AUSTRALIA - KOREA
BUSINESS COUNCIL

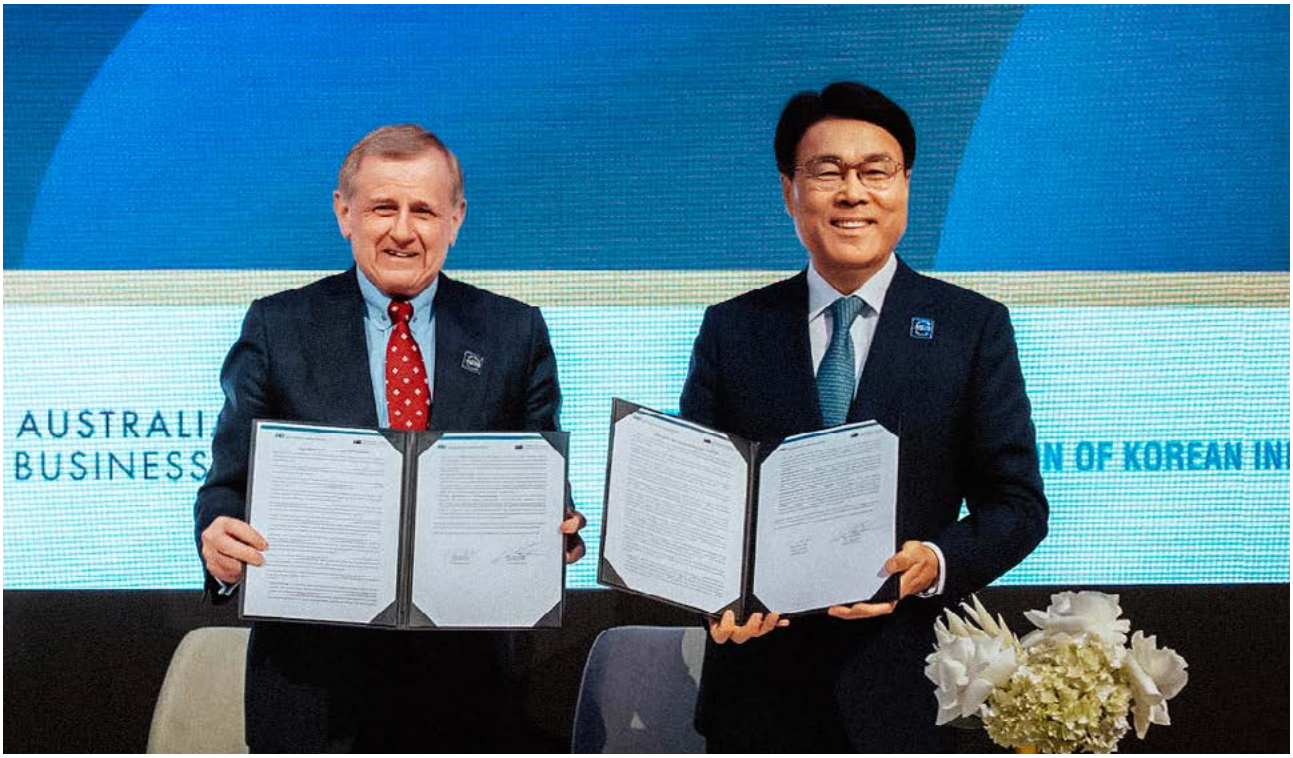
PUBLISHED
May 2021

Mapping the Australia-Korea Hydrogen Intersections

REPORT

THE AUSTRALIA-KOREA BUSINESS COUNCIL (AKBC) EXISTS ON BEHALF OF ITS MEMBERS TO PROMOTE AND FURTHER THE AUSTRALIA-KOREA BILATERAL RELATIONSHIP.

akbc.com.au



About the Australia-Korea Business Council

This report has been developed by the Energy Sub-committee of the Australia-Korea Business Council (AKBC). The AKBC is the leading national body committed to strengthening the Australia-Korea economic relationship. We exist on behalf of our members to deepen economic ties by connecting businesses, communicating opportunities and championing mutually beneficial policy and commercial outcomes.

