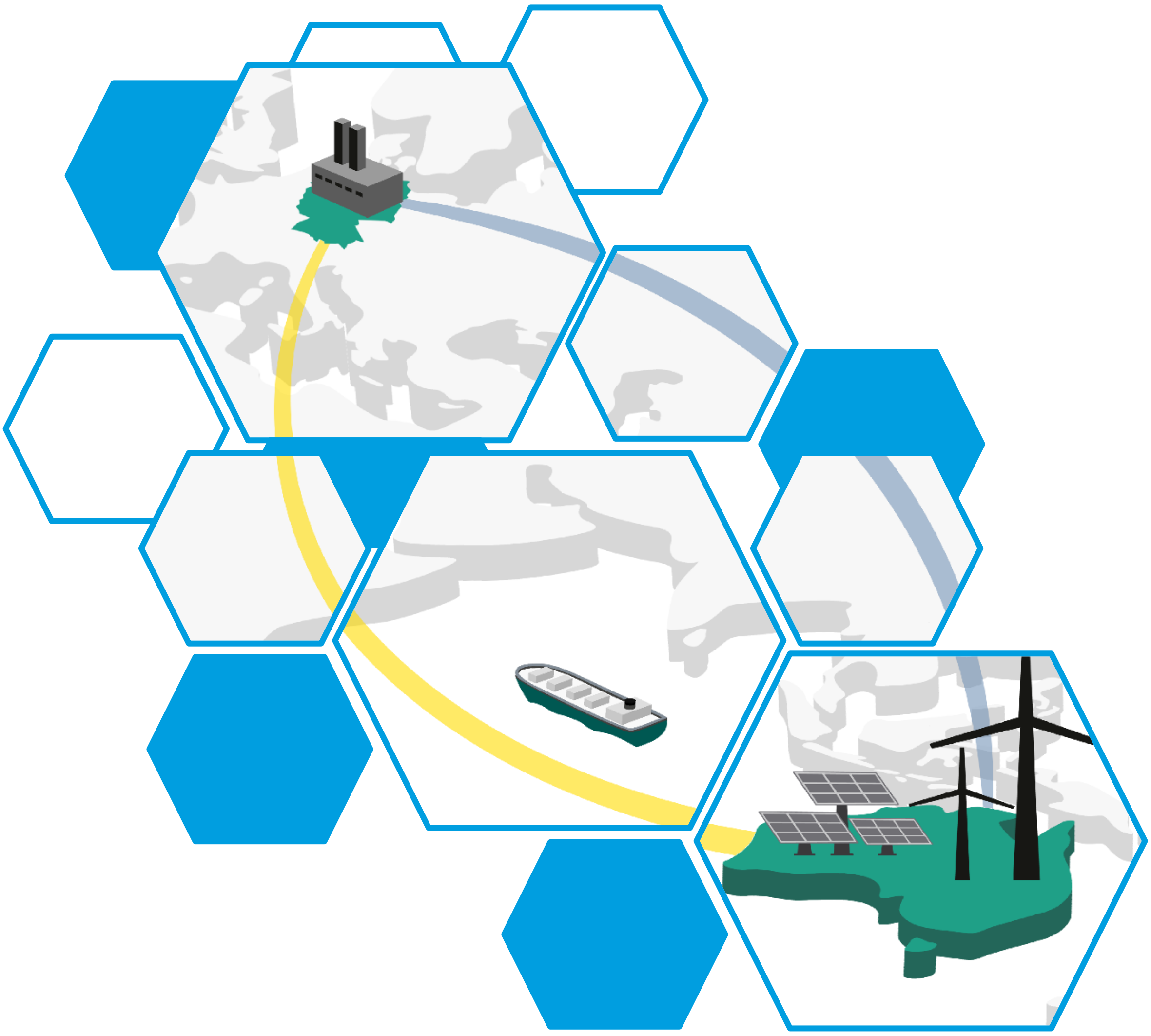
HySupply-Germany

Demand-Side Action Plan for the German-Australian Supply Chain for Renewable Hydrogen

October 2022



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Imprint

In September 2020, the Departments of Foreign Affairs and Trade (DFAT) and Industry, Science, Energy and Resources (DISER) of Australia and the Federal Ministry of Education and Research (BMBF) of the Federal Republic of Germany have jointly agreed to fund a feasibility study which investigates the potential of a German-Australian supply chain for hydrogen from renewables. acatech – National Academy of Science and Engineering together with the Federation of German Industries (BDI) are coordinating HySupply-Germany while the University of New South Wales (UNSW) is leading the Australian consortium.

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October 2022

Summary

This Demand-Side Action Plan from HySupply-Germany provides an update on Germany's evolving hydrogen economy and formulates actions that need to be implemented within the next 24 months to allow for renewable hydrogen imports from Australia by 2030 the latest.

