hydrogen HeadStart program*. Australian Government. <https://www.dccew.gov.au/energy/hydrogen/hydrogen-headstart-program>
- Department of Climate Change, Energy, the Environment and Water. (2024d). *Hydrogen hub for Townsville*. Australian Government. <https://www.dccew.gov.au/about/news/hydrogen-hub-townsville>
- Department of Climate Change, Energy, the Environment and Water. (2024e). *National Hydrogen Strategy 2024*. Australian Government. <https://www.dccew.gov.au/sites/default/files/documents/national-hydrogen-strategy-2024.pdf>

- Department of Climate Change, Energy, the Environment and Water. (2025). *Building regional hydrogen hubs*. Australian Government. <https://www.dcccew.gov.au/energy/hydrogen/building-regional-hydrogen-hubs>
- Department of Defence. (2023). *National Defence: Defence Strategic Review*. Australian Government.
- Department of Defence. (2024a). *Defence Future Energy Strategy*. Australian Government.
- Department of Defence. (2024b). *Defence Net Zero Strategy*. Australian Government.
- Gibbins, J., & Chalmers, H. (2008). Carbon capture and storage. *Energy Policy*, 36(12), 4317–4322. <https://doi.org/10.1016/j.enpol.2008.09.058>
- Hydrogen and Renewable Energy Act 2023 (SA). <https://www.legislation.sa.gov.au/lz/path=/c/a/hydrogen%20and%20renewable%20energy%20act%202023>
- International Energy Agency. (2022). *Australian Clean Hydrogen Trade Program (ACHTP)*. International Energy Agency. <https://www.iea.org/policies/14738-australian-clean-hydrogen-trade-program-achtp>
- Kar, S. K., Sinha, A. S. K., Bansal, R., Shabani, B., & Harichandan, S. (2023). Overview of hydrogen economy in Australia. *Wiley Interdisciplinary Reviews: Energy and Environment*, 12(1), e457.
- Khan, M. Z. A., Khan, H. A., Ravi, S. S., Turner, J. W. G., & Aziz, M. (2023). Potential of clean liquid fuels in decarbonizing transportation sector – An overlooked net-zero pathway? *Renewable and Sustainable Energy Reviews*, 183, 113483. <https://doi.org/10.1016/j.rser.2023.113483>
- Kim, S., Park, J., & Lee, J. H. (2025). Integrating solid direct air capture systems with green hydrogen production: Economic benefits and curtailment reduction. *Computers & Chemical Engineering*, 198, 109102. <https://doi.org/10.1016/j.compchemeng.2025.109102>
- Krevor, S., De Coninck, H., Gasda, S. E., Ghaleigh, N. S., de Gooyert, V., Hajibeygi, H., Juanes, R., Neufeld, J., Robert, J. J., & Swennenhuis, F. (2023). Subsurface carbon dioxide and hydrogen storage for a sustainable energy future. *Nature Reviews Earth & Environment*, 4(2), 102–118. <https://doi.org/10.1038/s43017-022-00376-8>
- Lau, H. C., Ramakrishna, S., Zhang, K., & Radhamani, A. V. (2021). The Role of Carbon Capture and Storage in the Energy Transition. *Energy & Fuels*, 35(9), 7364–7386. <https://doi.org/10.1021/acs.energyfuels.1c00032>
- Li, G., & Yao, J. (2024). Direct Air Capture (DAC) for Achieving Net-Zero CO₂ Emissions: Advances, Applications, and Challenges. *Eng*, 5(3), 1298–1336. <https://doi.org/10.3390/eng5030069>
- Li, H. X., Edwards, D. J., Hosseini, M. R., & Costin, G. P. (2020). A review on renewable energy transition in Australia: An updated depiction. *Journal of Cleaner Production*, 242, 118475. <https://doi.org/10.1016/j.jclepro.2019.118475>
- Mazloomi, K., & Gomes, C. (2012). Hydrogen as an energy carrier: Prospects and challenges. *Renewable and Sustainable Energy Reviews*, 16(5), 3024–3033. <https://doi.org/10.1016/j.rser.2012.02.028>
- McEwen, M. (2025). *Trinity Campus in Permian Basin will test direct air capture, store CO₂ by 2026*. Midland Reporter–Telegram. <https://www.mrt.com/business/oil/article/trinity-campus-dac-testbed-21199524.php>
- McQueen, N., Gomes, K. V., McCormick, C., Blumanthal, K., Pisciotta, M., & Wilcox, J. (2021). A review of direct air capture (DAC): scaling up commercial technologies and innovating for the future. *Progress in Energy*, 3(3), 032001. <https://doi.org/10.1088/2516-1083/abf1ce>
- Net Zero Economy Authority. (2024). *Pilbara Hydrogen Hub*. Australian Government. <https://www.netzero.gov.au/pilbara-hydrogen-hub>
- Newborough, M., & Cooley, G. (2020). Developments in the global hydrogen market: The spectrum of hydrogen colours. *Fuel Cells Bulletin*, 2020(11), 16–22. [https://doi.org/10.1016/S1464-2859\(20\)30546-0](https://doi.org/10.1016/S1464-2859(20)30546-0)
- Ogden, J. M. (2003). Modeling Infrastructure for a Fossil Hydrogen Energy System with CO₂ Sequestration. In J. Gale & Y. Kaya (Eds.), *Greenhouse Gas Control Technologies – 6th International Conference* (pp. 1069–1074). Pergamon.
