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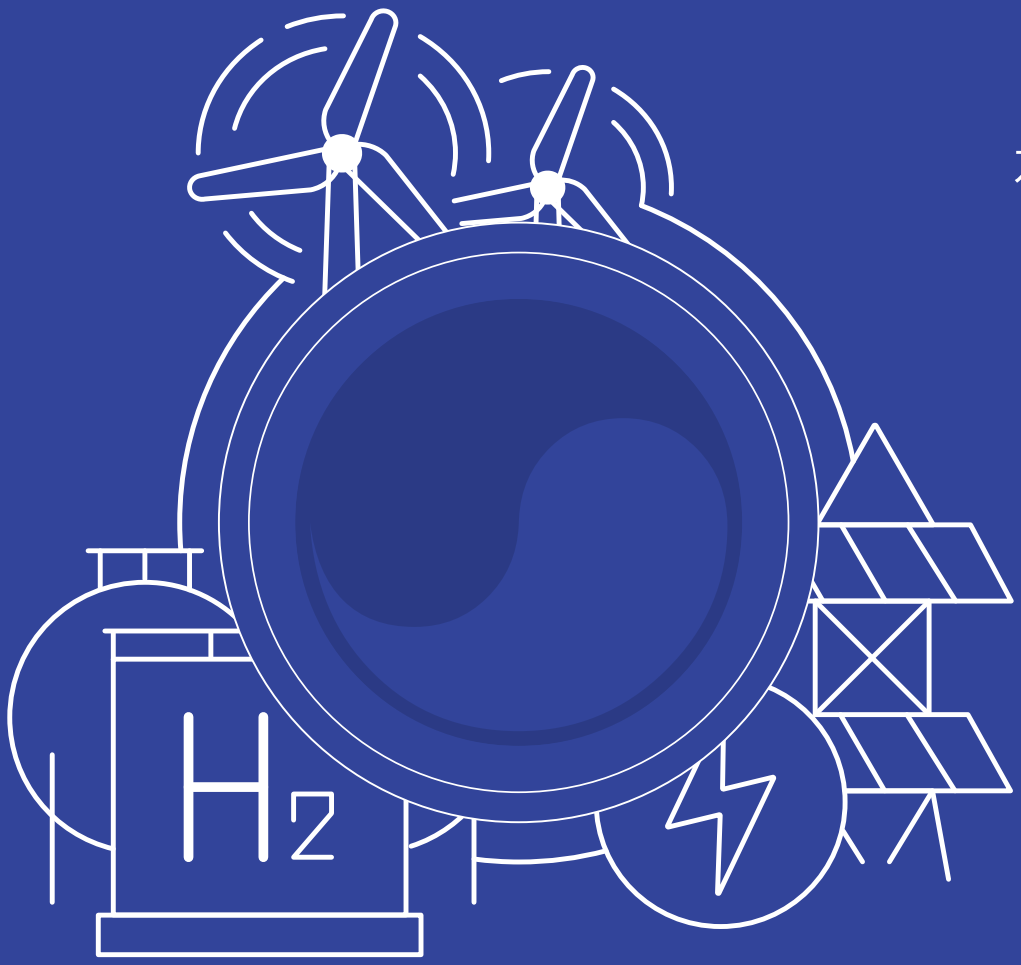

STRATEGIC ENERGY: THE EMERGING AUSTRALIA-KOREA HYDROGEN PARTNERSHIP

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Executive Summary

Australia and Korea are early leaders in the development of the hydrogen economy. Australia has vast renewable potential for green hydrogen production, and is well-positioned to become a major exporter. Korea will be one of the first global demand centres, and its private sector is rapidly driving regional market development.

Establishing a hydrogen partnership can serve as a foundation for a new phase in Australia-Korea ties. As they seek to strengthen their bilateral ties, hydrogen is a mutually-beneficial issue in which they can activate the partnership model of bilateral cooperation, and exercise broader regional leadership.

A strong foundation for government-to-government hydrogen cooperation already exists. The Korea-Australia Free Trade Agreement, and the long-standing Joint Committee for Energy and Mineral Resources Consultations and Cooperation, are at the core. These intergovernmental mechanisms will steer the activities of the new Australia-Korea 'Low and Zero Emissions Technology Partnership'.

Korean companies have made sizeable commitments to develop the hydrogen industry. This presents Australian hydrogen-focused firms with attractive commercial opportunities. Korean firms have organised into hydrogen-focussed public-private partnership groups, offering one-stop gateways for Australia to find partners.

Exploring hydrogen technology for industrial de-carbonisation and production of 'green commodities' such as steel will complement energy sector efforts. Joint projects involving Australian and Korean players are already underway, led by Korean firms such as POSCO and Korea Zinc.

Bilateral hydrogen cooperation can also be scaled up with other Indo-Pacific partners to develop regional energy transitions. There will be interest in the Indo-Pacific region in any technical assistance and investment across the hydrogen value chain. Korea and Australia's development of low emissions iron ore and steel technologies will interest rapidly industrialising countries in the region.


H2

Introduction

Hydrogen is emerging as a strong foundation for the future of the Australia-Korea partnership. As a valuable tool for decarbonisation, energy security, and economic development, hydrogen is poised to transform the global energy sector in coming decades. The two countries enjoy strong complementarities in the sector. Korea is a major driver of Indo-Pacific hydrogen demand as it looks to diversify its energy mix. Australia is an ideal trading partner and has designs to become the region's hydrogen supply superpower. Developing these ties could help refresh and reinvigorate the bilateral economic partnership and also advance more strategic aims. Hydrogen could serve as a gateway for evolving the Australia and Korea relationship from 'peers' to 'partners'.

The Korean and Australian governments are raising their commitments to hydrogen development. Yet new cross-border investment partnerships will necessarily underpin industry future growth and development. A framework for increased cooperation in this space exists in institutions such as the Korea-Australia Free Trade Agreement, Joint Committee for Energy and Mineral Resources Consultations and Cooperation, and new Australia-Korea Low and Zero Emissions Technology Partnership. There is also strong precedent for a successful bilateral resource development partnership, particularly in the liquefied natural gas sector.