- **More stringent climate policy leads to increased demands for hydrogen and the need for imports.** With Germany's new Federal Climate Change Act, the target of climate-neutrality was brought forward by five years and the emissions reduction targets for 2030 were tightened significantly which increased the demand and need for imports of hydrogen and its derivatives.

- **The energy crisis calls for new import infrastructures** to achieve independence from Russian fossil fuel imports and realise the REPowerEU import target of 10 million tonnes of hydrogen by 2030. To address this crisis, Germany is accelerating the build-up of new import infrastructures for LNG as well as for hydrogen derivatives such as ammonia.

- **German manufacturers are gearing up to enter a new era for electrolysers** by continuously driving the commercialisation of modules to 10 MW and beyond, especially for alkaline water electrolysis (AWE) and proton exchange membrane (PEM) electrolysis. These module sizes will be necessary to realise export-scale projects from Australia.

- **German and Australian policymakers and stakeholders need to take action within the next 24 months** to enable and accelerate the development of the German-Australian supply chain for renewable hydrogen and its derivatives. Not taking decisive actions will make imports by 2030 highly unlikely.

- **Securing offtake for renewable hydrogen and its derivatives in Germany is crucial** to kick-start export projects in Australia. This can be achieved by creating green lead markets to drive predictable demand in Germany, the successful implementation of H2Global and an Australian specific auction window, as well as Contract for Difference (CfD) mechanisms.

- **Implementing a certification scheme is central to enable the trade of hydrogen.** Most influential are the legal requirements coming from European Renewable Energy Directive that are however still pending. Germany and Australia should already foster dialogue on the possibilities to implement these requirements in Australia to potentially become the first international certified hydrogen supply chain.

- **Building up import infrastructures as the cornerstone of the German-Australian hydrogen bridge is key.** To support this, planning and approval procedures need to be significantly accelerated and regulation for and access to infrastructures should be non-discriminatory. Strengthened public-private partnerships can help to de-risk the investments while existing import hubs can provide fast-track solutions for early imports.

- **Scaling-up renewable hydrogen projects in Australia is a necessity for exports to Germany.** Financial incentives can drive down cost and mitigate risk for hydrogen production. Projects should be matured in collaboration with German technology providers while also ensuring social license. A joint hydrogen innovation hub can facilitate the scale-up of technologies and knowledge sharing between both countries.

- **Coordinating existing and emerging German-Australian hydrogen collaborations** is essential for an efficient implementation of the supply chain. One central platform with representatives of the existing initiatives and a Special Commissioner for Germany can lead the coordination efforts. Monitoring the progress of the partnership and regular delegations will help to keep the momentum.

- **From fact-finding to fact-making:** To implement the actions and realise the supply chain by 2030 the latest, the German-Australian partnership and all associated stakeholders need to act fast, be pragmatic, think big, and play together as a team. Only then the bridge for renewable hydrogen will become a reality.

Context of this Action Plan

The aim of HySupply has been to investigate the feasibility of the German-Australian supply chain for hydrogen produced from renewables including hydrogen-based energy carriers (derivatives). This feasibility study consists of different milestones that have been carried out over the course of two years:

As a first step, the working paper from the German project group **A Meta-Analysis towards a German-Australian Supply Chain for Renewable Hydrogen** elaborated on Germany's future demands for hydrogen and its need for imports. The analysis focused on different transport vectors including liquid hydrogen (LH_2), liquid organic hydrogen carriers (LOHC), ammonia (NH_3), and methanol (MeOH). The paper shows that the long-distance transport of hydrogen and its derivatives between Australia and Germany is technically feasible with renewable ammonia and methanol being overall the most mature pathways.

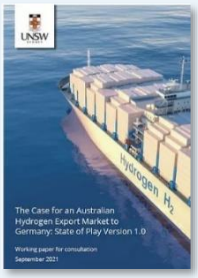
The second milestone was marked by the report **The Case for an Australian Hydrogen Export Market to Germany: State of Play Version 1.0** of the Australian consortium which demonstrated Australia's leadership opportunity to export renewable hydrogen in the future. The report shows that already today, Australia's best locations can produce renewable hydrogen at 2-6 €/kg. Preliminary modelling also indicates that renewable ammonia offers the most economical pathway with delivered hydrogen cost between 3.5-8.8 €/kg at the Port of Rotterdam. The report is accompanied by a **hydrogen cost tool** and a **shipping cost tool**.

The third milestone was achieved through HySupply-Germany's legal study which investigated the **Regulatory framework for a German-Australian hydrogen bridge** of the previously analysed transport options. The results confirm that the import of renewable hydrogen from Australia to Europe is legally feasible. However, depending on the transport options, some legal hurdles occur which can impede their timely implementation.

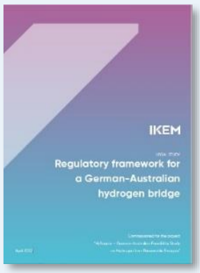
The **Certification Report** from HySupply-Australia describes the key characteristics and 'good design' principles of certification schemes as well as existing and emerging certification schemes that are potentially applicable to bilateral trade of renewable hydrogen between Australia and Germany.

