June 2024

Amandine Denis-Ryan || CEO, IEEFA Australia
Cameron Butler || Guest Contributor

Local ammonia production the ideal early adopter for green hydrogen

- *Ammonia production is a logical first beneficiary of the Australian government's Future Made in Australia budget measures, which have allocated more than AUD15 billion of critical funding support for green hydrogen.*
- *If near-term investment can be unlocked to deliver economies of scale, the government incentives could make green hydrogen cost-competitive with gas for ammonia production by the early 2030s.*
- *Switching a portion of existing ammonia feedstock to green hydrogen could create large volumes of near-term demand; a proposed project in Western Australia presents a rare opportunity to demonstrate green ammonia production at scale.*
- *Introducing progressive requirements for green explosives uptake by miners could help kickstart Australia's green hydrogen industry while minimising the financial impact, especially if combined with further government support for early projects*

In its 2024-25 budget announced in May, the Australian federal government unveiled a suite of measures to support the energy transition and Australia's emergence as a "renewable energy superpower". Central to these efforts is the AUD22.7 billion *Future Made in Australia* package, which includes roughly AUD8 billion over the next decade for Australia's green hydrogen industry, and a further AUD7 billion through to FY 2040-2041.

The bulk of this funding – around AUD13 billion – relates to a Hydrogen Production Tax Incentive (HPTI). For green hydrogen projects that reach final investment decision by 2030, the HPTI will provide an incentive of AUD2 per kilogram (kg) of renewable hydrogen produced over a period of up to 10 years between 1 July 2027 and 30 June 2040. This is twice as high (on a per kg basis) as subsidies recently awarded in the European Hydrogen Bank's first auction, but less than half the USD3/kg incentive available under the US's much-vaunted Inflation Reduction Act.

The HPTI is complemented by a AUD2 billion expansion of the Hydrogen Headstart program, which provides a total of AUD4 billion in funding credit to help bridge the commercial gap for first-mover projects. These are significant commitments that should start to address the chicken and egg dilemma that has thus far frustrated development of global green hydrogen supply chains: where high production costs have suppressed demand and stymied cost reductions that come with economies of scale.

Alongside these announcements, the budget included other supporting measures for Australia's hydrogen industry, such as the AUD1.7 billion Future Made in Australia Innovation Fund, a fast-tracked Guarantee of Origin scheme, and funding for infrastructure planning, social licence measures, and industry safety training and regulation.

Recent IEEFA analysis suggests Australia's ammonia industry is in pole position to capitalise on these budgetary measures. As the initial hype over the many theoretical uses for hydrogen – such as in buildings and road transport – has waned in recent years, the field has narrowed to a handful of applications where electrification or fuel substitution may prove particularly difficult. In Australia, the most promising applications include green ammonia and green iron. Ammonia is a logical first mover, given that hydrogen (currently produced from methane) is already its primary chemical feedstock, and some green hydrogen can already be substituted in existing facilities.

Australia's green ammonia 'triple win'