> ***"Hydrogen promises to anchor Australia-Korea relations for the next several decades."***

This report explores Australia and Korea's emerging hydrogen partnerships and the major priorities for public and private interests seeking to advance it. The two countries have a golden opportunity to adapt their relationship for a new era and overcome past obstacles to more meaningful engagement. This extends from the economic to the strategic realm. It includes openings for increasing their individual and shared influence in multilateral institutions and among the developing economies of the Indo-Pacific region. The scale of potential activity will require vision and ambition fit to animate Australia-Korea relations for decades.

This report argues that hydrogen should be a major priority in efforts to develop the next phase of the Australia-Korea economic and strategic relationship. Fortunately, businesses from each country are already forming the partnerships required. But government-to-government and business-to-business linkages must continue to develop for the Australia-Korea hydrogen partnership to reach its full potential. The great scale of the sector's promised opportunity is matched by a massive set of challenges, particularly around the need to rapidly bring down costs and build out infrastructure across the value chain. To achieve this, supportive regulations, standards and other policies need to be established, and Australia and Korea are well-placed to lead this effort globally.

A foundation for an Australia-Korea hydrogen partnership

Australia-Korea relations are broad-based, and enjoy positive levels of cooperation across diplomatic, economic, and security domains. However, the level of their cooperation resembles that of "peers" – countries with similar interests, who operate adjacently rather than in concert[1]. This is based on the two countries' equal status on the global and regional stage. It stands in contrast to the "partnership" model of international relations, where countries collaborate in broader regional and global fora to advance their shared interests. Australia-Korea bilateral relations are in search of an impactful foundation upon which a partnership model can be advanced.

Unfortunately, it has been challenging to find such a foundation, as efforts to reinvigorate Australian and Korean cooperation have experienced geopolitical counter-currents. Korea's preoccupation with the North Korean nuclear threat, and a complicated bilateral relationship with China, overshadows diplomatic and security cooperation with Australia. The hydrogen economy is a specific issue in which they can activate the partnership model and propel bilateral relations into future directions. With an estimated USD1.2 trillion in investment needed across global hydrogen value chains by 2030, hydrogen represents a cooperation opportunity of enormous scale encompassing several policy domains[2]. This not only includes the bilateral components of hydrogen cooperation, but also policy coordination in advancing the hydrogen transition on a regional and global scale.

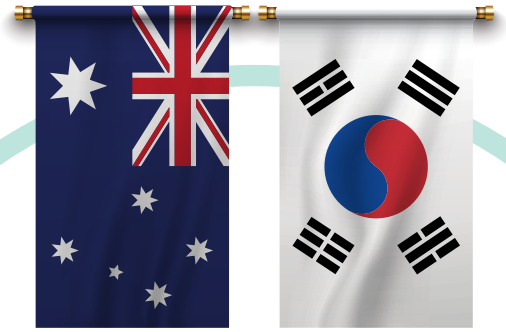
> *"Australia and Korea can apply the partnership model to their cooperation on hydrogen."*

Broader strategic justifications support the logic of partnership development. The advent of an international trade in hydrogen will help preserve beneficial interdependencies and minimise negative ones developed in the fossil fuel era. The hydrogen transition also provides importing countries such as Korea new and more diverse sources of primary energy than established hydrocarbon producers[3]. It allows countries such as Australia currently dependent on fossil fuel exports the opportunity to maintain their international presence. The development of industry value chains will diminish the capacity for authoritarian governments which have dominated hydrocarbon supply to manipulate the market and undermine energy security. A new hydrogen-based energy partnership with Australia would minimise Korea's reliance on high-risk energy chokepoints, such as the Middle East's Strait of Hormuz and Southeast Asia's Strait of Malacca.

Fortunately, Korea and Australia already have a strong bilateral framework for hydrogen cooperation. For more than three decades, government-to-government (G2G) cooperation in energy and resources has existed alongside and complemented business-to-business (B2B) engagement. In 2005, the governments combined the existing *Korea-Australia Energy Consultations Group* and the *Korea-Australia Committee for Mineral Resources Development into the Australia-Korea Joint Committee for Energy and Mineral Resources Consultations and Cooperation* (JCEM)[4].

The JCEM has convened twenty-nine times since its formation, and provides a framework for the exchange of information and views on developments in energy and energy resources. This encompasses trade, investment, technology, and policy consultations[5]. The JCEM now has an agenda for hydrogen and broader clean energy cooperation. In a substantial development, both governments in November 2021 announced the Australia-Korea Low and Zero Emissions Technology Partnership. This partnership focuses on utilising hydrogen as a decarbonisation tool alongside other clean energy technologies (See Figure 1). A working group established under the JCEM will steer progress, meeting annually.

FIGURE 1: THE AUSTRALIA KOREA LOW AND ZERO EMISSIONS TECHNOLOGY PARTNERSHIP



SOURCE: PRIME MINISTER OF AUSTRALIA[6]

AUSTRALIA AND KOREA SHARE THE AMBITION OF FAST-TRACKING LOW- AND ZERO-EMISSIONS TECHNOLOGIES AND BRINGING THEIR COST ADVANTAGE TO PARITY WITH HIGH-EMITTING TECHNOLOGIES.

Through this agreement, both countries have committed to make tangible progress on these early priorities:

1. CLEAN HYDROGEN AND CLEAN AMMONIA TECHNOLOGY
2. TRADE SYSTEMS FOR HYDROGEN SUPPLY
3. LOW EMISSIONS STEEL AND IRON ORE
4. CARBON CAPTURE, UTILISATION AND STORAGE (CCUS)

The partnership will also advance bilateral cooperation in the following technologies:

1. HYDROGEN FUEL CELL ELECTRIC VEHICLES
2. HYDROGEN POWER GENERATION
3. ENERGY STORAGE
4. SOLAR
5. CRITICAL MINERALS SUPPLY CHAIN

A WORKING GROUP NESTED WITHIN THE AUSTRALIA-KOREA JOINT COMMITTEE FOR ENERGY AND MINERAL RESOURCES CONSULTATIONS AND COOPERATION (JCEM) WILL MEET ANNUALLY TO PROGRESS THE WORK OF THIS PARTNERSHIP.