The next milestone was introduced by **Australia's Supply-Side Roadmapping Exercise** which identified key barriers and opportunities across five topic areas and formulated strategic next steps to realise Australia's hydrogen export potential. This **Demand-Side Action Plan** formulates actions that need to be implemented within the next 24 months to allow for renewable hydrogen imports from Australia by 2030 the latest.

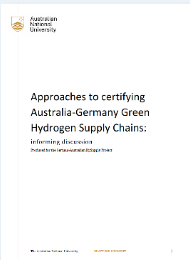
HySupply-Germany's Meta-Analysis (2021)



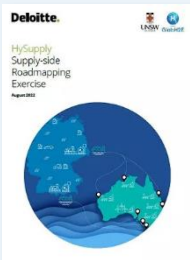
HySupply-Australia's State of Play Report (2021)



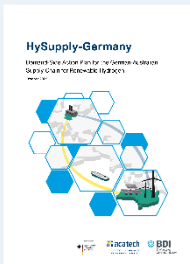
HySupply-Germany's Legal Study (2022)



HySupply-Australia's Certification Report (2022)



HySupply-Australia's Supply-side Roadmapping Exercise (2022)



HySupply-Germany's Demand-Side Action Plan (2022)

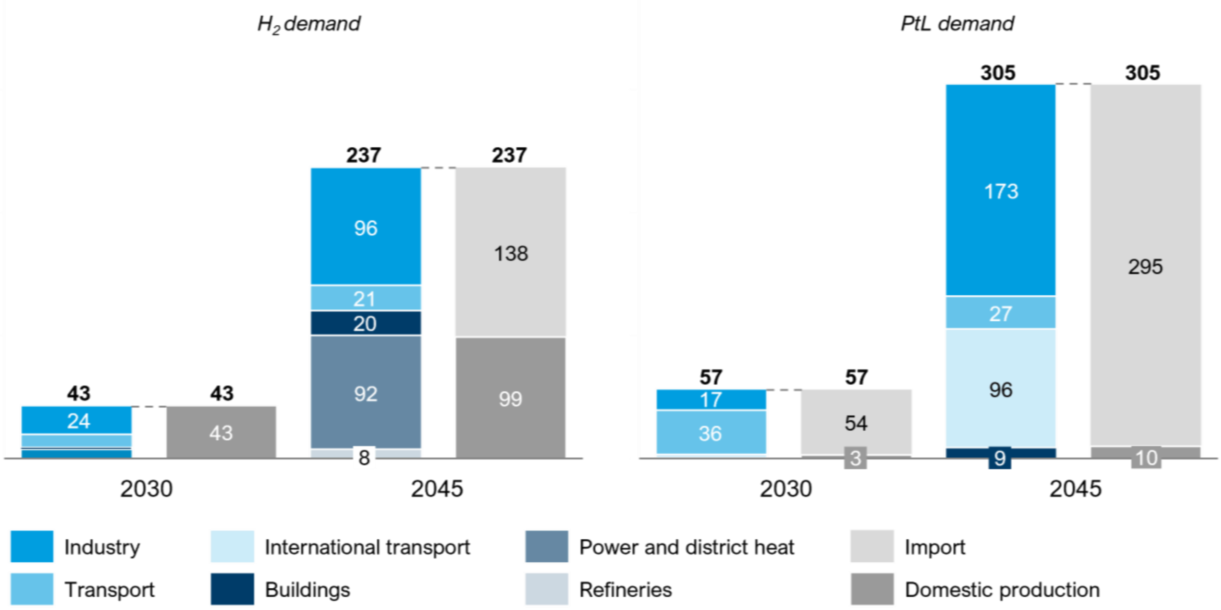
Update on the German Hydrogen Economy

Tighter climate targets result in higher hydrogen demands

HySupply-Germany's first milestone, the working paper "A Meta-Analysis towards a German-Australia Supply Chain for Renewable Hydrogen", elaborated on the role of renewable hydrogen in Germany's energy system to achieve climate-neutrality by 2050 and the need for imports to cover its demands. After the finalization of the working paper in June 2021, Germany amended its Federal Climate Change Act which enshrined the target of climate-neutrality by 2045 and increased Germany's former reduction target for 2030 significantly.

One of the first studies that re-modelled Germany's future energy system with the new target level was the "Climate Paths 2.0" study[1] which was commissioned by the BDI and conducted by Boston Consulting Group (BCG). The study reaffirms that electricity from renewables will be the most important energy carrier to defossilise the energy system. However, compared to the previous Climate Path study 1.0, the demand for hydrogen and its derivatives are projected to be significantly higher and imports will be even more crucial to cover the demand.