- Oliveira, A. M., Beswick, R. R., & Yan, Y. (2021). A green hydrogen economy for a renewable energy society. *Current Opinion in Chemical Engineering*, 33, 100701. <https://doi.org/10.1016/j.coche.2021.100701>
- Palmer, J. L. (2009). Addressing energy as a military cost. *Australian Defence Force Journal*, 178, 6–31.
- Panchenko, V. A., Daus, Y. V., Kovalev, A. A., Yudaev, I. V., & Litti, Y. V. (2023). Prospects for the production of green hydrogen: Review of countries with high potential. *International Journal of Hydrogen Energy*, 48(12), 4551–4571. <https://doi.org/10.1016/j.ijhydene.2022.10.084>
- Premier of Victoria. (2025). *Leading the Way in Renewable Hydrogen Transport*. Victorian Government. <https://www.premier.vic.gov.au/leading-way-renewable-hydrogen-transport>
- Rattenbury, S. (2021). *Australia's first public hydrogen refuelling station opens in Canberra*. ACT Government. https://www.cmtedd.act.gov.au/open_government/inform/act_government_media_releases/rattenbury/2021/australias-first-public-hydrogen-refuelling-station-opens-in-canberra
- Rosa, L., & Mazzotti, M. (2022). Potential for hydrogen production from sustainable biomass with carbon capture and storage. *Renewable and Sustainable Energy Reviews*, 157, 112123. <https://doi.org/10.1016/j.rser.2022.112123>
- Sarker, A. K., Azad, A. K., Rasul, M. G., & Doppalapudi, A. T. (2023). Prospect of Green Hydrogen Generation from Hybrid Renewable Energy Sources: A Review. *Energies*, 16(3), 1556. <https://doi.org/10.3390/en16031556>

- Tao, M., Azzolini, J. A., Stechel, E. B., Ayers, K. E., & Valdez, T. I. (2022). Review – Engineering Challenges in Green Hydrogen Production Systems. *Journal of The Electrochemical Society*, 169(5), 054503. <https://doi.org/10.1149/1945-7111/ac6983>
- Taylor, A. (2021). *Future hydrogen industry to create jobs, lower emissions and boost regional Australia*. Australian Government. <https://www.minister.industry.gov.au/ministers/taylor/media-releases/future-hydrogen-industry-create-jobs-lower-emissions-and-boost-regional-australia>
- Tillett, A. (2022). *Defence looks to hydrogen to fulfil ambitious climate goal*. Financial Review. <https://www.afr.com/politics/federal/defence-looks-to-hydrogen-to-fulfil-ambitious-climate-goal-20220912-p5bhcr>
- Van Renssen, S. (2020). The hydrogen solution? *Nature Climate Change*, 10, 799–801. <https://doi.org/10.1038/s41558-020-0891-0>
- Viva Energy Australia. (2025). *Australia enters new energy future with first public hydrogen station at Viva Energy Hub in Geelong*. Viva Energy Australia. <https://www.vivaenergy.com.au/media/news/2025/australia-enters-new-energy-future-with-first-public-hydrogen-station-at-viva-energy-hub-in-geelong>
- Younas, M., Shafique, S., Hafeez, A., Javed, F., & Rehman, F. (2022). An Overview of Hydrogen Production: Current Status, Potential, and Challenges. *Fuel*, 316, 123317. <https://doi.org/10.1016/j.fuel.2022.123317>
- Yu, M., Wang, K., & Vredenburg, H. (2021). Insights into low-carbon hydrogen production methods: Green, blue and aqua hydrogen. *International Journal of Hydrogen Energy*, 46(41), 21261–21273. <https://doi.org/10.1016/j.ijhydene.2021.04.016>