



A Refreshed National Hydrogen Strategy: Building the Future Power-to-X Economy

Submission for the National Hydrogen Strategy Review 2023

NSW Powerfuel Including Hydrogen Network

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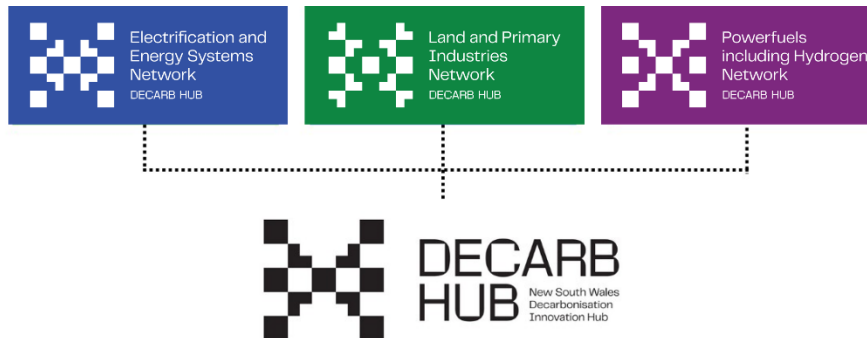
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About the NSW Decarbonisation Innovation Hub and Powerfuels Including Hydrogen Network

The [NSW Decarbonisation Innovation Hub](#) supports a mature and collaborative decarbonisation innovation community in NSW through three innovation networks in the areas of power-to-x, energy & electricity system, and land & primary industries.



The [Powerfuels Including Hydrogen Network](#) (Network) is one of the innovation networks under the NSW Decarbonisation Innovation Hub. The Network supports the de-risking of powerfuels including hydrogen projects to address specific and systemic barriers through design, analysis, advanced research & engineering services. The Network aims to engage existing stakeholders locally, nationally & globally as the nexus for the acceleration of NSW's industrial translation of mature and emerging P2X technologies. The expertise in this Network will address challenges and promote innovative solutions across clean fuels and chemical value chains.

Network Partners



Network Lead

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Network Members



Executive Summary

NSW Power-to-X

The transition to a hydrogen economy holds immense promise for a low-carbon and sustainable energy future. However, the successful realisation of this potential relies heavily on well-crafted policy support that addresses the intricate challenges involved. In tandem with advancing the hydrogen sector, it is equally critical to direct policy attention towards promoting the development and integration of Power-to-X technologies and industries. These technologies, encompassing the transformation of hydrogen into derivatives like green ammonia, methanol, and sustainable aviation fuel, present a pivotal avenue for reducing carbon emissions across multiple sectors. Policymakers must therefore adopt a dual-focused strategy: fostering an enabling environment for the growth of hydrogen infrastructure while simultaneously cultivating frameworks that encourage research, investment, and deployment of P2X innovations.

Such a holistic approach not only bolsters the hydrogen economy but also ensures a comprehensive transition towards green powerfuels, chemicals and feedstocks many will play vital roles in decarbonising hard-to-abate industries, marking a substantial and economic transition for Australia.

Since the unveiling of the NSW Power-to-X Industry Prefeasibility Study and Roadmap in 2021, New South Wales (NSW) has emerged as a frontrunner in P2X development, fortified by collaborative endeavours from governmental bodies, industries, and research institutions. Remarkable achievements underscore this advancement, including groundbreaking R&D breakthroughs, commercial projects that exemplify the real-world application of P2X technologies, impactful events that foster knowledge exchange, and feasibility studies that underscore the viability of P2X in the region as well as the establishment of the NSW Decarbonisation Innovation Hub and Powerfuels including Hydrogen Network.

In the realm of research and development, NSW has witnessed the successful scaling up of advanced electrolysis techniques, resulting in increased efficiency and reduced costs for hydrogen and P2X production. Commercial projects in NSW have demonstrated tangible outcomes. The NSW P2X community has convened in various events, such as international symposia on hydrogen innovation and P2X technology showcases. These gatherings have facilitated cross-sectoral collaboration, knowledge sharing, and the forging of partnerships that accelerate the deployment of P2X solutions. Feasibility studies have underscored the practicality of P2X technologies in NSW.

Collectively, these achievements highlight the remarkable progress made in P2X development within NSW, a testament to the concerted efforts of governmental agencies, industries, and research institutions working cohesively to realise the goals outlined in the NSW Power-to-X Industry Prefeasibility Study and Roadmap. As a result, NSW stands poised to not only play a pivotal role in the hydrogen economy but also to drive substantial change in various sectors through the adoption of sustainable P2X solutions.



Network Submission to the National Hydrogen Strategy Review

In light of the remarkable advancements witnessed in NSW P2X, it becomes evident that the groundwork laid by NSW's success has the potential to serve as a model for other states and, on a larger scale, for the entire nation's future P2X economy. Australia stands at a pivotal juncture with a unique opportunity to foster a future powerfuels industry that aligns seamlessly with its decarbonisation goals, while generating substantial economic and social benefits. This venture holds the promise of not only bolstering our environmental aspirations but also diversifying our economy by attracting high-value-added industries.