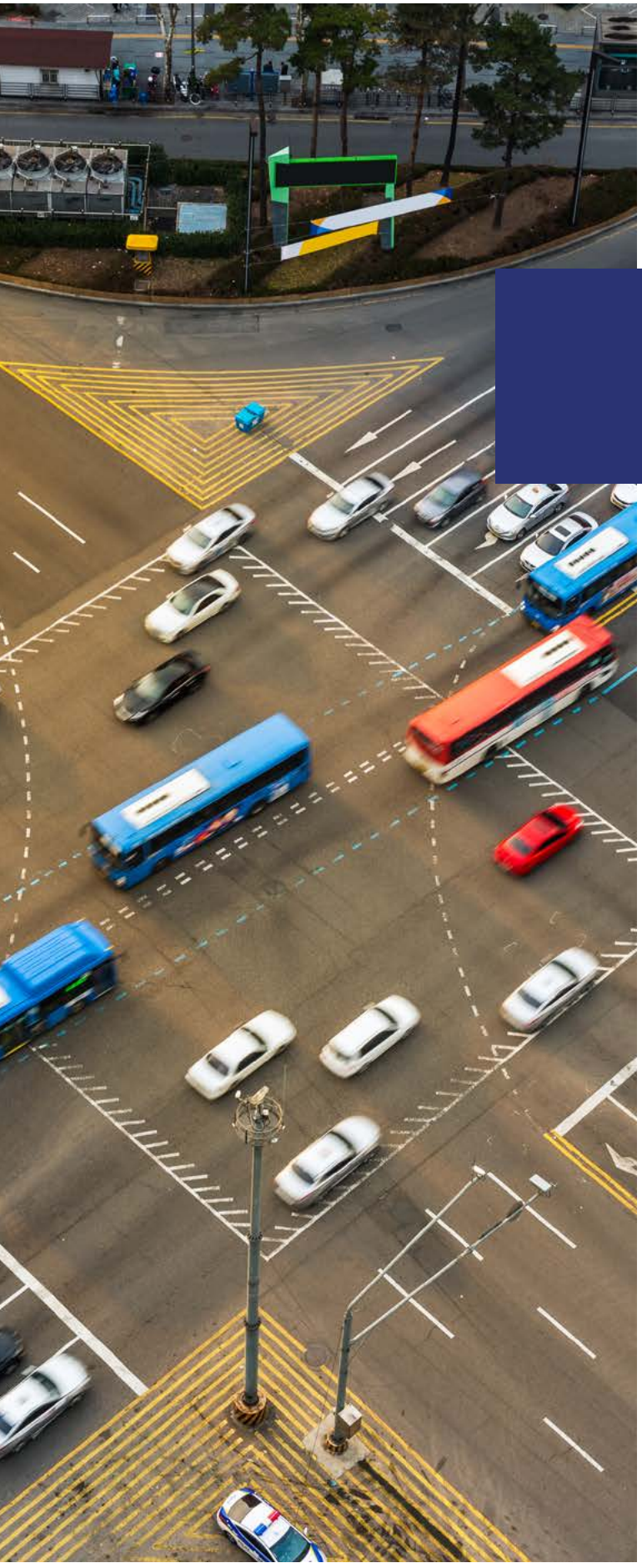
The AKBC was established in 1978 to promote two-way trade and investment with Korea through economic cooperation, dialogue and cultural understanding. Our counterpart in Korea, the Korea-Australia Business Council (KABC) was established in the same year, and we maintain a close relationship through our annual AKBC-KABC Joint Meeting.

The AKBC is chaired by the Hon Simon Crean and led by an Executive Committee of outstanding industry and government leaders. We have a diverse membership base that includes government, business and academic institutions, all with wide ranging commercial interests in Korea.

Korea is one of Australia's largest bilateral trading partners and the opportunities for deepened engagement and economic success are increasing, particularly as many Australian businesses look to diversify their export markets. We see hydrogen as a leading opportunity to further promote our bilateral relationship in the coming decades. As both our countries look to a greener future, hydrogen has the potential to play a key role in creating jobs, stimulating growth, and bringing our two countries closer together.