The JCEM sits alongside mechanisms established in the Korea-Australia Free Trade Agreement (KAFTA). KAFTA entered into force in 2014 and lays the foundation for further Australia-Korea economic integration with strong investment provisions, and wide-ranging tariffs elimination on Australian agriculture products, resources, energy, and manufactured goods. KAFTA's Chapter 16 establishes a bilateral framework for energy and mineral resources cooperation. Its key mechanism is the Committee on Energy and Mineral Resources Cooperation. This KAFTA committee has been active since the agreement's entry-into-force, and has been hosted alongside the 29th meeting of the JCEM in November 2019[7]. The meetings are an opportunity for governments to identify and progress energy and resources issues of mutual benefit.

With the above frameworks in place, Australia and Korea not only have a strong case for a hydrogen partnership, but many of the purposeful tools needed to achieve one. The next step is to find complementarities in their economic policies and industries to turn policy dialogue into policy action.

"Australia and Korea have existing frameworks through which to pursue a hydrogen partnership."

Taking stock of Korea-Australia hydrogen complementarities

Korea and Australia are among the most committed advocates of hydrogen market development. 'Green hydrogen' – manufactured using only renewables – is the ideal solution, but 'blue' hydrogen using fossil fuel inputs with carbon capture and storage may prove a required transition product (See Figure 1). Estimates for hydrogen's potential range as high as satisfying a quarter of final energy demand by 2050[8]. Importing low-carbon hydrogen increases decarbonisation options for countries with limited domestic renewables, such as Korea. And for renewables-rich countries like Australia, it opens new energy export opportunities. The two economies therefore benefit from a potential division of labour, with Australia developing green hydrogen export capacity while Korea establishes new energy systems on the demand side.

The two leading customers for hydrogen exports in the Indo-Pacific are Korea and Japan. The Korean Government views hydrogen as servicing four goals: reducing emissions, improving air quality, ensuring future energy security, and increasing economic development[9]. Korea released its *Hydrogen Economy Roadmap and National Roadmap of Hydrogen Technology Development* in 2019. These contain policies for fostering hydrogen economic transitions that would produce estimated growth worth KRW43 trillion (AUD49 billion), 420,000 new jobs and the elimination of 27.8 million tonnes of carbon emissions by 2040[10]. Their focus is on supporting hydrogen adoption in the transportation and power generation sectors. There are also nascent Korean investigations of how to integrate hydrogen into hard-to-decarbonise applications, such as steelmaking, and industries dependent on them, such as shipbuilding.

> ***"Korea is raising Indo-Pacific ambition on hydrogen market creation."***

Korea's hydrogen ambitions have significant regional and global implications. Its goal of becoming a world-leader in hydrogen fuel cells will precipitate competition with rival industrial powers, while also driving global uptake of the technology. Rising national demand for hydrogen will simultaneously enhance cooperation with prospective supplier nations and their industry members. The 2019 Roadmap anticipated national hydrogen consumption to grow over ten-fold to 1.9 million tonnes per annum (mtpa) by 2030, and then to 5.26 mtpa by 2040. About 70 percent will come from green (zero carbon) sources by 2040, and 100 percent by 2050. Korea expects to begin construction of receiving bases and import infrastructure in 2022, to enable commercial-scale imports by 2030[11].

FIGURE 2: COLOURS OF HYDROGEN

Green hydrogen. From electrolysis of water using renewables, producing zero carbon emissions

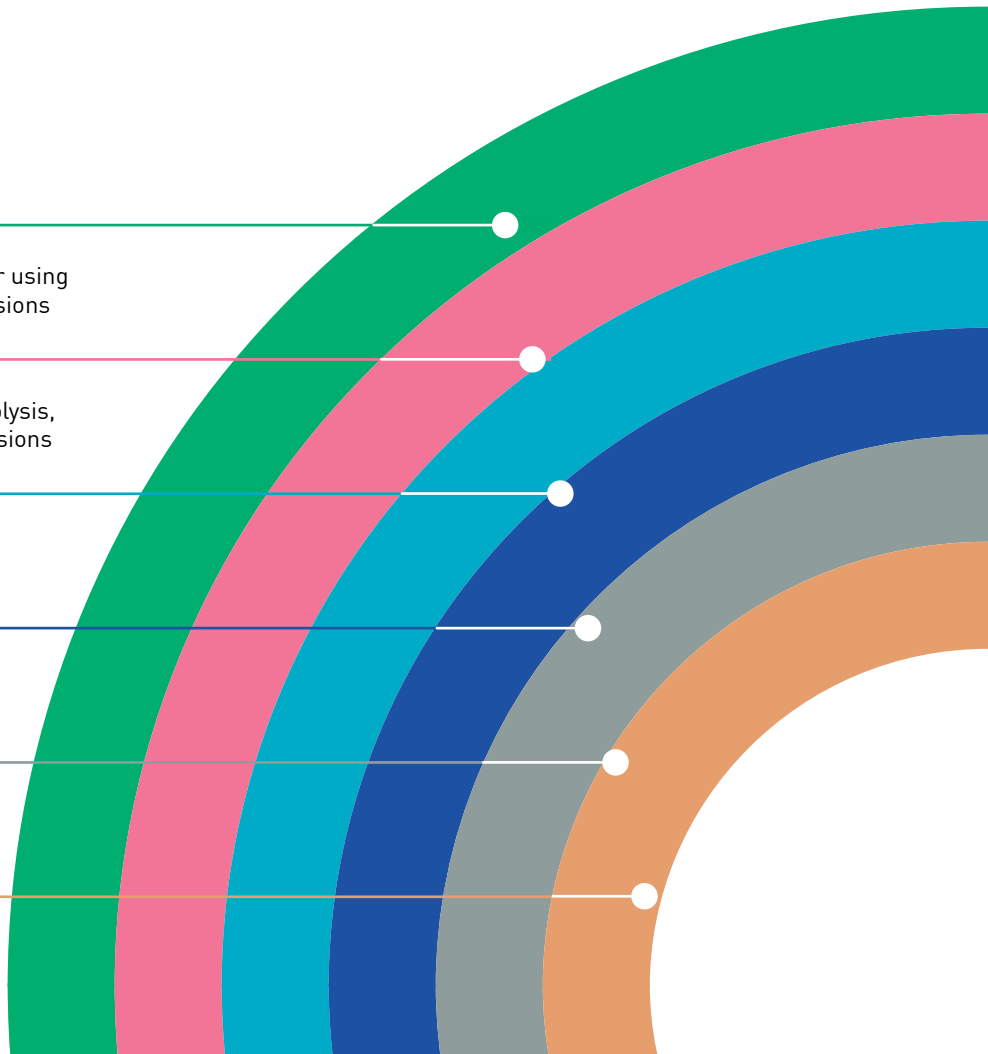
Pink hydrogen. From electrolysis of water using nuclear power, producing zero carbon emissions but radioactive waste