However, achieving such a transformative shift necessitates robust collaboration between State and Federal Governments, as well as active engagement from industries and academia. To harness the full potential of the powerfuels sector and to effectively steer Australia towards a sustainable and prosperous future, considerations can be made within the refreshed National Hydrogen Strategy including:

1. **Supporting the Development of Emerging and Disruptive Technology.** Emerging technology players, particularly those that could reduce the levelised cost of production for P2X, should be identified for targeted support to promote domestic R&D and advanced manufacturing in the powerfuels sector. Existing grant schemes in Australia being targeted at later stage projects and mature technologies. The current schemes lacking the agility and flexibility to support cutting-edge technologies from innovation communities that have the potential to reshape global P2X and hydrogen value chains.
2. **Revenue Support and Demand-Side Pull Measures.** Current price levels, coupled with a limited willingness to pay premiums above conventional fuel prices, are hindering the feasibility of large-scale investments. To drive down production costs in the medium term, it is imperative to encourage demand and investment through policies that bridge the price and revenue gap until powerfuel price premiums normalise.
3. **Delivering Cohesive Government Assistance.** Improving the mechanisms for delivering government assistance would expedite project implementation and assist potential investors and developers seeking entry into the Australian markets. Particular areas of concern include simplifying project approval pathways to align with competitors for streamlined process and accelerated timeline. Additionally, efforts should focus on simplifying interactions with investors, as developers often grapple with understanding departmental roles and application procedures involving multiple levels of government and regions.
4. **Expanding Regional Powerfuel Supply Locations and Overcoming Competition for Renewable Resources.** Given the diverse applications of powerfuels, it is likely that multiple supply locations near end-use sites will be needed across Australia. Major hydrogen production hubs are located around coastal areas aligning with exporting capability and infrastructure. The supply of clean powerfuel and chemicals from inland production centres should be considered in



meeting domestic demand. The increasing competition between domestic and export as well as for renewable energy resources should be addressed through policy mechanisms.

5. **Overcoming Project Development and Market Challenges.** Global supply chain and labour market challenges are constraining project delivery, with uncertainty over standards delaying projects once equipment is received from international suppliers. The prolong wait time for electrolysers and equipment are emerging as an issue to attract vendor interest at the present scale of Australian projects, with projects up to 55 MW lacking vendor interest. Access to skilled engineering, construction labour and project management professionals is evolving as a significant challenge without an established workforce education and development framework.
6. **Australia within the Global Policy Landscape.** Australia can leverage its competitive advantages over other nations to establish a foothold in the competition of global P2X economy. International support mechanisms (e.g. the US Inflation Reduction Act) are perceived as both a threat and opportunity for Australian industry growth, shifting powerfuel production and procurement to locations with stronger incentives but also serving as an opportunity to grow Australian emerging technology suppliers.
7. **Achieving and Maintaining Social License.** Securing community support and maintaining a social license to operate are essential for powerfuel projects. This entails considering the sustainability of inputs like carbon dioxide, water and other feedstocks adopting a holistic system approach to minimise adverse community impacts. The local community's concerns regarding water impacts need careful consideration, and clarifying the acceptability of various other feedstock sources is essential to provide greater certainty for investors and project planners.

The Network provided responses and recommendations to questions in the consultation paper for the National Hydrogen Strategy review. These responses and recommendations aim to reflect a balanced view from NSW stakeholders for a national context. The Network submission should not be considered as a way to override individual submissions from our partners and members.

The 2019 National Hydrogen Strategy put Australia at the forefront for an emerging hydrogen economy at the global stage. Four years passed on, the review of the strategy offers the opportunity to rethink, reposition and rewrite the national blueprint for clean fuel and chemicals – building the future P2X economy. The Network and members welcome the opportunity to further contribute to the refreshed National Hydrogen Strategy and looking forward to work collaboratively with stakeholders realise our vision for a clean energy superpower.



Network Responses and Recommendations to Consultation Questions

How can Australia enable decarbonisation through the development of a hydrogen industry?

1. Is prioritising the decarbonisation of ammonia production the most prospective way to achieve both hydrogen industry growth and industrial decarbonisation in the short-term?

Network response:

Ammonia is one of the many derivatives that could be produced from hydrogen. Ammonia has been considered as one of the P2X products that stimulate hydrogen production and industry capability building benefited from existing market, production capacity and potential applications in mining, agriculture and energy sectors.

However, there are strong interests from industry in other P2X products and technologies that would have substantial benefits to decarbonise hard-to-abate sectors while achieving hydrogen industry growth. For example, synthetic aviation fuel is considered the most feasible and economic options to replace jet fuel for long-haul aviation in the short-term. Other P2X products such as methanol, green steel and syntenic methane all have potentials in decarbonising sectors which will not have direct benefit from ammonia production. These P2X commodities should be prioritised with a sectorial-based approach to offer decarbonisation pathways.

Network recommendation:

NHS commissions a comprehensive techno-economic analysis on Australia P2X to be conducted to assess the economics and production capabilities of all P2X products as well as their end user cases.

2. What other actions in the other sectors will have the greatest decarbonisation impacts?

Network response:

The sectors are very well covered in the discussion paper for large domestic or international demands. Co-locating sectors that have existing or increasing demand of hydrogen and P2X would reduce the cost for electricity infrastructure, fuel transportation and distribution and feedstock supply. A place-based approach building new or transiting existing industrial zones into hydrogen hubs would have significant impacts to decarbonise sectors but also have aggregated demand for the regions.

Network recommendation:

NHS considers actions for each sector should be considered in broader context of precinct planning for domestic use and global supply chains for exporting.

3. What sectors are best placed to be early adopters of hydrogen?



Network response:

The adoption of hydrogen and P2X rely on multiple factors, including technology readiness level, government incentives, industry support and social licence and community acceptance. Energy and road transport have been accepted as the early adopters for hydrogen and P2X under many policies and programs, in Australia and globally.