→ **akbc.com.au**

IMAGE **AKBC -** Hon Simon Crean, Chairman, Australia-Korea Business Council and Jeong-Woo Choi, CEO & Chairman, POSCO and Chairman, Korea-Australia Business Council at signing ceremony of the 2019 AKBC-KABC Joint Meeting in Sydney.



Background

The development of a sustainable and mature hydrogen market between Australia and Korea has the potential to define the bilateral relationship over the next century. The AKBC has been at the forefront of communicating the burgeoning possibilities of this partnership to its members and stakeholders across business and government.

Our latest contribution to the dialogue on hydrogen is our report, Mapping the Australia-Korea Hydrogen Intersections (Report), which is being led by our energy sub-committee comprising executives of member firms who are deeply engaged in the opportunities in hydrogen between Australia and Korea. Its objective is to map the key intersections of the Australia-Korea hydrogen relationship and define the areas of collaboration that can be seized in the short, medium and long term.

In early-2021, AKBC members and other interested parties provided their feedback to the draft report, which has informed this final report and provides the basis of the AKBC's policy position on hydrogen, highlighting opportunities for the private and public sectors across our two countries.

Mapping hydrogen's future

Hydrogen is the energy carrier, technology and export market of Australia and Korea's futures. This future is quickly becoming a commercial reality as the benefits of hydrogen and its applications strike the imagination of businesses in both countries.

Hydrogen has the capacity to reduce emissions, be developed sustainably, transported efficiently, and solve an energy transition challenge as the world shifts away from carbon-intensive fuels. For Australia and Korea, this speaks not only to a compelling investment prospect, but also to a bilateral trade and diplomatic opportunity that could lay the foundation for a hydrogen market in the 21st century.

Australia and Korea, as both strong trading partners and APAC neighbours, are natural strategic allies. However, the great potential for an Australia-Korea hydrogen market lies in the synergy between our strengths and weaknesses. Korea is the world's leading fuel cell technology producer and has a wealth of experience developing refuelling stations and fuel cell electric vehicles (FCEV). However, it relies heavily on importing its energy needs. Since 2015, roughly 93 per cent of its energy production came from imports and as the country transitions away from thermal coal and other resources, it has identified a stable supply of hydrogen as crucial to ensuring its energy security.

Australia holds the key to Korea's hydrogen needs – a secure market of hydrogen and, in particular, green hydrogen. On the global stage, Australia is likely to be one of the top three exporters of hydrogen by 2030 and will need global partners to realise the full potential of its energy strategy. Korea, which has the fuel cell expertise and import shortfall, could accelerate Australia's transition to becoming a global hydrogen powerhouse.

Vital to the strength and maturity of any major bilateral market is buy-in and strategic policy direction from government. Both the Australian and Korean governments have identified hydrogen as a crucial technology to transition to a lower carbon future.

In 2019, the Korean Government released the Hydrogen Economy Roadmap of Korea and the National Roadmap of Hydrogen Technology Development. These set specific targets and timelines for developing and deploying hydrogen technologies with the overarching objective of becoming a global leader in stationary fuel cells for power generation and FCEV. Another major pillar of Korea's hydrogen strategy is securing a stable supply of hydrogen. In July 2020, the Korean Government announced the Green New Deal policy, outlining eight projects in three sectors, amounting to an investment of approximately US$60 billion by 2022 and US$140 billion by 2025. Korea has also set the goal of achieving 70 per cent of hydrogen imports from C02-free sources.

In January 2020, the Korean National Assembly passed the Hydrogen Economy Promotion and Hydrogen Safety Management Law, which provides the legal foundation for the support of the hydrogen industry, safety standards, certification processes, and roles and responsibilities of government agencies including H2 Korea. H2 Korea was appointed the state-owned entity connecting central and local government with private companies and has oversight of international collaboration on behalf of Korea's Ministry of Trade, Industry and Energy (MOTIE).