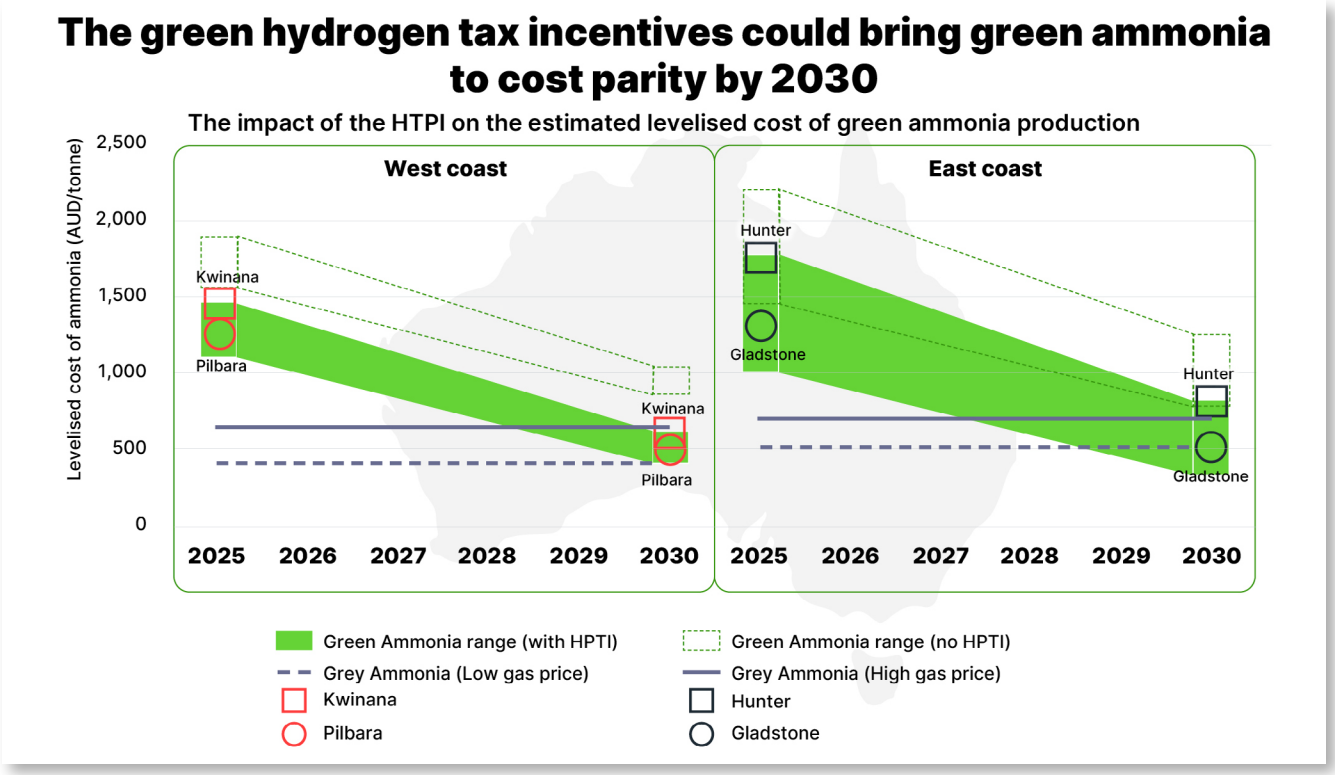
In Australia, ammonia is used in about equal parts to produce fertilisers and explosives. Australia's ammonia supply chain is energy- and emissions-intensive, accounting for roughly 5% of Australia's total gas use and around 4 million tonnes of carbon dioxide equivalent a year. The potential to partially or entirely replace current gas-based hydrogen means that ammonia production offers a ready-made demand source for green hydrogen, with far lower technological or commercial risk compared with other sectors where potential uses remain nascent.

As such, IEEFA identified a potential 'triple win' from decarbonising Australia's existing ammonia facilities: alleviating domestic gas market pressure; reducing emissions; and catalysing Australia's emerging green hydrogen industry. Despite this potential, most proposed green ammonia initiatives in Australia remain in their infancy and primarily target exports rather than substituting gas in domestic production. These initiatives have been impeded by uneconomical production costs compared with conventional methods, a lack of demand due to higher prices, and inadequate policy incentives.

> **"A potential 'triple win' from decarbonising Australia's existing ammonia facilities: alleviating domestic gas market pressure; reducing emissions; and catalysing Australia's emerging green hydrogen industry."**

By helping to bridge the cost premium for green hydrogen, the *Future Made in Australia* announcements significantly bolster the economic argument for a rapid transition to green ammonia, and to potential derivatives such as green explosives. Eligibility for the HPTI requires projects to reach final investment decision before 2030. This advantages existing ammonia facilities given that they already operate within mature supply chains with established, reliable customers who could provide firm offtake agreements.