However, the market and industry have indicated that there is a clear interest in sectors with limited application of electrification technology in recent years e.g. maritime and aviation fuels for long haul and heavy transport, feedstock for chemical manufacturing displacing fossil-based products, energy and mobility use for remote communities and industry operations. The early adopters for hydrogen and P2X require case-by-base assessment, considering local context as well as the deployment of completing technologies (e.g. electrification, biofuel).

Network recommendation:

Reconsider the early adopter sectors for hydrogen and P2X with a case-by-case approach assessing local context and factors.

4. Are there specific barriers that may limit hydrogen uptake in each of these sectors?

Network response:

The widespread adoption of hydrogen across various sectors is a promising pathway, but several barriers hinder its uptake. These barriers span across policy, skills, supply chain, standards, and more. Understanding and addressing these challenges for each sector is crucial for unlocking P2X economy full potential:

- a. **Policy Consistency and Incentives:** Ambiguous or inconsistent policy frameworks and incentives can discourage investments in hydrogen projects among commonwealth, state and local government. Clear, stable policies that provide long-term visibility and financial support are essential to attract private sector involvement.
- b. **Skill Shortages and Workforce Development:** Developing and maintaining a skilled workforce for hydrogen and P2X technologies is a challenge for an industry that is still in its infancy. Specialised expertise in areas like electrolysis, fuel cells, and storage systems is often lacking, necessitating focused training programs and educational initiatives. Generalists that have demonstrated experience in P2X projects development is often in the shortage; e.g. project managers, financial analysts and legal professionals.



- c. **Supply Chain Development:** Establishing a robust supply chain for hydrogen production, storage, and distribution is complex. Sourcing equipment, materials, and technologies while adhering to quality standards can be challenging, particularly for emerging markets. Current projects rely heavily on imported supply, imposing significant risks from supply chain disruption.
- d. **Infrastructure Investment:** The need to build new infrastructure, such as hydrogen refuelling stations and pipelines, energy transmission infrastructure, feedstock supply and exporting infrastructure requires substantial investment. Overcoming financial hurdles and securing funding for such projects can impede progress.
- e. **Scaling Up Technology:** Many P2X technologies are in the early stages of development, making it necessary to scale up efficiently while minimising risks. Bridging the gap between lab-scale advancements and large-scale deployment can be challenging.
- f. **High Production Costs:** Producing hydrogen through methods like electrolysis or from renewable sources can be costly compared to conventional fossil fuels. Technological advancements and economies of scale are needed to make hydrogen production cost competitive, not only against fossil products but also global peers competing for hydrogen supply market.
- g. **Lack of Standardisation:** The absence of uniform standards for hydrogen quality, storage, transportation, and equipment can hinder interoperability and increase costs. Developing internationally recognised standards is essential for harmonising the industry.
- h. **Public Perception and Awareness:** Overcoming public scepticism and fostering awareness about hydrogen's benefits, safety, and potential is vital. Public support can influence policy decisions and encourage investments, particularly critical for the first wave of commercial projects.

Network recommendation:

NHS considers the general barriers for each sector in developing actions to address those challenges.

5. What are the actions required to overcome those barriers and realise the opportunities?

Network response:

Addressing each of barriers required targeted and tailored actions, most importantly collective efforts from stakeholders across government, industry and research. Suggested actions in addressing barriers from Consultation Question 4 include:



a. Policy Consistency and Incentives:

- **Harmonise Policies:** Facilitate coordination between Commonwealth, State, and local governments to develop consistent and aligned policies that encourage hydrogen and P2X projects.
- **Long-Term Commitments:** Establish stable, long-term policies that provide investors with the confidence needed for their involvement in hydrogen initiatives.
- **Incentive Mechanisms:** Introduce financial incentives, grants, tax breaks, and feed-in tariffs to attract private sector investments in hydrogen projects.

b. Skill Shortages and Workforce Development:

- **Education Programs:** Collaborate with universities and training institutions to create specialised educational programs focused on P2X technologies and their practical applications.
- **Training Initiatives:** Develop hands-on training initiatives that upskill the existing workforce and provide practical experience in hydrogen and P2X projects.
- **Industry-Academia Partnerships:** Establish partnerships between industry and academia to bridge the gap between theoretical knowledge and practical skills required in the sector.

c. Supply Chain Development:

- **Local Content Requirements:** Encourage the use of domestic suppliers and manufacturers through incentives or regulations to reduce reliance on imported equipment and materials.
- **Industry Collaboration:** Foster collaboration between companies along the supply chain to identify bottlenecks, share best practices, and develop innovative solutions.

d. Infrastructure Investment:

- **Public-Private Partnerships:** Develop partnerships between governments and private sector entities to share the financial burden of infrastructure investments, ensuring their economic viability.
- **Project Financing Support:** Provide access to low-interest loans, grants, and project financing options to reduce the financial hurdles associated with building hydrogen infrastructure.

e. Scaling Up Technology:



- **Demonstration Projects:** Fund and support demonstration projects that showcase the scalability and viability of P2X technologies in real-world scenarios.
 - **Pilot Plants:** Invest in pilot plants that replicate industrial-scale operations, allowing for the refinement of processes and identification of challenges before full-scale deployment.
- f. High Production Costs:
- **Research Funding:** Allocate funding for research and development aimed at enhancing the efficiency and cost-effectiveness of hydrogen production methods.
 - **Economies of Scale:** Encourage large-scale deployment of P2X technologies through financial incentives and guaranteed off-take agreements to achieve economies of scale.
- g. Lack of Standardisation:
- **Standard Development:** Collaborate with international organizations and industry stakeholders to establish comprehensive standards for hydrogen quality, storage, transportation, and equipment.
 - **Regulatory Alignment:** Align domestic regulations with international standards to facilitate cross-border trade and technological integration.
- h. Public Perception and Awareness:
- **Public Awareness Campaigns:** Launch educational campaigns to inform the public about the benefits, safety, and potential of hydrogen technologies, dispelling myths and addressing concerns.
 - **Stakeholder Engagement:** Engage with local communities, environmental groups, and media to ensure accurate and transparent communication about hydrogen projects' impact and benefits.