With Australia's abundant renewable energy generation capability through solar, wind and hydro power, one of the key opportunities between our countries is to export green hydrogen from Australia to Korea to enable power generation, mobility and industrial processes such as steel and chemical production with green hydrogen.

Also in 2019, the Australian Government released its National Hydrogen Strategy, which outlines the key hydrogen milestones between 2020-2030, based on the speed in which the hydrogen market advances. This was followed by the Australian Government's release of its First Low Emissions Technology Statement 2020 identifying hydrogen as one of five key priority low emission technologies with the accompanying stretch goal of achieving hydrogen gas (H2) under $2 per kilogram.

Additional funding was committed by the Australian Government in late April 2021, with the Government announcing $566 million of funding over the next eight years towards international partnerships, $276 million to create four new hydrogen hubs across the country, and another $263 million for the development of carbon capture and storage projects.

State and Territory Governments have also developed their own hydrogen policies, offering critical insights into how they want to invest in the hydrogen market and provide further opportunities for bilateral cooperation. Additionally, private sector interest in domestic hydrogen projects has initiated the beginning of a wave of investment in technology and has set a foundation for an export market to be developed over the coming decade.

As these national strategies coalesce, the myriad of opportunities in hydrogen are emerging. This report identifies five key areas of potential bilateral cooperation, collaboration and application of hydrogen energy and technology, including:

1. Power generation
2. Transportation
3. Industry energy and feedstock
4. Export
5. Research and development

By mapping these opportunities, discussed in more detail below, we hope to establish an investment roadmap for the Australian and Korean private and public sectors.

Both the Australian and Korean governments have identified hydrogen as a crucial technology to transition to a lower carbon future.

1 Power generation– the future of hydrogen fuel cells

Korea's hydrogen strategy sets a goal to supply hydrogen fuel cells for power generation and achieve commercialisation to enable their export, with a view to expand the use of hydrogen fuel cells in households and buildings. Korea is also developing hydrogen gas turbines as a commercial energy generation source and expects this to be commercialised by 2030.

Australia's hydrogen strategy highlights the opportunity for hydrogen to be used in combination with renewable electricity to power remote sites like mines and small regional communities via micro-grids, energy zones or hubs where the green hydrogen produced can be used in the immediate vicinity of the production facility. This could be an alternative to diesel based remote area power systems which have adverse environmental impacts and may be commercially competitive before 2025. More broadly, there are opportunities for the application of hydrogen fuel cells in locations across Australia where there is significant penetration of wind and solar, both to create additional demand for renewable electricity via electrolysis and as regenerating large scale dispatchable power to support electricity grid stability at times when output is low.

One critical factor limiting the potential of remote site power generation lies in the transportation of hydrogen. Overcoming this challenge requires the development of ancillary infrastructure and technology for bulk hydrogen transportation over long distances. This can be done via increasing road transport efficiency and improving blending technologies and pipeline materials so that existing national gas pipelines can transport hydrogen.

Australia-Korea intersections	
Short-term (2020-2025)	Australia and Korea to partner to use Korean hydrogen fuel cell technology for: → Remote sites such as mining and regional communities in Australia. → Behind-the-meter power purchase agreements (BTM PPA) for high-quality and continuous power users. → Proof of viable large-scale hydrogen power generation projects at the microgrid level.
Medium-term (2025-2030)	→ Future regional industrial precincts to scale up and integrate with existing and future energy systems. → Hydrogen (together with batteries) used for energy storage to displace diesel in most remote microgrids. → Collaboration between Australian and Korean industry and researchers in gas turbines and reciprocating engines.
Long-term (2030-2050)	→ Expansion into aviation, space, defence assets and sites. → Hydrogen becomes the preferred energy storage system to partner with renewable energy.

IMAGE **Doosan Fuel Cell -** Daesan Hydrogen Fuel Cell Power Plant, where Doosan Fuel Cell supplied 114 units of 440kW fuel cells(50MW in total capacity), is the world first hydrogen fuel cell power site supplying electricity to about 160,000 households in Chungnam, Korea.