H_2 and PtL demand by sector and application 2030–2045 (TWh)



Note: H_2 = hydrogen from electrolysis of renewable energies (during the transition – before 2040 – purchase of blue hydrogen is also conceivable); PtL = renewable synthethic fuels made of green hydrogen (especially synthetic crude, methanol); international transport = sea and air transport departing from Germany | Adapted from BCG (2021)[1]

More than half of the demand for low-carbon hydrogen in 2030 is projected to come from the industry sector, especially for producing green steel and green chemicals. The remaining demand will be driven from parts of the transport sector and from refineries. It is not expected that imports of pure hydrogen will be viable by that time which means that the total demand of 43 TWh (1.3 million tonnes) will have to be provided by domestic production. In 2045, the demand for low-carbon hydrogen is expected to amount to 237 TWh (7.1 million tonnes) with 96 TWh coming from the industry, 92 TWh from power and district heat applications as well as some 20 TWh from the transport and building sector respectively. It is expected that almost 60% of this demand will have to be met by imports.

[1] More information: **Climate Paths 2.0 – A Program for Climate and Germany's Future Development (BCG 2021).**

For hydrogen derivatives (Power-to-Liquid, PtL), Germany's demand in 2030 is projected to be 57 TWh with 36 TWh coming from the transport sector translating to around 3 million tonnes of synthetic fuels. Demands of 17 TWh are expected to come from industry with methanol and ammonia being the most important derivatives. Already then, Germany will almost completely depend on imports. Considering 2045, the demands for hydrogen derivatives will increase to over 300 TWh with more than half coming from industry. Some 96 TWh are projected to be needed in the international transport sector for hydrogen derivatives such as sustainable aviation fuel, ammonia, and methanol as shipping fuels. Again, Germany's future demand will have to almost completely be provided by imports.

Energy crisis calls for new import infrastructures

The energy crisis caused by Russia's invasion of Ukraine has disrupted European and global energy systems. As a response to this war of aggression, the EU has embargoed all imports of oil and coal from Russia and only small amounts of natural gas are still delivered to Europe. The result is an unprecedented supply and price shock for the European energy market and especially for Germany.

To make Europe independent of fossil fuels from Russia, the EU has announced its REPowerEU plan which aims to increase energy savings, diversify energy supplies, and accelerate the rollout of renewables. It also doubles the EU's ambition for hydrogen to 20 million tonnes (667 TWh) by 2030, of which 10 million tonnes are to be met by imports from countries outside of the EU. In addition, the President of the European Commission (EC), Ursula von der Leyen, recently announced to create a European Hydrogen Bank to invest €3 billion for the procurement of hydrogen.

Germany has been hit particularly hard as Russia was its largest energy supplier covering 30% of Germany's entire energy needs. Most notably, 55% (~500 TWh) of Germany's demands for natural gas were covered by Russian supplies which currently almost came to standstill. While other natural gas suppliers to Germany such as Norway and the Netherlands have increased their deliveries via pipelines to Germany, the volumes still fall short to cover the pre-crisis demand. To address this shortage, the German Government has ramped-up the development of import capacities for liquified natural gas (LNG) by introducing the LNG Acceleration Act (LNGG) which mostly applies to Floating Storage and Regasification Units (FSRUs). The Act significantly reduces the time for their approval processes by relaxing environmental impact regulations and limiting the right of third parties to appeal. From December 2022 to the end of 2023, a total of six FSRUs will gradually come online to provide LNG import capacities. In addition, three land-based LNG terminals will be constructed in Brunsbüttel, Stade, and Wilhelmshaven which are expected to be operational in the next few years. The German Government and several German energy importers have signed declarations of intent with third parties for the delivery of LNG cargos, for example, with Australian energy company Woodside Energy for up to twelve cargos per year starting in 2023.

This new, necessary momentum for LNG terminals has also spurred the development of import capacities for renewable hydrogen and derivatives such as ammonia. The two land-based LNG terminals in Brunsbüttel and Stade aim to be 'H_2-ready' from the start and thus also allow for the import of hydrogen and ammonia. Moreover, RWE has announced their plans to construct an import terminal for renewable ammonia by 2026 with a capacity of 300,000 tonnes per year next to its planned LNG terminal in Brunsbüttel. In addition, the Port of Wilhelmshaven strives to become a new hub for green energy, enabling hydrogen imports of some 870,000 tonnes (29 TWh) by 2030. In the Port, Uniper has announced to establish an import terminal for renewable ammonia with an integrated cracking-unit to supply up to 295,000 tonnes (9.8 TWh) of renewable hydrogen to nearby industries. From 2026, Tree Energy Solutions (TES) are planning to import synthetic LNG at the Port which will either be distributed to offtakers or used to produce hydrogen onsite via autohermal reforming with subsequent CO_2 capture. The captured CO_2 will then be liquified and shipped back in the same marine vessel to produce new synthetic LNG in the exporting country.