Network recommendation:

NHS considers the general actions in addressing barriers for each sector.

How could Australia further activate its hydrogen and related industries?

6. Should Australian governments adopt a more sector driven approach to hydrogen industry development?

Network response:



The development of the hydrogen and P2X industry in Australia requires a balanced framework that combines both cross-sectorial approach and sector-specific actions. While a cross-sectorial approach is essential to ensure harmonised policies, standards, and infrastructure development, it's equally crucial to recognise the distinct requirements of various industries. A sector-driven approach allows us to tailor strategies that address the unique barriers and opportunities each sector faces when adopting hydrogen and P2X technologies.

By adopting a cross-sectorial approach, Australian governments can promote knowledge sharing, encourage resource optimisation, and facilitate the creation of a cohesive P2X ecosystem. This framework ensures that lessons learned and best practices from one sector can be applied to others, preventing unnecessary duplication of efforts and resources.

However, to truly unlock the potential of hydrogen across diverse industries like transportation, energy, manufacturing, and more, it's essential to implement sector-specific actions. These actions might involve targeted funding for research and development in sectors where hydrogen integration is more challenging, such as heavy industries. They could also include creating regulatory frameworks that specifically address safety and standards for hydrogen in transport applications.

Network recommendation:

NHS considers requires a balanced framework that combines both cross-sectorial approach and sector-specific actions.

Targets and mandates

7. Should Australian governments adopt national hydrogen production and/or use targets for hydrogen?

Network response:

Australia has a national price target of hydrogen production in place but could benefit from production and use targets, not only for hydrogen but also for other P2X products.

Production targets set a quantifiable goal for the volume of hydrogen to be produced. This drives investment and innovation in hydrogen production technologies and infrastructure. They guide industry stakeholders on the scale of production needed to meet demand, providing clarity for planning and investment decisions. Production targets also encourage collaboration between different stakeholders, such as governments, industries, and research institutions, to collectively work towards a common goal.



Use targets specify the quantity of hydrogen to be consumed in various sectors, such as transportation, energy, and manufacturing. They guide the integration of hydrogen into these sectors. Use targets encourage the development of infrastructure and technologies to support hydrogen utilisation, such as refuelling stations, fuel cells, and industrial processes. They provide direction for policy development, helping governments prioritise sectors for intervention and incentives. Sector specific use targets should be considered.

The adoption of national hydrogen production and use targets, encompassing not only hydrogen but also other P2X products like ammonia, methanol, and aviation fuels, can be a strategically sound decision for Australia. These targets would serve as a clear signal to stimulate production and investment in hydrogen.

National targets have the potential to drive innovation, attract investments, and stimulate research and development across the entire value chain, from production to utilization. These targets can encourage collaboration between governments, industries, research institutions, and communities, leading to accelerated technological advancements and market growth. Additionally, well-defined targets can provide a measure of accountability and transparency, ensuring that the nation stays on track towards achieving its climate and energy objectives.

By incorporating P2X products like ammonia, methanol, and aviation fuels into the targets, the Australian government can take a holistic approach of decarbonisation with hydrogen economy. These products hold immense potential for reducing emissions across various sectors, from agriculture to transportation. Aligning targets for these products with hydrogen will create synergies and stimulate the development of an integrated P2X ecosystem, ultimately driving Australia's position as a global leader in sustainable energy solutions.

Network recommendation:

NHS considers both production and use target for hydrogen and P2X products.

8. If targets are adopted, what type of activities and/or sectors should this target be tailored towards? For example, production targets, demand targets for sectors such as transport, renewable gas target. Please describe how such targets would attract investment.

Network response:

If targets are adopted, they should be tailored towards a range of activities and sectors that can maximise the impact of hydrogen and P2X technologies on decarbonisation and sustainable economic growth. Here are several key target areas and how they can attract investment:

a. Production Targets:



- Renewable Hydrogen Production: Setting targets for producing a certain volume of renewable hydrogen encourages investment in technologies like electrolysis powered by renewable energy sources.
 - Green Ammonia and Methanol Production: Establishing targets for green ammonia and methanol production stimulates investments in advanced catalysts and scalable processes, attracting capital to ventures that can contribute to both energy and industrial sectors.
- b. Demand Targets for Sectors:
- Transportation: Implementing targets for the use of hydrogen and hydrogen-based fuels in transportation (e.g., fuel cell vehicles) attracts investment in local refuelling infrastructure and vehicle manufacturing.
 - Industrial Applications: Targets for hydrogen adoption in industries like steelmaking, chemical production, and refining drive investments in retrofitting processes and infrastructure to use clean hydrogen as a feedstock or energy source.
 - Heating and Power Generation: Targets for using hydrogen in heating and power generation encourage investments in combined heat and power plants (CHP), hydrogen boilers, and fuel cells for distributed energy generation.
- c. Infrastructure Targets:
- Refuelling and Distribution Networks: Targets for the number of hydrogen refuelling stations and distribution infrastructure attract investment from energy companies and infrastructure developers. Clear targets mitigate the uncertainty of market demand and encourage the expansion of refuelling networks.
 - Hydrogen Pipelines: Setting targets for building hydrogen pipelines stimulates investment in the construction of the necessary infrastructure to transport hydrogen over longer distances.
- d. Export Targets:
- Hydrogen Exports: Targets for hydrogen and P2X exports will position Australia as a key global player in the emerging hydrogen and P2X export market.