2 Transportation – Korea a manufacturer and global leader, Australia a consumer

Green hydrogen has the potential to assist both Korea and Australia achieve their decarbonisation agendas, particularly in the transportation sector. Australia, given its reliance on fossil fuels in agriculture, mining and forestry equipment, has a unique opportunity to be among the leading countries with respect to decarbonisation of its transportation; and Korea is well positioned to assist Australia in its adoption of these lower emission technologies quickly and extensively, as well as doing so safely.

Positioning itself as a global leader in fuel cells and FCEV technology, Korea's hydrogen strategy outlines transportation industries as a potential new industrial ecosystem including passenger cars, commercial vehicles, trucks, forklifts, trains, ships and airplanes.

In Australia, together with passenger vehicles, hydrogen is expected to play a key role as a fuel within industry and the transition from diesel powered fleet vehicles to hydrogen powered fleet vehicles such as trucks, buses and heavy machinery. The key advantages of hydrogen powered heavy vehicles over battery-powered electric vehicles (EV) include weight savings and shorter refuelling time. Unlike EVs, where the size and weight of batteries are relative to the intended use, duration or distance of the vehicle, hydrogen vehicles only require a larger hydrogen tank to increase range. These advantages, together with the fact that fleet styled vehicles are generally utilised around a central source (for example, a mine), mean fleet supply costs can be significantly lower. The advantages of hydrogen vehicles compared to EVs in the light passenger vehicle market are less compelling as these competitive advantages are eroded and they require substantial refuelling infrastructure investment.

Australia is therefore well positioned to be an early adopter for Korea's technology in hydrogen mining vehicles, long-distance trucks, tractors and forklifts. South Korea could play a key and early role in Australia and utilise the relatively small market as an effective testing ground for systems to be developed in larger markets. Further, due consideration should also be given by Korean companies to explore establishing operations in Australia and providing componentry to local Australian producers, such as the manufacturing or assembly of hydrogen vehicles, vehicle parts or refuelling stations. This could also be extended to electrolyser assembly units or manufacturing plants which are expected to be in high demand to enable the production of green hydrogen from large-scale hydrogen projects. Similarly, Korean players securing subterranean storage facilities in Australia could be key to minimising disturbances in the supply of hydrogen.

In a high hydrogen technology uptake scenario, it is predicted that hydrogen haulage vehicles will be the haulage vehicle of choice in Australia by 2030. However, overcoming challenges such as the capital cost of vehicles and required infrastructure will be critical to the development of a hydrogen mobility market in Australia. The use of green hydrogen in heavy road transport is a leading example of where its application could achieve cost parity with fossil fuel transportation the earliest.

With strong existing Korean investment across Australia, especially in the mining sector, Korean companies are uniquely positioned to promote and pioneer a decarbonised agenda, and this could be accelerated by bringing in Korean Original Equipment Manufacturers (OEMs) and securing funding from the Export Council of Australia (ECA). There are significant early mover advantages that Korean companies can capitalise on given there are few global competitors compared to the EV market and an already substantial interest in adopting such vehicle technologies in Australia, particularly around large industrial regional operations. Further, as Australia becomes increasingly reliant on imports for liquid fuels, the ability to diversify fuel technologies will likely be viewed favourably by governments.

Collaboration to facilitate a greater understanding of requirements, technologies and locations between leading Korean hydrogen bus and truck OEMs and key stakeholders in Australia – such as leading infrastructure asset managers and operators, energy providers, fleet users and operators with the most advanced net zero emissions targets – can play a key role in the acceleration of the adoption of these mobility opportunities in Australia.

Australia-Korea intersections	
Short-term (2020-2025)	→ The ACT Government has acquired a fleet of 20 Hyundai NEXOs. → Public refuelling stations to support hydrogen vehicles are being constructed in Canberra, Melbourne and Brisbane. → Mining sites in remote areas of Western Australian are installing or planning to install refuelling stations for heavy vehicles.
Medium-term (2025-2030)	→ Public refuelling stations to support hydrogen vehicles extensively rolled out across major freight highways and metropolitan areas. → Creation of test bed in Australia for Korean technology to decarbonise vehicle fleets such as haulage trucks, forklifts and drones used in agriculture, mining and forestry. → Pioneering of a decarbonisation agenda by Korean investors across a number of sectors, and opportunity to advance this by engaging Korean OEMs and attracting ECA funding. → Pilot projects for fuel cell-powered automated (unmanned) trains operating between mining sites and export ports. → Pilot projects for smaller shipping vessels such as ferries and tugboats.
Long-term (2030-2050)	→ Hydrogen automated (unmanned) trains become the mainstay of long-haul freight. → Cruise (leisure), bulk/container carriers (commercial), small-mid size airplanes (passenger/freight), long-haul road trains (passenger). → Hydrogen powered space transport and delivery systems.