Applying the HPTI (available from FY 2027-28) will reduce production costs of green ammonia (made from green hydrogen) in coming years, such that they could reach parity with conventional grey ammonia (made from methane) in some regions for projects starting construction before 2030 (see the figure below). However, such cost declines won't just happen; they depend on rapidly developing the green hydrogen supply chain to unlock learning benefits and economies of scale. Building this scale despite the cost premium on green ammonia will require near-term leadership and investment from ammonia producers and customers, potentially supplemented by additional government support.



Source: IEEFA
Note: Green ammonia costs in a given year represent the cost of production for facilities that started construction that year, after applying government tax incentives that commence in FY 2027-28. Costs in 2025 were scaled from the original IEEFA analysis to reflect recent inflationary and supply chain pressures and linearly interpolated to 2030 values. Costs between 2025 and 2030 have been interpolated linearly and are approximate. The green ammonia cost range represents costs across all regions that have been identified as attractive for green hydrogen production. Potential production costs in the four Australian regions currently producing ammonia are specified. Costs of grey ammonia are based on previous IEEFA analysis of potential market dynamics and correspond to a likely range in the late 2020s and early 2030s.

Importantly, these results provide just one perspective of potential cost trajectories for green ammonia, which can vary widely and will depend on uncertain future technology costs, among other assumptions such as financing costs. While sustained inflation, supply chain constraints and sluggish deployment have seen green hydrogen costs increase in recent years, cost declines are anticipated in coming years.

The dearth of operational projects makes it difficult to gauge near-term green hydrogen production costs in Australia. They could be as low as AUD7/kg in some regions, or closer to AUD9/kg based on global comparisons. In any case, they appear a long way from previous hopes of green hydrogen below AUD2/kg by 2030, highlighting the gap between hype and recent commercial realities. Australia is not alone in this regard, with most governments on course to miss green hydrogen policy targets due to a lack of offtake.

Unlocking vital investment

In better news, as shown in the above figure, the HPTI materially improves the relative economics of green ammonia and could bring it to cost parity in the early 2030s. Additional government and customer support will be required for early movers, who will still face high cost premiums.

A proposed gas-based expansion of CSBP's ammonia plant in Kwinana, Western Australia, scheduled for final investment decision this year, presents a rare near-term opportunity for large-scale domestic demonstration of green hydrogen in ammonia production. Running this project with green hydrogen would avoid 0.5 million tonnes of annual greenhouse gas emissions and create demand for around 53,000 tonnes of green hydrogen annually. Further funding support would strengthen the economic argument for a large-scale green ammonia plant in Kwinana.

Five of the six green hydrogen projects shortlisted for the initial AUD2 billion of Hydrogen Headstart funding have suggested ammonia as a potential end use. However, only one – through Orica's partnership with Origin Energy to develop the Hunter Valley Hydrogen Hub – has an explicit commitment to utilise green hydrogen in production of ammonia for domestic use. Targeting the rest of Australia's existing ammonia production (including the proposed CSBP expansion) would be a logical priority for the recently announced funding expansion of the Hydrogen Headstart program.

In addition, our research previously showed that Australia's mining companies could pledge to absorb the near-term cost premium with a minimal impact to their operating costs. Through their use of explosive products, miners consume about half of Australia's ammonia production, but they currently lack incentives for change due to insufficient policy mechanisms and limited transparency or scrutiny regarding the contribution of these products to company emissions. By quantifying and setting reduction targets on upstream emissions from explosives, miners could guarantee offtake and provide the certainty required to shift investment from suppliers.

The potential 300,000 tonnes of green ammonia produced by the CSBP expansion would be enough to produce around one third of Australia's current mining explosives use. If the CSBP project were completely supplied with local green hydrogen, our analysis suggests increased costs of 0.3%-0.7% for mining companies that completely switch to these lower-emissions explosives before 2030. However, if costs were spread across the entire mining industry – where each company partially replaces their current explosives – this equates to an impact of less than 0.2%. This illustrates how introducing progressive requirements for green explosives uptake in mining could distribute the costs of shifting to green hydrogen over the whole sector, creating large-scale demand for green hydrogen at a small cost impact for miners.