Network recommendation:

NHS considers co-designing production and demand targets with stakeholders.

9. Should Australian governments use regulatory mandates to drive demand for hydrogen? If mandates were adopted, what type of activities and/or sectors could mandates be directed towards? Please describe how such mandates would attract investment.



Network response:

Using regulatory mandates to drive demand for hydrogen can be a powerful tool to accelerate the adoption of hydrogen technologies and stimulate investment. Such mandates can provide a clear signal to industries, investors, and stakeholders about the government's commitment to a hydrogen-based economy. However, careful consideration is needed to ensure that mandates are effectively designed and aligned with market realities.

Network recommendation:

NHS considers co-design regulatory mandates with stakeholders to maximise incentives.

Addressing Supply Chain Risks

10. What are the most significant supply chain barriers being faced by Australia's hydrogen industry? Where should Australian governments focus efforts on securing elements of supply chains needed to enable the accelerated growth of the hydrogen sector?

Network response:

Australia's hydrogen industry has immense potential, but it faces significant supply chain barriers that need to be addressed for sustained and accelerated growth. A notable challenge is the heavy reliance on overseas supply for critical components and materials needed for hydrogen production, storage, and distribution. This dependence poses risks in terms of supply chain disruptions, which could hinder the industry's progress.

To overcome these barriers and foster a robust hydrogen ecosystem, the Australian government should focus efforts on securing elements of the supply chain domestically on electrolyser and equipment, storage technologies, raw material processing and value-adding production, infrastructure development and deployment.

Network recommendation:

NHS considers actions for local hydrogen manufacturing capability on critical equipment, technology and system.

11. Should Australia develop and support local manufacturing capabilities to secure the hydrogen supply chain? What are the specific areas of opportunity (e.g. fuel cell or electrolyser manufacturing or hydrogen transportation related manufacturing)?

Network response:



Developing and supporting local manufacturing capabilities for the hydrogen supply chain is crucial for Australia's long-term energy security, economic growth, and technological advancement. This approach not only reduces dependency on overseas suppliers but also creates a resilient domestic ecosystem that fosters innovation, job creation, and sustainable industry growth. Among the specific areas of opportunity, fuel cell and electrolyser manufacturing stand out as critical focal points for future hydrogen economy:

- Local electrolyser manufacturing reduces vulnerability to global supply chain disruptions, ensuring a consistent supply of this crucial component for hydrogen production. Developing local manufacturing capabilities encourages the advancement of electrolyser technology, positioning Australia as a leader in the field.
- Developing local fuel cell manufacturing capabilities can create high-skilled jobs in areas like engineering, assembly, testing, and maintenance. Local manufacturing allows for direct engagement with fuel cell technology, enabling continuous innovation and improvement of performance and efficiency. Domestic manufacturing provides the flexibility to tailor fuel cells to specific applications, enhancing the adaptability and competitiveness of local industries.

Network recommendation:

NHS considers fuel cell and electrolyser manufacturing as prioritised areas for development and support of local manufacturing capabilities.

12. What are the barriers to developing and supporting local manufacturing capabilities?

Network response:

Developing and supporting local manufacturing capabilities for fuel cells and electrolysers comes with several challenges that need to be addressed for successful implementation.

One significant challenge is the high initial investment required. Establishing manufacturing facilities demands considerable capital for infrastructure, equipment, research and development, and workforce training. Securing adequate funding, especially for startups and SMEs, can be a hurdle without financial support from government or industry.

Technical expertise is another barrier. Developing and scaling up fuel cell and electrolyser manufacturing necessitates specialized knowledge in materials science, engineering, and process optimisation. Building this expertise and the necessary workforce may take time.

The complexity of the supply chain is also a challenge. Manufacturing these components involves intricate arrangements of raw materials, components, and specialized machinery.

Developing and integrating this supply chain locally requires careful planning and coordination. Achieving economies of scale is essential for cost-effective manufacturing. However, local production might initially struggle to attain competitive costs due to smaller production volumes compared to established global manufacturers.



Network recommendation:

NHS considers actions to address barriers to developing and supporting local manufacturing capabilities.

13. What is the role of industry and governments to ensure the hydrogen industry has access to an appropriately sized and skilled workforce?

Network response:

Developing a skilled workforce for the hydrogen industry requires a collaborative approach between industry and governments.

Governments have a significant role in creating an enabling environment for workforce development. They can establish policy frameworks that incentivise the growth of a skilled hydrogen workforce, offering funding for research and education and facilitating collaborations between industry stakeholders and educational institutions. By promoting vocational training and apprenticeships, governments bridge skills gaps and provide accessible pathways for individuals to join the hydrogen industry. Government support in workforce planning, forecasting, and offering incentives further solidifies the foundation for a competent and sustainable hydrogen workforce.