3 Industry energy and feedstock – replacing carbon-intensive fossil fuels with hydrogen

Globally, industries such as shipping, steel-making and chemical production see hydrogen as a long-term alternative to their dependence on fossil fuels. Abundant clean hydrogen will present the opportunity to decarbonise sectors currently dependent on thermal coal, gas and liquid fossil fuels.

It could give Australian and Korean manufacturers of energy-intensive products such as steel a comparative market advantage because they will be able to use low-cost hydrogen near where it is produced. As an example, POSCO, Korea's largest steel maker, has indicated it will become the largest green hydrogen consumer when the hydrogen reduction steelmaking process is adopted, which involves hydrogen replacing coal as the reductant. As POSCO is planning to become one of the largest green steel producers globally, Australia, as an existing supplier to POSCO, is well positioned to supply POSCO with green hydrogen.

Due to Korea's large-scale industrial base and refining and petrochemical industry, one of Korea's major goals is to utilise hydrogen generated as a by-product of petrochemical processes. To that end, it has already secured the technologies necessary to produce hydrogen pipelines and high-purity hydrogen. For example, Hanwha Energy has built a power plant that uses by-product hydrogen to generate electricity using Doosan hydrogen fuel cells, which will power up to 160,000 households annually.

In Australia, an immediate opportunity is the use of clean hydrogen as an industrial feedstock – primarily for ammonia production (mainly used for fertiliser) and refining – to realise a clean energy transition. This requires the displacement of grey hydrogen used in steam methane reforming with green hydrogen from renewable energy. The point that this will be economically viable is driven by the price of natural gas against reductions in the cost of hydrogen via electrolysis. With the cost of renewable energy falling and no further development of technology required, the cost of green hydrogen is expected to become comparative to grey hydrogen by 2025 – this could occur even sooner if government subsidies or other incentives were introduced.

The chemical industry accounts for more than 90 per cent of global hydrogen production, with approximately half used to produce ammonia. Indications suggest that the demand for hydrogen from existing industries is expected to grow by 25 per cent by 2050. Where Australia currently accounts for around 1 per cent of global ammonia production, there is significant opportunity for growth as a commodity and a viable medium for hydrogen export.

In what is a prime example of Australia-Korea collaboration, Korea Zinc (through its Australian subsidiary Ark Energy) is committed to support its Sun Metals zinc refinery in North Queensland to become the first refinery in the world to produce green zinc. It is also developing a hydrogen hub in Townsville that will supply green hydrogen to its own fleet of five 140 tonne rated fuel cell prime movers as well as supply third party customers. Ark Energy plans to build Queensland's domestic hydrogen economy first ahead of exporting green hydrogen to its parent, Korea Zinc and other customers in North East Asia.

The falling cost of renewable energy is also expected to help Australia transition its economy from a resource extraction energy industry to a manufacturing one. It will also help preserve the longevity of Australia's existing exports and potentially create new industries. Australia's Low Emissions Statement highlights low emissions aluminium and steel as two priority areas for Australia, with the production of renewable hydrogen as a way of linking low-cost renewable energy with energy intensive industries such as metals manufacturing. Low-cost renewable energy, for example, could pave the way for hydrogen being used to convert iron ore into iron for the manufacturing of "green steel." More advanced processing could then

continue offshore in Korea. The technological risks of production of aluminium and steel, however, must be addressed before this becomes a reality.