> **"Switching 30% of Australia's current ammonia production away from gas in existing ammonia facilities could create demand for around 110,000 tonnes of green hydrogen."**

In addition to this new plant, industry consultation suggests up to 30% of feedstock could be shifted to green hydrogen in existing ammonia plants without major equipment upgrades, presenting an immediate demand-side opportunity to kickstart the industry. Switching 30% of Australia's current ammonia production away from gas in existing ammonia facilities could create demand for around 110,000 tonnes of green hydrogen, which is well within the budget made available by the government's HPTI over the next decade (roughly 335,000 tonnes per year). The cost implications of such a switch would depend on the relative costs of producing green and grey hydrogen, which will vary by region and over time.

Shifting 30% of existing ammonia production to a green hydrogen feedstock would be equivalent to decarbonising 57% of the explosives used in Australian mining. IEEFA analysis suggests that even conservatively assuming a 150% cost premium (post-HPTI) for these green hydrogen inputs would translate to less than a 0.15% increase in operating expenses for miners purchasing derivative explosives. In combination with the CSBP expansion, this could decarbonise the equivalent of 85% of mining explosives by the early 2030s for a combined cost impact of less than 0.35%.

> **“In combination with the CSBP expansion, this could decarbonise the equivalent of 85% of mining explosives by the early 2030s for a combined cost impact of less than 0.35%.”**

Because blending green hydrogen into existing ammonia facilities results in a lower-emissions product rather than a distinct stream of green ammonia, a certificate-based mechanism could be implemented. This would allow producers to generate certificates corresponding to the amount of green hydrogen used in ammonia production, which purchasers such as mining companies could buy to certify a portion of their explosives as ‘green hydrogen-based’. Such a system would ensure green hydrogen usage is accurately accounted for, providing tangible incentives to producers, and enabling purchasers to verify the green credentials of the products they buy. It would also help ensure that all facilities, whether their ammonia is used for explosives or fertilisers manufacturing, can maximise their green hydrogen input.

By 2030, expected cost reductions would improve the economic case for retrofitting existing facilities for higher shares of green hydrogen, or to develop new ammonia projects with a completely decarbonised hydrogen feedstock. However, transitioning the existing stock of gas-based capacity would be no mean feat given the capital-intensive nature of ammonia assets, where companies typically expect financial returns over more than 25 years. The potential financial write-offs for accelerated decommissioning or conversion of existing facilities present a significant barrier, underscoring the need for a coordinated approach with robust government support (both policy and financial) and proactive demand-side actions from customers.

This is a pivotal moment for Australia’s energy transition. While we currently lack a green hydrogen supply chain, our ammonia industry offers a ready-made demand source that can help develop the necessary infrastructure, expertise and innovation to position Australia as a global renewable energy leader. Looking beyond ammonia, this could unlock future economic opportunities like green iron and steel, and ensure that the *Future Made in Australia* policy lives up to its name.

About IEEFA

The Institute for Energy Economics and Financial Analysis (IEEFA) examines issues related to energy markets, trends and policies. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. www.ieefa.org

About the Authors

Cameron Butler

Cameron is a guest contributor at IEEFA, focusing on Australia's industrial sectors. Cameron most recently worked within Deloitte's Climate and Sustainability practice, specialising in transition risk and other analysis to inform client decarbonisation strategies. Prior to this he worked at ClimateWorks Centre, undertaking research and developing decarbonisation scenarios across all sectors of the Australian economy. Throughout 2022, he led research and analysis for the Australian Industry Energy Transitions Initiative, a multi-year programme focused on accelerating action towards net zero emissions in Australia's critical supply chains.

Amandine Denis-Ryan

Amandine is a recognised expert in net zero emissions transitions across the economy. She led the development of the first domestic net zero emissions pathway for Australia and subsequent updates, which are considered to be the reference for Paris-aligned pathways and used by business, finance and government organisations. She has worked with and advised many organisations on the strategy, investment and risk implications of the energy transition. adeniryan@ieefa.org