Turquoise hydrogen. From methane pyrolysis, resulting in solid carbon that prevents emissions from entering the atmosphere

Blue hydrogen. From fossil fuel sources, with carbon capture and storage to partially offset emissions

Grey hydrogen. From steam reformation of natural gas, with carbon emissions still released into the atmosphere

Brown hydrogen. From coal gasification, with the highest intensity of carbon emissions released into the atmosphere



The Korean Government has provided significant support to hydrogen development both nationally and internationally. An estimated KRW2.6 trillion (AUD 2.2 billion) in public funding has been allocated to the sector as of 2020[12]. The Government implemented the *Hydrogen Economy Promotion and Hydrogen Safety Management Law* to guide sectoral development in 2020. It has also played an important role in the hydrogen diplomacy space. Korea has signed numerous hydrogen bilateral agreements, including with Australia, and the country's *H2Korea* public-private alliance fosters international cooperation on industry development (See Case Study 1)[13]. The Korean Ministry of Trade, Industry and Energy has reportedly studied six prospective countries – including Australia, the US, and Saudi Arabia – to act as a major supply partner to fuel its ongoing ambitions[14].

Sizeable industry commitments have responded to these governmental efforts. Most significantly, a group of fifteen Korean companies formed the Korea H2 Business Summit in late 2021, and have committed to invest over USD37 billion into the sector by the end of this decade (Case Study 2). Many of the members of the Summit have existing investments and interests in Australia (See Table 1). Hyundai Motors Group plans to invest AUD8 billion (KRW7.6 trillion) under its FCEV Vision 2030, and the HyNet consortium of which it is a part also plans to build 100 new hydrogen refuelling stations by 2022[15]. Australian gas company Woodside is a HyNet partner. State-run utility KOGAS also plans to invest USD37 billion overseas by 2040 to establish renewable power generation facilities for green hydrogen production[16].

CASE STUDY 1: H2KOREA: A MODEL FOR FOSTERING PUBLIC-PRIVATE PARTNERSHIPS

H2KOREA Hydrogen Convergence Alliance

H2Korea is a public-private coordinating body that facilitates development of the Korean and international hydrogen market. Its activities include supporting formation of policy and legislation, development of private sector infrastructure and technology, demonstration projects and international cooperation and standard formation. In 2019, H2Korea signed a memorandum of understanding with the Australian Hydrogen Council (AHC), which provided for the creation of a working group and information exchange. The AHC similarly represents Australian hydrogen industry groups but lacks the same formal connection with government and international coordinating role of its Korean counterpart.

CASE STUDY 2: KOREA H2 BUSINESS SUMMIT – LEADING DOMESTIC AND INTERNATIONAL INVESTMENT

In September 2021, fifteen major companies formed a hydrogen-focussed business council to lead Korea's hydrogen transition. Members have pledged to invest a combined USD37.3 billion into the sector by 2030. International engagement and investment is included in their scope. A council member CEO said "We will create a fund to promote large-scale investment and to advance big infrastructure projects and overseas operations that require significant amounts of funding." The formation of the council is a significant development given its broad membership, with many companies setting aside long-standing competitive sentiments and adopting a "Team Korea" approach to cooperation in an emerging sector.

SOURCE: KOREA HERALD[17]

Australia has the ambition to emerge as a hydrogen export powerhouse. Developing export opportunities is the main priority of the *National Hydrogen Strategy* of 2019, and the various subnational equivalents that accompany it[18]. As well as Australia's vast renewables endowment, its advantages include a position as a trusted regional energy supplier to the Indo-Pacific. Australia has set three hydrogen-related goals for 2030: become a top three hydrogen exporter to the Indo-Pacific; become a destination of choice for international hydrogen investors; and have major offtake or supply chain agreements with major importers[19].

The Australian government estimates hydrogen could add more than AUD50 billion to GDP by 2050, along with 16,000 direct jobs and 13,000 from construction of related renewable infrastructure[20].