Industry plays a pivotal role by designing and implementing specialised training programs, such as internships and apprenticeships, to equip individuals with the necessary skills for roles within the hydrogen sector. Identifying skills gaps and working with educational institutions to tailor curricula ensures that the workforce remains aligned with industry demands. Moreover, industry's promotion of STEM education from an early age and continuous upskilling opportunities for existing employees enhance the industry's talent pool and expertise.

Network recommendation:

NHS considers co-designing workforce development programs with industry and government.

14. In addition to electrolyzers, where do you see a role for domestic hydrogen related manufacturing to address supply chain risks and ensure Australia meets its decarbonisation targets such as hydrogen buses/heavy vehicles?

Network response:



Beyond electrolyzers, there are several areas where domestic hydrogen-related manufacturing can play a pivotal role in addressing supply chain risks and supporting Australia's decarbonisation targets. For example, manufacturing hydrogen storage tanks, pipelines, and distribution equipment domestically reduces reliance on imports and enhances supply chain resilience. This is vital for ensuring a consistent supply of hydrogen to support transportation, industrial, and energy applications.

On the hydrogen buses and heavy vehicles, Australia might not have vehicle manufacturing capabilities, there are still opportunities to collaborate with international motor makers and other industries to achieve these goals.

Network recommendation:

NHS consider hydrogen storage and distribution for domestic manufacturing.

How can we ensure our hydrogen industry attracts the necessary investment?

15. What in addition to the commercial cost gap is preventing Australian hydrogen projects progressing beyond a financial investment decision?

Network response:

Refer to response to Consultation Question 4 and 5.

Network recommendation:

Refer to recommendation for Consultation Question 4 and 5.

16. What signals are effective overseas and can apply to unlock greater investment?

Network response:

Refer to response to Consultation Question 6 to 10.

Network recommendation:

Refer to recommendation for Consultation Question 6 to 10.

17. Are there any other measures needed to unlock investment in the development of the Australian hydrogen industry including from international and Australian institutional investors?



Network response:

Refer to response to Consultation Question 6 to 10.

Network recommendation:

Refer to recommendation for Consultation Question 6 to 10.

18. When would it be appropriate to take a 'tech neutral' approach to developing hydrogen, and when would a more directed approach be warranted?

Network response:

Taking a 'tech neutral' approach to developing hydrogen can be appropriate when there is a well-established market with multiple viable technologies, and the goal is to encourage competition and innovation to drive down costs and improve efficiency. In such cases, a technology-agnostic policy approach can foster a competitive landscape, allowing various hydrogen production methods to prove their viability based on economic, environmental, and technological merits. However, a more directed approach is warranted when there are clear environmental imperatives and strategic goals to address. In the case of hydrogen, a directed approach is particularly necessary when prioritising sustainable and low-carbon solutions. Green hydrogen, produced using renewable energy sources like solar or wind power, holds greater potential to contribute to decarbonisation and reduce greenhouse gas emissions.

Network recommendation:

NHS considers directed approach to support green hydrogen produced from renewable energy and sustainable feedstocks.

19. What further regulatory work is required as we accelerate the development of the hydrogen industry? What barriers do you currently see?

Network response:

Currently, a lack of clarity over Australian standards is inhibiting project development and causing project delays. NSW project developers and emerging technology providers highlighted that uncertainty with regard to Australian standards is inhibiting project development, particularly concerning AS3000. The lack of clarity is a result of different interpretations of standards between international vendors and purchasers and different manufacturing requirements within each jurisdiction.



Network recommendation:

NHS works with Standards Australia to provide certainty and clarification of standard development and application.

How can we ensure our hydrogen industry develops in a way that benefits all Australians?

20. What actions do you view as being critical to build and maintain community support for Australia's developing hydrogen industry?

Network response:

To establish and sustain community support for Australia's developing hydrogen industry, prioritising safety and maintaining open communication are crucial. Initiatives that focus on educating communities about hydrogen safety, coupled with early engagement efforts, can help alleviate concerns and build trust. Open and transparent communication channels should be maintained to share project progress, safety measures, and potential benefits with the community. Addressing safety concerns head-on, collaborating with local authorities to ensure emergency response plans, and showcasing the broader advantages of the industry, such as job creation and clean energy contributions, are also key. By actively involving communities through site visits, workshops, and public forums, the industry can demonstrate its commitment to safety and sustainability, fostering a positive relationship and ensuring a supportive foundation for hydrogen development.

Network recommendation:

NHS considers community engagement and communication action for hydrogen project deployment.

21. How should the interests of the emerging hydrogen industry with respect to water security be balanced with other users?

Network response:

Balancing the interests of the emerging hydrogen industry with concerns over water security and the needs of other users requires a collaborative and adaptable approach. To achieve this balance, it's important to encourage water-efficient practices within the hydrogen industry, such as adopting advanced cooling systems and closed-loop water recycling. Collaboratively establishing water use priorities based on critical sectors like agriculture, public water supply, and environmental preservation can help allocate water resources effectively. Exploring opportunities for shared water resources, promoting water reuse and treatment, and considering non-traditional sources like desalination or treated wastewater can diversify water supply and reduce competition. Regulatory frameworks, innovative technologies, local context considerations, stakeholder



engagement, and monitoring mechanisms all play vital roles in ensuring the hydrogen industry's growth aligns with regional water security concerns and the broader needs of the community.

Network recommendation:

NHS considers developing a water usage framework for hydrogen industry.

22. How else can Australian governments ensure that First Nations communities are resourced to effectively participate, benefit and be empowered by the development of the hydrogen industry?