The Port of Rotterdam is also strenghtening its position as the largest energy import hub for Germany. In addition to already being the largest hub for methanol imports, the Port has announced plans for five ammonia terminals, two LOHC terminals, and one LH_2 terminal. By 2030, the Port aims to supply 4.6 million tonnes of hydrogen (153 TWh) to Europe. The distribution to the German hinterland is envisioned through the proposed Delta Corridor.

A new era for electrolysers in Germany

The ambitious goals put forth by the EC's new REPowerEU plan as a reaction to the energy crisis will require significant scale-up in manufacturing and deployment of electrolysers at an unprecedent pace. In the next seven years, deployed electrolyser capacities must increase from currently less than 1 GW to more than 200 GW to meet the EU's total demand target of 20 million tonnes of renewable hydrogen by 2030.[2] As a result, the EU and the German industry are called upon to significantly gear up manufacturing capabilities and to enter a new era for electrolysers.

In May 2022, the EC and 20 industry CEOs signed a joint declaration to increase annual electrolyser production capacities by 2025 to 17.5 GW. In addition, a European Electrolyser Partnership was formed under the European Clean Hydrogen Alliance which aims to drive coordination between manufacturers, subcomponent suppliers, and policy makers. Moreover, in July 2022 the EC approved up to €5.4 billion of public support for the funding scheme IPCEI Hy2Tech[3], expecting to unlock an additional €8.8 billion in private capital. The approval covers 41 projects in total and includes 21 projects to boost electrolysis technology capabilities.

German manufacturers are continuously driving the commercialization of modules to 10 MW and beyond, in particular for alkaline water electrolysis (AWE) and proton exchange membrane (PEM) electrolysis. These module sizes will be necessary to realize export projects where the required capacity is typically above 250 MW. Other technologies in development such as solid oxide electrolysis cell (SOEC) and anion exchange membrane (AEM) electrolysis are less mature. Enapter AG is the leading provider for AEM electrolysers, currently offering 1 MW modules to the market. Sunfire is the leading provider for SOEC with modules that have a capacity of 2.7 MW. One of these modules has already been installed for Neste in the port of Rotterdam. Subcomponent suppliers for electrolysers are also increasing their investments and efforts in scaling-up up manufacturing and supply chain capabilities.

The largest German AWE manufacturer thyssenkrupp nucera has an existing global supply chain to provide 1 GW capacity per annum. Their standardised 20 MW modules will be used to implement several projects. Most notably, more than 2 GW will be delivered to Air Products for NEOM which is expected to be operational in 2026. Other major signed deliveries include 200 MW to Shell's hydrogen project in the port of Rotterdam (expected operation 2024) and 60 MW to the facility of Unigel in Brazil (expected operation 2023). The company also plans to scale-up annual production capacities to 5 GW in 2025. The other major AWE manufacturer is Sunfire GmbH. Their 10 MW modules will be used to implement a 30 MW hydrogen project for Uniper (expected delivery 2024). Moreover, the company plans to construct a factory in Germany to output 500 MW per annum.

Siemens Energy is the largest manufacturer in Germany for PEM electrolysers. Their 10 MW modules will be used to realise a 50 MW project for European Energy A/S in Denmark with delivery expected for mid-2023. In June 2022, the company has also announced to form a joint venture with French gas company Air Liquide SA to drive the scale-up of electrolyser production capacities. First units from the new production line are anticipated for the second half of 2023 and capacities will be increased to 3 GW per annum in 2025. Another notable German manufacturer is H-TEC Systems, a fully owned subsidiary of MAN Energy Solutions. Their 2 MW module has been delivered to GP Joule and the company is also offering a 10 MW module consisting of several smaller ones.

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[2] Measured in terms of electricity input assuming electrolyser efficiency of 70% and an average electrolyser utilisation of 4,000 FLH.

[3] More information: **European Commission IPCEI Hy2Tech.**

HySupply-Germany's Demand-Side Action Plan

Demand-Side Action Plan

HySupply-Germany consulted more than 50 experts including current and potential future offtakers, technology providers and subcomponent suppliers, trading firms, port authorities, leading scientists, industry associations, and representatives of the Federal Government. The purpose of this stakeholder consultation was to get a collective understanding of the key challenges and opportunities alongside the hydrogen supply chain between Australia and Germany. As part of this process, HySupply-Germany carried out a delegation trip to Australia in May 2022 which was led by Germany's Federal Minister of Education and Research and accompanied by some 25 experts from the German industry and academia.

The views obtained through the stakeholder consultation were clustered into five action fields that each contain key actions to implement the German-Australian hydrogen supply chain, especially from the perspective of the demand side. Since the project development including planning and approval processes, procurement of equipment, and the construction of facilities and infrastructures will take several years, the actions of the **next 24 months** will determine whether Germany can realise renewable hydrogen or derivative imports from Australia by 2030 the latest.

Action field 1
Offtake to provide a visible market for Australian project developers and mature projects through final investment decisions, ultimately allowing for exports.