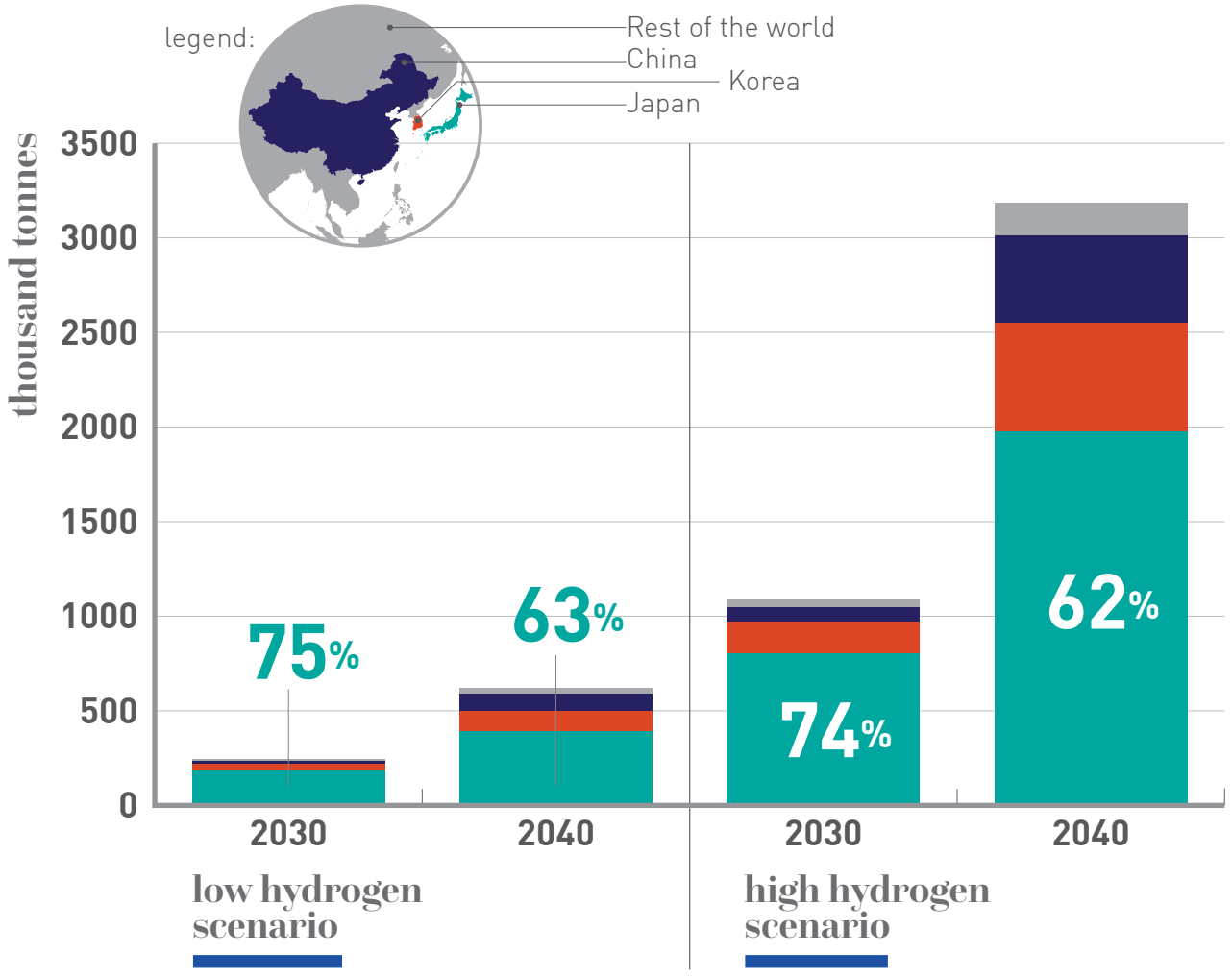
> *"Australia's engagement with H2Korea, the Korea H2 Business Summit, and HyNet could be a vital conduit for establishing a hydrogen partnership."*

The Australian government has pledged AUD1.2 billion funding for the hydrogen industry. Commitments include the development of seven dedicated hydrogen industrial hubs across the states and territories. These will co-locate value chain members in a bid to accelerate commercial activity, cost savings and innovation[21].

Government and industry are also working to forge international partnerships. The Australian Renewable Energy Agency has estimated Australia could export as much as 3.18 mtpa of hydrogen by 2040 under optimal international market conditions[22]. Japanese volumes dominate the total, followed by Korea (see Figure 3).

Australia will also require international technology partners. Germany and other European countries could establish strong positions in the electrolyser supply market. Indo-Pacific countries including Korea are likely to emerge as major fuel cell providers for Australia's domestic needs. Another opportunity is an emerging trade in 'green commodities' such as steel and aluminium, whose production processes substitute hydrogen for fossil fuel inputs. The Grattan Institute has argued that by shifting to green hydrogen usage, Australia can also capture 'downstream' opportunities – such as minerals processing – that are not available for its existing hydrocarbon-reliant industries[23]. Major iron ore miner Fortescue Metals Group has been the most visible operator in this space. It has committed to using green hydrogen and other renewable technologies to achieve net zero emissions from its own operations by 2030, and help its customers to do the same by 2040[24].

FIGURE 3: AUSTRALIA'S HYDROGEN EXPORT MARKETS, LOW- AND HIGH-PENETRATION SCENARIOS, 2030 AND 2040



Australia has made hydrogen a central plank of its recent energy diplomacy. This includes participating in hydrogen-specialist dialogues including the *Hydrogen Energy Ministerial* (HEM) and *International Partnership for Hydrogen and Fuel Cells in the Economy* (IPHE). A major focus of its engagement has been promoting a hydrogen 'Guarantee of Origin' certification scheme. This seeks to provide transparency and certainty to customers on different methods of hydrogen production, so that 'green', 'blue' and other types can be easily distinguished in the marketplace.

> ***"Importantly, Australia and Korea do not have to invent a new playbook to develop the hydrogen industry."***

Australia and Korea's longstanding model of joint resource development could be replicated for hydrogen[25]. Under this model, Korean resource buyers negotiate long-term supply contracts and minority investment relationships with potential Australian suppliers, sharing the benefits and risks of new project development. The model emerged from Korea's need to secure raw material imports to support the growth of its heavy industry. It also met the needs of Australian resource companies by giving them access to project finance and securing long-term contracts to sustain large projects for several decades[26]. Korean firms POSCO and KOGAS have contributed a combined AUD4 billion in investment into the Australian economy using this model over the past thirty years[27]. Similar drivers are propelling hydrogen cooperation today.

Coal, iron ore, LNG, and, most recently, lithium are sectors where Australia-Korea joint resource development has flourished. In each case, certain features of the model were fine-tuned to meet the specific needs of the developing industry. The same fine-tuning must be done for hydrogen. LNG offers the closest comparison to a hydrogen export system, in terms of the infrastructure required to support the trade with transport and storage. With their investment history in Australia, POSCO and KOGAS are poised to be early movers in applying this model to hydrogen. This includes taking equity positions in hydrogen projects, representation on boards to coordinate corporate planning, and securing supply through offtake agreements with Australian hydrogen producers.