Network response:

To ensure that First Nations communities actively participate, benefit, and are empowered by the development of the hydrogen industry, Australian governments should employ a comprehensive and culturally sensitive approach. This involves consistent cultural engagement and consultation to incorporate traditional knowledge and values into project planning. Capacity-building initiatives should be implemented, providing relevant skills and training opportunities for community members. Collaborative partnerships between the industry, government, and First Nations communities should be fostered to ensure shared decision-making and resource allocation. Economic opportunities should prioritise local employment, procurement, and ownership, while environmental and cultural impact assessments must address sacred sites and spiritual landscapes. Education and awareness campaigns should inform communities about industry benefits and potential impacts, and strategies should be developed to ensure sustainable, long-term benefits beyond project lifecycles. Integrating traditional ecological knowledge and promoting governance structures that represent community interests will play crucial roles in fostering the meaningful participation, benefit, and empowerment of First Nations communities in the hydrogen industry's growth.

Network recommendation:

NHS considers establishing hydrogen project guideline for First Nation communities as well programs to support activities under the guideline.

23. Is there more information that First Australians would like to receive about the renewable energy and hydrogen sector? What information should be provided?

Network response:

This information for First Nation communities should address their unique interests and concerns. It should include explanations of the benefits and opportunities the sector presents for



First Nations communities, encompassing economic advantages, job prospects, and community development.

Additionally, insights into the sector's environmental impact, engagement processes that involve First Nations voices in decision-making, and considerations for cultural preservation would be valuable. Details on skill development, economic participation, technological understanding, and the sector's alignment with environmental stewardship values are also essential. Lastly, information on regulatory frameworks, policy support, and strategies for ensuring long-term sustainability of benefits should be provided. Disseminating this information through culturally relevant channels will empower First Australians to engage actively and make informed decisions within the renewable energy and hydrogen sector.

Network recommendation:

NHS considers working closely with First Nation communities in designing educational information and material about hydrogen and renewable energy.

24. What regulatory barriers will become more prominent as we accelerate the development of the hydrogen industry?

Network response:

Refer to response to Consultation Question 19.

Network recommendation:

Refer to recommendation for Consultation Question 19.

25. What market conditions would indicate the need for a hydrogen reserve, price cap or other fuel security measures?

Network response:

The need for hydrogen reserves, price caps, or other fuel security measures becomes apparent in specific market conditions that suggest potential disruptions or volatility in hydrogen supply and prices. Instances such as supply interruptions due to natural disasters or geopolitical tensions might necessitate a hydrogen reserve to ensure a stable supply during emergencies. Price volatility could warrant the implementation of price caps to shield industries and consumers from sudden price spikes that might impact affordability and predictability.

Energy security concerns arise when an overreliance on hydrogen imports from specific regions poses risks, prompting the consideration of domestic reserves or diversified supply sources. In the early stages of the hydrogen market's development, setting price caps or establishing reserves could provide stability and promote investor confidence as the supply-demand landscape evolves.



Fuel security measures might also support the transition to a hydrogen-based economy by assuring a reliable supply during this transformative period.

Network recommendation:

NHS considers a systematic assessment of market conditions that could indicate hydrogen fuel security measures ensuring a resilient and well-functioning market.

26. How can Government/s ensure that the early strong investment in sector transitions to government revenue as the sector matures?

Network response:

There are several revenue models that government can explore:

- a. **Production Sharing Agreements:** These agreements would outline that as the hydrogen sector attains a certain level of profitability and revenue generation, the government will receive a proportional share of the revenue. By implementing such agreements, the government can directly benefit from the growth and success of the hydrogen sector, fostering a mutually beneficial partnership between private enterprises and public revenue generation.
- b. **Equity Participation:** This entails the government maintaining ownership interests in these entities, ensuring that as they progress and generate revenue, the government can capitalize on dividend income or capital gains. This method aligns public and private interests, translating the sector's growth into tangible government revenue.
- c. **Revenue-Sharing Models:** These models entail predetermined agreements where a portion of the hydrogen sector's revenue is shared between the government and industry stakeholders. This cooperative approach guarantees that the government receives an equitable portion of the economic value derived from the sector's advancement, fostering an environment of collaboration and ensuring consistent revenue streams.
- d. **Reinvestment and Innovation Incentives:** Governments can provide tax incentives to hydrogen companies that reinvest a portion of their profits into research, development, and innovative initiatives. This not only nurtures ongoing sector expansion but also indirectly contributes to revenue generation by fostering sustained economic activity, enhancing the value chain, and creating opportunities for increased government revenue over time.

Network recommendation:

NHS considers revenue models that suitable for Australian hydrogen industry.



How should we develop the necessary infrastructure needed to support the development of our hydrogen industry?

27. How can the next infrastructure assessment be delivered to maximise the value to governments and industry?

Network response:

Infrastructure assessment should be designed to assess specific issues such as water supply and treatment, electricity transmission and distribution infrastructure, renewable energy generation and storage. Hydrogen end-user infrastructure should be included in the assessment, for example, hydrogen transport refuelling infrastructure, hydrogen pipeline and storage facilities as well as exporting infrastructure such as ports, logistic hubs and terminals.

Network recommendation:

NHS considers alternative approach for infrastructure assessment on specific issues across hydrogen supply chains.

28. How can Australian governments ensure the efficient use of existing infrastructure, and delivery of new infrastructure, including common user infrastructure?

Network response:

Refer to response to Consultation Question 27.

Network recommendation:

Refer to recommendation for Consultation Question 27.