Action field 2
Certification to ensure legal certainty for German offtakers and thus enable the import of renewable hydrogen from Australia to Germany.

Action field 3
Import infrastructures to be ready to receive the first imports and to enable cross-border distribution to the offtakers in Germany.

Action field 4
Export scale of renewable hydrogen projects in Australia to allow for economies of scale and to enable viable long-distance transport to Germany.

Action field 5
Coordination of existing and emerging bilateral initiatives for hydrogen collaboration to strengthen Germany's position in Australia.

Note: A stakeholder icon indicates primary or secondary ownership and responsibility to implement the action.

European Union | **German Government** | **Australian Government** | **Industry** | **Research**

Action field 1: Offtake

Large-scale projects require a positive final investment decision (FID) to procure equipment, start construction, and eventually go into operation and production. In order to take this FID, project developers in turn need to be confident that the project is bankable which signals to investors that it will generate profits in the future. This can be guaranteed by a legally binding agreement with a company that defines terms and conditions regarding quantities and price for the offtake of the desired product over a certain period. Without such a long-term offtake agreement, it is very unlikely that an FID will be made.

Currently, it is very challenging for German companies to commit to an offtake agreement due to a range of uncertainties including the lack of long-term predictability of regulatory framework conditions, the unavailability of import- and distribution infrastructures, the investment cost associated with new hydrogen-based processes, as well as the anticipated higher cost for the imported renewable hydrogen or derivative compared to fossil fuels. In turn, Australian project developers are not taking FID on their export projects as their perceived risk is too high since there is no visible market for renewable hydrogen in Germany.

NEXT 24 MONTHS

Key actions	Primary	Support
Create **green lead markets in Germany to drive predictable demand** for hydrogen and its derivatives through quotas and mandates (e.g. in aviation and marine transport) and push sustainable public procurement on the Federal and State level.		
Successfully execute **the first H2Global[4] auction as soon as possible to verify the usability** of the mechanism. Explore future design changes such as significantly longer contracts on the demand side and auctions for other products such as direct-reduced-iron (DRI).		
Introduce an adjusted **Australian-specific window for H2Global** and secure funding from both countries to procure and auction renewable fast-track options such as ammonia at export-scale. This will help to reduce first-mover risk and drive down cost.		
Operationalise the proposed European Hydrogen Bank and procure large quantities of renewable hydrogen through Contracts for Difference (CfD) thus unleashing the full power of the European market for renewable hydrogen imports against competitors in Japan, Korean, and Singapore. The Australia-EU corridor would by far be the largest in the world and would significantly drive down cost.	EU	

[4] H2Global's double auction mechanism covers the difference between lowest possible hydrogen or derivative supply price and the highest willingness to pay on the demand side. More information: **The H2Global Mechanism.**

Action field 2: Certification

Regardless of how the hydrogen molecule is produced, the chemical properties are identical which means that one cannot distinguish how the hydrogen was produced. This information is critical because different hydrogen production technologies and the respective energy input are associated with different emissions intensities. In Germany, there are certification bodies that already have standards in place to provide a credible proof of the avoided emissions from the different forms of hydrogen[5]. Nevertheless, since hydrogen produced from renewable energy sources has currently higher costs than conventionally produced hydrogen from fossil fuels, end-users have a strong interest in a standard which offers further added value.

For European end-users, such a value added can be provided for example when they can account the hydrogen towards the achievement of renewable energy targets. In the EU, the Member States are mandated to set their targets so that the EU's overall renewable energy target will be met which is determined by the Renewable Energy Directive (RED II). Through one of its Delegated Acts (DA), the RED II will determine the requirements for renewable electricity used to produce Renewable Fuels of Non-Biological Origin (RFNBO) which includes renewable hydrogen. Although this DA only addresses the transport sector, it is expected that the criteria will be adopted for other sectors as well which makes the DA central for any hydrogen certification considerations with the European market. The biggest challenge is the fact that the proposed requirements of the DA are too stringent and still pending which makes it difficult for German and Europeans companies to commit to offtake agreements on renewable hydrogen.[6]

NEXT 24 MONTHS

Key actions	Primary	Support
Foster dialogue between Australian and German stakeholders and support their participation in regulatory developments. Establish a common understanding of what requirements will have to be met by a certification scheme that enables the import of renewable hydrogen from Australia to Germany.		
Adjust the criteria of the DA of the RED II to ensure that they are sufficiently flexible for the EU´s hydrogen economy and for the urgently needed imports of renewable hydrogen from third countries. It is particularly important to allow the use of existing renewable energy plants to produce renewable hydrogen and to use tools such as Guarantees of Origin (GOs) to proof the origin of the renewable electricity.	EU	
Make use of existing and emerging certification schemes and initiatives such as CertifHy and Australia's Guarantees of Origin Scheme (GOs)[7]. Once such schemes are successfully implemented, the opportunity to conclude a Mutual Recognition Agreement between Australia and the EU should be pursued which allows for the recognition of GO's from third countries.[8]	EU	