CASE STUDY 3: POSCO'S AUSTRALIAN HYDROGEN PRESENCE

POSCO is Korea's largest steel-making company. In 2018-19, POSCO purchased over AUD8 billion worth of Australian resources, making it the single largest buyer of Australian exports. It has invested almost AUD2 billion in Australia since 1982. POSCO is pursuing hydrogen production alongside the development of green steel and manufacturing steel components for hydrogen infrastructure. In 2021 and 2022, POSCO signed decarbonisation and low-emissions partnerships with hydrogen-related components with BHP, Fortescue Metals Group (FMG), Rio Tinto, Roy Hill, and Origin Energy. Its scale and technological capabilities mean it will be a leading partner in the development of an Australia-Korea hydrogen partnership.

SOURCES: POSCO AUSTRALIA[28], AUSTRALIAN FINANCIAL REVIEW[29]

TABLE 1: MEMBERS OF KOREA H2 BUSINESS SUMMIT

COMPANY	CURRENT OR POTENTIAL ROLE IN HYDROGEN VALUE CHAIN
POSCO	Hydrogen production, development of green steel technology and manufacturing steel components for hydrogen infrastructure.
HYUNDAI	Automotive hydrogen fuel cell technology and mass-production of hydrogen powered vehicles.
SK	Liquid hydrogen infrastructure for vehicles, import terminals, production of grey and blue hydrogen. SK Group announced it will invest USD1.4 billion to develop gas fields in northern Australia. It will import 1.3m tonnes of LNG per year for 20 years to produce hydrogen in Korea, with associated CCUS intended to be deployed in Australia[30].
LOTTE CHEMICAL	Aims to produce "blue" hydrogen and "green" hydrogen overseas, high-pressure hydrogen storage units.
SAMSUNG SAMSUNG C&T	Transportation and distribution infrastructure, refuelling facilities.
GS	Advancements in "blue" hydrogen methods, carbon capture and sequestration.
DOOSAN	Fuel cell technology, ultralight mobile hydrogen tanks, hydrogen-powered drones, liquefaction. In a pilot project, Doosan Heavy Industries & Construction is planning to produce green hydrogen from a wind farm on Jeju island[31].
HYUNDAI HEAVY INDUSTRIES	Technical guidelines for design and safety of offshore green hydrogen plants[32].
Hanwha	Green hydrogen production, innovations in electrolysis technology, ultralight hydrogen storage. In Australia, Hanwha Energy is raising capital to fund a solar energy-based green hydrogen project in Australia[33].
HYOSUNG	Hyosung has broken ground on a large liquid hydrogen production plant, billed as the world's largest, in partnership with the multinational chemical company Linde Group[34]. Currently produces hydrogen as a by-product from its petrochemical manufacturing process. It also produces high-strength carbon fibre used to make hydrogen tanks.
ISU	Hydrogen included in its present petrochemical product value chain at its Onsan Plant[35].
Korea Zinc	Green hydrogen production to power industrial facilities and processes such as zinc smelting. Sun Metals, its Australian subsidiary, operates a zinc smelter near Townsville, Queensland and an adjacent solar farm which will produce green hydrogen for fuel cell powered trucks.
KOLON INDUSTRIES	Manufacturer of polymer electrolyte membranes (PEMs), a component of hydrogen fuel cells for cars[36].
ILJIN	Hydrogen storage and fuel tanks for electric vehicles such as passenger cars, small trucks and for other vehicles. Hydrogen transport technologies, mobile refuelling stations.
E1	LNG importer and distributor with terminals in Yeosu and Incheon[37].

FIGURE 4: TIMELINE – EARLY STEPS IN THE AUSTRALIA-KOREA HYDROGEN PARTNERSHIP

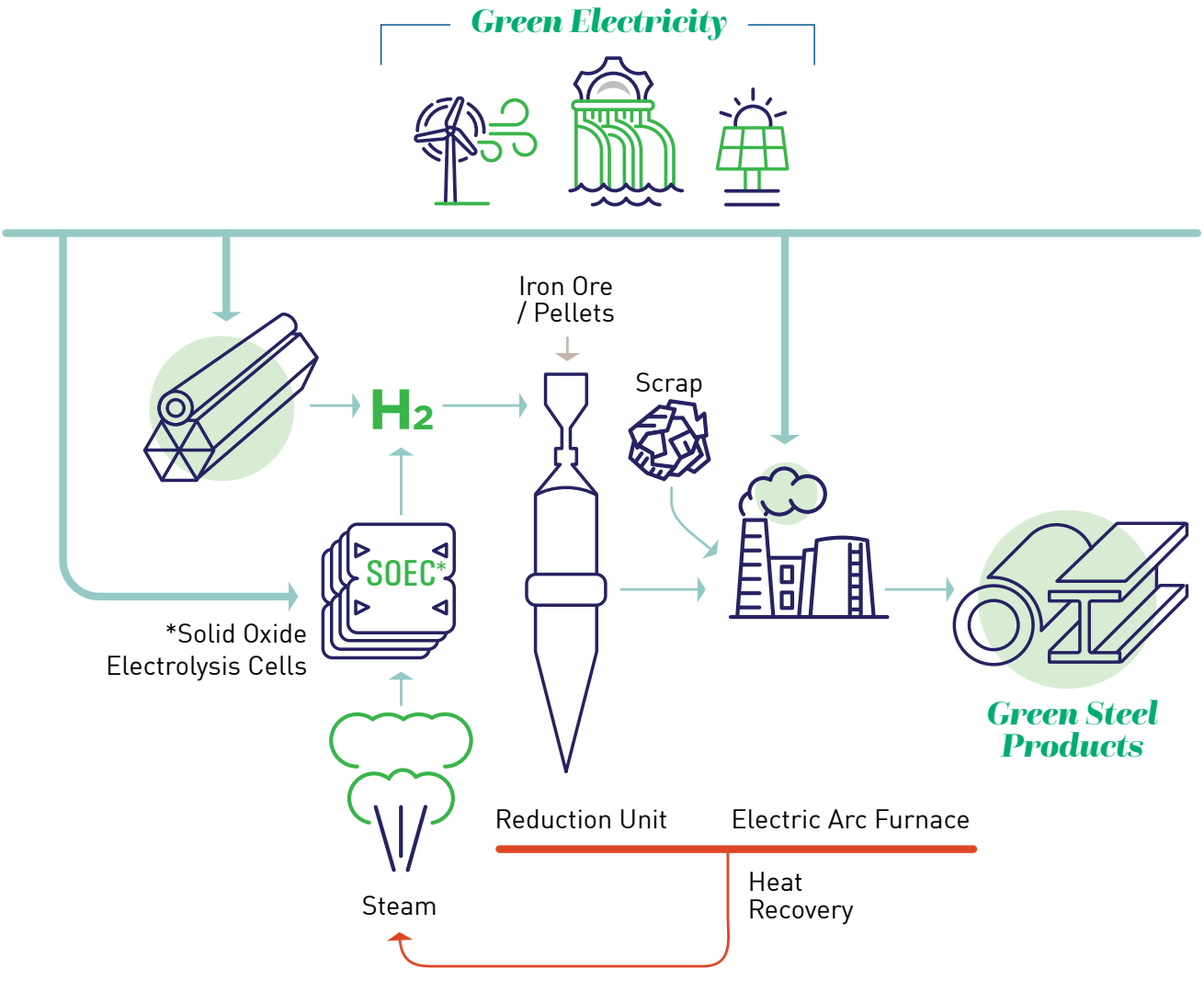
Leveraging hydrogen for the Australia-Korea relationship