29. How should the infrastructure needs of the hydrogen industry be balanced with other infrastructure users including electricity generators?

Network response:

Refer to response to Consultation Question 27.

Network recommendation:

Refer to recommendation for Consultation Question 27.



30. What are the trade-offs (or synergies) of developing a hydrogen industry with other government goals?

Network response:

Developing a hydrogen industry entail navigating a complex landscape of trade-offs and synergies with various government goals and policy objectives. One trade-off involves cost allocation, where investing in hydrogen infrastructure and research might compete with funding for critical areas like healthcare and education. However, a well-managed hydrogen industry can generate revenue over time, contributing to resources for these essential services. Similarly, resource allocation trade-offs arise as the hydrogen industry competes with other renewable energy projects or environmental conservation efforts for land and water resources.

On the other hand, synergies emerge with objectives like climate goals, as a hydrogen industry aligned with clean energy targets can significantly contribute to carbon emissions reduction. The industry can also enhance renewable energy integration by serving as a storage solution, thus bolstering grid stability and the utilisation of intermittent energy sources.

Moreover, the growth of the hydrogen sector can generate new job opportunities across various sectors, supporting employment growth and local economies. The development of a hydrogen industry will drive technology innovation. Additionally, the industry can enhance energy security by diversifying the energy mix and reducing reliance on fossil fuels, offering a backup energy source during disruptions. A thriving hydrogen sector can also position a country as an exporter of hydrogen and related technologies, contributing to economic growth and international trade.

Network recommendation:

NHS assesses trade-offs and synergies of developing a hydrogen industry with government goals for balanced economic development.

31. How can existing gas infrastructure be repurposed to address priority use cases for hydrogen?

Network response:

Refer to response to Consultation Question 27.

Network recommendation:



Refer to recommendation for Consultation Question 27.

How can we enable a hydrogen export industry (including the export of goods manufactured with hydrogen)?

32. How can agreements with other nations best support Australia's hydrogen industry?

Network response:

Agreements with other nations hold immense potential in bolstering Australia's hydrogen industry, offering avenues for collaboration, market access, and global advancement. One effective strategy involves forging bilateral partnerships and trade agreements that ensure reliable access to international markets. Crafting terms that facilitate seamless trade, encompassing tariff arrangements, quotas, and quality standards, can promote the inflow and outflow of hydrogen-related goods and services.

Other forms of agreements on research and innovation collaboration, mutual infrastructure development, regulations, standards, and certification processes, joint-funding initiatives, skills and workforce development could boast complementary strengths in optimising global hydrogen supply chain.

Leveraging diplomatic channels can amplify the impact of agreements, enabling the advocacy for international policies and regulations that facilitate hydrogen trade, investment, and collaboration. Agreements present an avenue for knowledge exchange platforms that convene experts, policymakers, and industry leaders from different nations. Regular forums, conferences, and discussions can foster collaborative innovation, ensuring that Australia's hydrogen industry thrives within a global context, contributing to international decarbonization efforts, and positioning Australia as a key player in the evolving hydrogen economy.

Network recommendation:

NHS explores bilateral and multinational agreement opportunities with other nations.

33. How should Australia ensure that the necessary foreign investment in hydrogen industry, and export projects leads to lasting benefits for all Australians?

Network response:

Refer to response to Consultation Question 26.

Network recommendation:

Refer to recommendation for Consultation Question 26.



34. What other issues should Australian governments consider in relation to revising the National Hydrogen Strategy?

Network response:

In the process of revising the NHS, Australian governments should take into account several key considerations beyond consolidating state initiatives. As many state governments have already unveiled their hydrogen strategies and programs, it is imperative that the NHS review takes a cohesive approach, fostering collaboration and unity among states to maximize the collective impact of hydrogen development efforts.

Firstly, the NHS revision should prioritise the harmonisation and integration of state hydrogen initiatives. By aligning state strategies with the overarching national framework, Australia can present a united front, leveraging the strengths and resources of each jurisdiction to create a more potent and streamlined approach to hydrogen advancement. This synergy can enhance efficiency, minimize duplication of efforts, and ultimately contribute to the accelerated growth of the hydrogen industry. Furthermore, adopting a 'Team Australia' mindset is essential. The revised NHS should encourage a collaborative spirit among states, emphasising mutual support and shared goals. Establishing a platform for state collaboration rather than competition fosters an environment where regions can work together to attract investment, share knowledge, and develop joint projects that capitalise on the diverse expertise and resources available across the nation. Creating a framework that facilitates collaboration, however, requires a deliberate effort to overcome potential barriers and conflicts. Australian governments should develop mechanisms that promote equitable investment distribution and avoid a scenario where states compete for limited resources. By ensuring that collaboration is both incentivized and facilitated, the NHS can drive a more cohesive and unified approach to hydrogen development. Furthermore, the review should acknowledge the potential benefits of aligning state strategies to unlock opportunities for economies of scale. Shared research, infrastructure, and supply chain development can enhance cost-effectiveness and competitiveness, while also reducing barriers for private sector participation.

The revised NHS should emphasise the importance of long-term sustainability and stability. Providing a clear roadmap for state collaboration, investment priorities, and policy evolution can offer industry stakeholders the certainty and confidence needed to commit to long-term projects and partnerships. By nurturing a united approach, Australia can harness the full potential of its hydrogen resources and capabilities, positioning itself as a global leader in the emerging hydrogen economy.

Network recommendation:



NHS considers consolidating state and territory government hydrogen strategies for the development of overarching national framework.