[5] For example, the green hydrogen standards by TÜV Rheinland and TÜV SÜD.
[6] The only way to currently ensure legal certainty that the hydrogen produced will be considered as renewable under RED II is when the electricity is obtained from direct connection to an installation generating renewable electricity.
[7] More information: **HySupply-Australia's Certification Report.**
[8] More information: **Article 19 of the RED II.**

Action field 3: Import infrastructures

Import infrastructures are the cornerstone for the German-Australian supply chain of renewable hydrogen. On the demand side, most relevant infrastructures for imports concern receiving terminals and storage facilities as well as the various modes of distribution to the offtaker such as pipelines, barges, trains, and trailers. Over the last months, Germany has started to engage in the first phases of development for such infrastructures that would enable international trade. However, there are currently no infrastructures for the large-scale import of renewable hydrogen and its derivatives available yet because most of these products are produced domestically from fossil fuels.

The establishment of new and cross-border infrastructures faces multiple obstacles. In particular, long planning and approval processes currently presentsignificant barriers to capital intensive investments for terminals, large-scale storage tanks, and pipelines. This is exacerbated by the fact that there are no clear responsibilities to target the necessary investments and establish these infrastructures. Another barrier will likely be the public acceptance especially for products that are classified as dangerous goods, which can significantly impede the viability of infrastructure projects in Germany.

NEXT 24 MONTHS

Key actions — Primary — Support

Massively accelerate planning and approval processes for all import infrastructures for hydrogen and its derivatives through a Hydrogen Accleration Act. This can be achieved by streamlining processes as well as digitising and empowering public administrations. The LNG Acceleration Act (LNGG) could serve as a role model if the support of the public can be ensured in the process.

Ensure that import infrastructure **regulation on the EU and Federal level is non-discriminatory and technology agnostic** towards hydrogen and all its derivatives. The proposed definitions by the European Commission in the Gas and Hydrogen Package currently only consider liquid hydrogen and ammonia as as hydrogen import infrastructure.

Strengthen public-private-partnerships for the development of hydrogen, derivatives, and CO_2 infrastructures in Germany and Europe to de-risk the investments and provide equal access across market players. The German KfW bank can play a central role as public co-investor since import infrastructures provide long-term and sustainable growth opportunities for strategic investments by Governments and private entities alike.

Leverage the capabilities of existing import hubs and their infrastructures in Rotterdam and Antwerp to provide fast-track solutions for imports from Australia well before 2030. In addition, the planned terminals for derivatives such as ammonia must be matured towards FID as quickly as possible. New stationary LNG terminals should scope the feasibility of accelerated imports for renewable hydrogen and derivatives.

Action field 4: Export scale

To be viable for long-distance transport and export, hydrogen projects will require a certain size to produce sufficient quantities of hydrogen. Otherwise, the project runs the risk of requiring much more energy input than what will be ultimately delivered to Germany. Therefore, the installed electrolyser capacity for the German-Australian supply chain should at least be in the range of 250-300 MW to provide good economies of scale for the electrolyser and help with optimising supply chains for the procurement of the necessary equipment and raw materials. In addition to the large-scale electrolyser, a viable export project requires about twice the capacity of dedicated renewable energies, at least one plant to convert the renewable hydrogen into a shippable carrier, and an export terminal to provide capacities for storage and export via tankers.

Such large-scale hydrogen projects and subsequent infrastructures require many resources such as land, water, and a skilled workforce to construct, operate, and maintain them. Moreover, they will require an efficient local manufacturing supply chain to implement the projects on time. In addition, strong public support for exports to Germany will be vital because these projects can put additional pressure on the country's own efforts to defossilise the domestic energy system and expand renewable energies.

NEXT 24 MONTHS

Key actions | Primary | Support

Introduce fiscal incentives for hydrogen production in Australia similar to the US Inflation Reduction Act[9] to enable the rapid build-up of export scale renewable hydrogen projects. Unbureaucratic financial support instruments will attract investments of German technology providers into manufacturing capacities in Australia.

Ensure that export projects obtain and maintain social license in Australia. Additional environmental and economic benefits for local communities will be key given potential sustainability criteria for imports in Germany and Europe. Australia can leverage these benefits against other competing exporters that will have a harder time meeting these criteria.

Advance export project proposals in Australia to FID by committing to funding and resource deployment. As regulatory certainty is being strengthened in Germany and the EU, Australian industry should mature projects through feasibility and FEED phases. Staging projects and collaboration with German OEMs, subcomponent suppliers, and offtakers can help to mitigate risks.

Establish a joint hydrogen innovation hub in Australia that showcases and demonstrates German technologies on large scale, addresses key barriers, and enables fast-track export solutions from Australia. The hub should also address key research demands such as ammonia cracking, methanol-to-kerosene production with integrated direct-air-capture, and the production of direct reduced iron (DRI).