Australian and Korea have abundant commercial opportunities to build hydrogen links. Significant activity occurred in 2021 alone, with many G2G and B2B partnerships announced (Figure 3). New public and private partnerships could aid achievement of shared goals around climate, energy security, and economic development. It could also enhance more strategic opportunities. At a minimum, the massive effort necessary to realise hydrogen's potential will require a more concerted and continuous diplomatic dialogue between the two governments.

> *"2021 was a significant year of progress towards a deeper Australia-Korea hydrogen partnership."*

Beyond exporting hydrogen as a fuel, there are also significant industrial opportunities. The bilateral partnership includes commitments to collaborate on developing technologies and cross-border value chains for hydrogen derivatives such as ammonia, and green iron ore and steel. The latter priority is a key point of departure from similar low emissions partnerships Australia has signed with other countries. It could position Korea and Australia as pioneers of decarbonisation in this vital sector of the global economy (Figure 4). The two governments have committed to jointly fund research and development, and demonstration projects that can accelerate commercialisation within their focus areas[38]. Australia has allocated AUD50 million to support the partnership, rising to as much as AUD100 million. Korea has pledged to match its commitments[39].

FIGURE 5: HOW 'GREEN' STEEL IS MADE



Maximising the bilateral hydrogen opportunity requires Korea and Australia to overcome the challenges that plague market development all over the world. The two most significant of these are the need to rapidly bring down sectoral costs, particularly around production of green hydrogen, and to rapidly scale up infrastructure across the value chain. The International Energy Agency estimates lowest cost global green hydrogen is currently about USD3/kg, compared to USD1/kg for blue hydrogen and less for unabated fossil fuel supplies. Putting hydrogen on track for net zero emissions by 2050, meanwhile, requires an estimated USD1.2 trillion investment through to 2030 alone[40]. Meeting these challenges is not only a matter of sufficient financial investment. It will heavily depend on establishing common regulations, standards, certifications, and other policies.

Leveraging clean energy finance is another point of cooperation between Australia and Korea. Australia's Clean Energy Finance Company (CEFC) is one vehicle suited to this purpose. Through its Advancing Hydrogen Fund, it offers AUD300 million to support the growth of an Australian hydrogen industry. Projects seeking finance through this initiative must be commercial, focussed on green hydrogen production, and able to scale to 10MW-plus electrolyser capacity[41]. The CEFC has already committed funds to an Australia-Korea project (see Case Study 4) and the Korean government is looking at the CEFC as a model as it seeks to establish its own government-sponsored clean energy financing institution[42].

CASE STUDY 4: DECARBONISING SUN METALS REFINERY IN QUEENSLAND

Korea Zinc in January 2022 announced it will invest USD50 million in Swiss-based energy storage technology company Energy Vault. Korea Zinc will use the company's gravity-battery technology to help decarbonise its Sun Metals zinc refinery near Townsville, Queensland. Korea Zinc plans to make its facility one of the world's first green zinc producers, with a goal of reaching 80 percent renewable power by 2030. Sun Metals also operates a 124MW solar farm to provide clean power to the adjacent refinery.

Energy Vault's technology will complement the SunHQ Hydrogen Hub, a project to deploy a 1MW polymer electrolyte membrane (PEM) electrolyser at the Sun Metals Refinery powered by electricity from the existing solar farm. The electrolyser will produce renewable hydrogen for five fuel cell electric trucks. Energy storage is an important component of this energy supply chain so operations can continue around the clock when the solar plant is not generating power. Korea Zinc, through its subsidiary Ark Energy, also has a 30 percent stake in the MacIntyre Windfarm in Queensland. Ark Energy is the recipient of an investment commitment from the CEFC of up to AUD12.5 million to advance the SunHQ Hydrogen Hub.

SOURCES: *REUTERS*[43], SUN METALS[44], ARK ENERGY[45], CLEAN ENERGY FINANCE CORPORATION[46].

However, Australia-Korea hydrogen cooperation should also move beyond a simply bilateral play. The strategic opportunities for Korea and Australia extend to working with other prospective Indo-Pacific hydrogen economies as a means of both building the market and their regional influence. There will certainly be interest throughout the region in any technical assistance Australia and Korea countries can provide from their development of low emissions iron ore and steel technologies. Particular demand will emerge among countries in Southeast Asia which are experiencing rapid industrialisation and urbanisation.