[9] The US Inflation Reduction Act offers 10-year production tax credits for "clean hydrogen" production facilities. Incentives begin at $US 0.6 and increase to $US3 per kilogram for hydrogen produced with a carbon footprint of less than 0.45 $kgCO_2$. These credits will likely make the US one of the cheapest regions in the world for hydrogen production.

Action field 5: Coordination

The prospect of the Australian-German hydrogen partnership has been first identified by the BMBF-funded acatech and BDI delegation trip to Australia in 2019. In September 2020, Germany and Australia signed the Joint Declaration of Intent which then kick-started HySupply. Since then, many more bilateral collaborations were established including the Hydrogen Sub-Working Group by the German-Australian Energy Cooperation, the Germany-Australia Hydrogen Accord and its Task Force, the technology incubator HyGATE, the German-Australian Hydrogen Alliance, and the German-Australian Green Hydrogen Crisis Taskforce.

While these initiatives are a strong and important signal that all stakeholders are seriously engaged in supporting the collaboration between both countries, they are not completely aligned. This in part leads to parallel structures that run the risk of cannibalizing each other. This puts Germany at a disadvantage, especially when compared to Germany's competitors for exports from Australia such as Japan, Korea, and Singapore. These countries pursue a much more coordinated approach between their ministries and industries in Australia and are therefore able to execute projects faster and more efficiently.

NEXT 24 MONTHS

Key actions | Primary | Support

Establish one central platform for the hydrogen partnership between Germany and Australia with representatives of the existing initiatives to coordinate and align all activities including funding programs such as HyGATE and H2Global as well as external stakeholder engagement. Ideally the platform unites ministries, industries, and research institutions from both countries. The platform should also lead the coordination and implementation of the proposed joint hydrogen innovation hub.

Appoint a Special Commissioner for the German-Australian Hydrogen Cooperation who is mandated by the Federal Government to speak and act on behalf of all ministries. The Commissioner should act as the focal point for all hydrogen activities of the German Government with Australia.

Continuously monitor the progress of the hydrogen partnership and the joint hydrogen innovation hub to evaluate the impact of actions, readjust them if necessary, and to set new targets. Existing monitoring processes for the energy transition in Germany can act as a blueprint.

Conduct regular delegation trips with senior officials from Government, industry, and the research community to keep the momentum for the bilateral hydrogen partnership going. Personal contact and face-to-face conversations are particularly important to develop long-term, trusting relationship.

The Way Forward

From fact-finding to fact-making

This Action Plan has demonstrated key actions that are decisive for the implementation of the German-Australian hydrogen supply chain from the perspective of the demand side. Together with HySupply-Australia's Supply-Side Roadmap[10], German and Australian policymakers and legislators as well as industry are provided with a set of actions that will deliver the promise on the bilateral hydrogen bridge.

Moving forward, the German-Australian partnership needs to build on the current momentum and fast-track the feasible solutions of today to realise the hydrogen bridge of tomorrow. To achieve this desired outcome, the implementation of the actions should be guided by the principles below.

- **Act fast:** Speed will be crucial if Germany and Australia want to implement the bilateral supply chain and capitalise on this massive opportunity within this decade. Any delay in the implementation of the supply chain increases the risks that financial capital, manufacturing capabilities, and skilled workforce shift to other markets, especially Asia, North America, and the Middle East.

- **Be pragmatic:** Both countries should follow a pragmatic approach that prioritises implementing the second-best solution now while quickly transitioning towards the best net-zero solution soon after. The first-mover risk in the supply chain must be turned into a first-mover advantage as emissions reduction and green investments should be encouraged not sanctioned. An accelerated and pragmatic implementation of the German-Australian supply chain for renewable hydrogen could also act as a blueprint for other green supply chains around the world.

- **Think big**: Additional feasibility studies will not help to drive down the costs of electrolysers and renewable hydrogen. Instead, large-scale demonstrators such as the proposed joint hydrogen innovation hub are needed that showcase the feasibility, enable innovation, and provide green growth opportunities. The potential for low-cost renewable hydrogen production in Australia and the projected future demands in Germany and Europe are too big to be restricted by small approaches.

- **Play as a team:** A supply chain for renewable hydrogen has never been realised before and no single market player is able to implement it alone.[11] If this endeavour is to be successful it will require the combined and coordinated efforts of German and Australian industry, research, and politics. Moreover, mutual benefits of this supply chain should be clearly and continuously communicated as public support for Australian renewable hydrogen and its derivatives will be crucial.

[10] More information: **HySupply-Australia Supply-side Roadmapping Exercise.**

[11] In support, HySupply has compiled an exclusive stakeholder catalogue of 35 German and Australian companies that have expressed an explicit interest in contributing to the development of the supply chain for renewable hydrogen. The catalogue can be used by the leading ministries of both countries and the participating companies as a foundation for implementing the hydrogen bridge and strengthening the partnership.