> *"Australia and Korea can leverage their hydrogen partnership to assist countries such as Vietnam decarbonise their industry."*

Vietnam is one example in which Australia-Korea technical assistance to develop the low emissions steel and other hydrogen technology will be synergistic. Australia is actively upgrading its economic partnership with Vietnam. Australia and Vietnam launched an enhanced economic engagement strategy in December 2021. The strategy includes an initiative to exchange information on new developments in the energy sector, including clean hydrogen[47]. Energy and resources account for over half of Australia's exports to Vietnam to meet its electricity demand and provide basic inputs to its growing industrial base[48]. In recent years, Korea has emerged as one of Vietnam's top trade and investment partners, boosting Vietnam's rapid industrialisation. In 2021, Korea was the second largest foreign investor in Vietnam with USD5 billion in investment spread across 361 projects[49]. Korean firms are active in Vietnam and are familiar with the country's business and regulatory environment.

Combining Australia's role as an energy and resources partner with Vietnam and Korea's status as a top investor in Vietnamese industry, a joint project to begin piloting hydrogen technologies in Vietnam is forthcoming. Early projects could include using Vietnam's developing solar and wind industry to trial small-scale production of green hydrogen to decarbonise industrial processes such as steelmaking. Pilot projects such as these can pave the way for larger-scale investments and export opportunities. Export Finance Australia has already provided a USD32 million loan to finance the construction of onshore wind farms in Quang Tri Province, demonstrating Australia's ability to contribute to Vietnam's energy needs including the kind of infrastructure needed to produce green hydrogen[50].

There is also a pervasive need for infrastructure in developing Indo-Pacific economies that may preclude many from accessing hydrogen opportunities. Korea and Australia could seek to close this gap by prioritising hydrogen developments and harmonising their commitments to regional development. While the Korean government is directly funding hydrogen and other clean energy projects domestically, it does not yet have a clean energy-focussed finance institution. Some policymakers in Korea view Australia's Clean Energy Finance Corporation as a potential model, having examined it in a case study as Korea's National Assembly shapes laws governing green financing[51]. Given possible synergies in countries such as Vietnam, a policy dialogue examining how Australia and Korea could develop hydrogen-focussed financing options for developing countries in the Indo-Pacific region will be impactful.

> ***"Indo-Pacific infrastructure initiatives have a role to play in the development of the hydrogen economy."***

Employing Australia's infrastructure initiatives and working closely with Multilateral Development Banks (MDBs) is another avenue for broader cooperation to boost the regional hydrogen economy. One prominent initiative is the Australian Infrastructure Financing Facility for the Pacific (AIFFP). This initiative is already making investments in clean energy. In the Solomon Islands, AIFFP is funding a project to connect the Tina River hydropower site to the electricity grid in Honiara, helping the country transition away from diesel generated electricity. AIFFP is also funding the development of large-scale solar in Papua New Guinea. There are also opportunities to cooperate with the Asian Development Bank (ADB), World Bank, and Asian Infrastructure Investment Bank (AIIB) to establish the renewable energy base needed to produce green hydrogen.

Conclusion & Recommendations

Korea and Australia are well-poised to cooperate as close partners across many domains in the hydrogen sector. This will expedite creation of the hydrogen market in each country and the wider Indo-Pacific. They already share strong G2G cooperation frameworks which can adopt and progress a hydrogen agenda. At the B2B level, their companies have an existing "joint resource development partnership" which can be adopted to establish the hydrogen industry. Korea has structured and well-resourced fora such as H2Korea and the Korea H2 Business Summit which can act as a gateway for more B2B engagement. Cooperation on hydrogen will strengthen their bilateral relationship and once established, a hydrogen partnership can extend their combined influence in the region.

Next steps to cement an Australia-Korea hydrogen partnership include the following:

1. **Incorporate hydrogen cooperation on the agenda across all Australia-Korea bilateral economic mechanisms.** This includes the long-standing Australia-Korea Joint Committee for Energy and Mineral Resources Consultations and Cooperation, and the KAFTA Committee on Energy and Mineral Resources Cooperation.

2. **Apply the Australia-Korea joint resource development partnership to match the specific needs of the emerging hydrogen industry.** This model emerged from matching the specific needs of Korean and Australian firms, leading to significant investments and resource development in sectors such as LNG, iron ore, and most recently lithium. This model can be applied to hydrogen.

3. **Encourage Australian hydrogen-focussed companies to pursue partnerships with their Korean counterparts.** Longstanding partners such as POSCO and KOGAS have invested almost AUD4 billion into the Australian economy, and are building hydrogen-focussed partnerships in Australia. They are key stakeholders for Australia as it pursues its ambition to become a top hydrogen exporter. Enhanced support could expedite outcomes including equity investments and long-term supply deals.

4. **Continue early focus on decarbonising iron ore and steelmaking.** This activity fits with the aims of Korea and Australia's Low and Zero Emissions Partnership and complements initial B2B engagement. Governments should aim to position Korea and Australia as early movers in this hard-to-abate and valuable sector of the global economy.

5. **Develop a strategy for Australia-Korean international engagement on hydrogen.** Australia and Korea have opportunities to engage on broader Indo-Pacific hydrogen market creation in ways that could advance shared economic and strategic priorities. The two governments should develop a strategy to advance collaboration on the formation of regulations, standards, certifications and other policies, as well as provision of technical and infrastructure assistance to emerging regional hydrogen economies.

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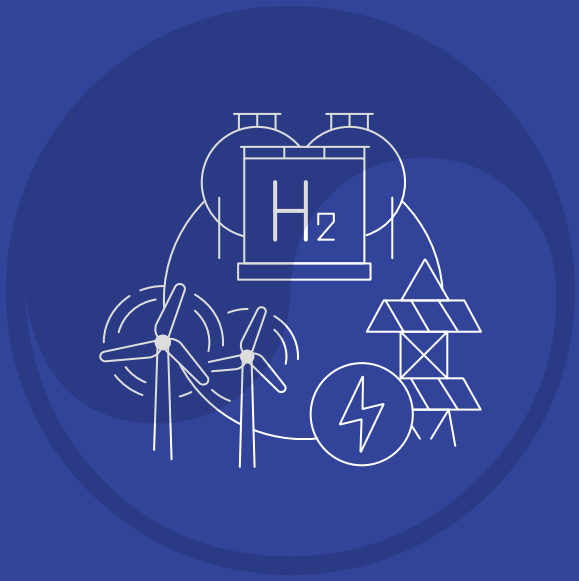

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