Rio Tinto is working with its joint venture partner Alcoa to manufacture a green aluminium product and both Australia and Korea have identified green steel as a future industry. Whyalla steelworks is planning to use hydrogen in place of metallurgical coal in the steelmaking process , and has set a goal to be the largest producer of carbon-neutral steel by 2030. While this could represent an area of competition between Australia and Korea, it may also provide opportunities for further R&D collaboration between our two countries.

A number of other industrial feedstock opportunities may materialise in Australia once the production cost of green hydrogen is more competitive, including low-emissions methanol, semiconductor fabrication and the production of food products such as transforming plant oils into margarines and semi-solid fats.

Australia-Korea intersections	
Short-term (2020-2025)	→ Displacement of grey hydrogen with either green or blue hydrogen for hydrogen as an industrial feedstock.
Medium-term (2025-2030)	→ Manufacture of green steel and green aluminium.
Long-term (2030-2050)	→ Deployment throughout other energy-intensive, hard-to-abate industries (e.g. cement). → Electrification of production processes where applicable, such as electric arc furnaces using hydrogen. → Australia is a major exporter of green steel to Korea.

4 Export – Australia positioned as a future supplier of hydrogen to Korea

Given Australia's abundance of solar and wind resources and the falling cost of renewable energy, together with our reputation as a trusted energy exporter, Australia has the potential to lead the global shift to hydrogen and produce hydrogen for global export.

South Korea has identified that by 2030 it will require hydrogen imports to sustain its energy needs. However, technologies required to store and transport hydrogen have yet to be developed and further research, including sophisticated analysis of supply chains for different technologies, is required. Korea is currently looking to develop a liquid hydrogen carrier, utilising LNG carrier building technology, starting in 2025. In the short-term, it is likely that hydrogen will be developed and produced in partnership with existing fossil fuel industries (such as blue hydrogen) and over time, grey hydrogen will transition to at least 70 per cent of green hydrogen or CO2-free hydrogen by 2040.

The Korean Government's strategy indicates that Korea's need for hydrogen will increase from 130,000 tonnes in 2018, to 470,000 tonnes in 2022, to 5,260,000 tonnes in 2040 for energy use. An additional 2,000,000 tonnes will also be required for industrial use. As indicated at the 2020 AKBC-KABC Joint Meeting, POSCO is seeking to partner with Australian companies in various business opportunities such as joint ventures and equity investments to produce green hydrogen.

To fully realise the export potential of green hydrogen, Australia would need to build a thriving domestic market for multiple end users of hydrogen, creating the economies of scale, skills and technology required to support major exports. This provides an opportunity for Korean technology to be deployed locally, which will help create 'new' domestic industry in Australia, further supporting economic growth and employment.

Focussing on the acceleration of the production of green hydrogen at scale will serve both the interests of Korea, as a net energy importer, and Australia, as a potential export powerhouse. The priority for both countries should be to form an understanding and agreement on the end-to-end supply chain infrastructure and configuration required to facilitate hydrogen production, export and import. Determining which hydrogen carrier is most appropriate for the international trade of hydrogen (ammonia, cryogenic hydrogen, methanol, liquid organic hydrogen carriers are among potential options) and determining which energy vector is the best performer requires further technical, economic, environmental and social analysis. Australia is already advanced in resolving this question, with major viability studies underway, such as the $500 million Victoria hydrogen supply chain pilot using the world's first liquid hydrogen carrier, and the Suiso Frontier to carry hydrogen produced in Victoria to Japan.

Australia-Korea intersections	
Short-term (2020-2025)	→ Australia-Korea Joint Feasibility Study on Export Supply Chain followed by pilot project(s).
Medium-term (2025-2030)	→ Joint assessment of pilot project(s) and scale up to commercialisation.
Long-term (2030-2050)	→ Australia becomes a major supplier of hydrogen to Korea.

5 Australia-Korea research and development partnerships

Both Australia and Korea recognise that international collaboration is essential to develop global hydrogen supply chains and expand the global hydrogen market. In particular, scientific and technological cooperation and partnerships are essential to address the technical barriers, economic costs and support a hydrogen economy, especially around fuel cell efficiency and storage.

International collaboration offers an effective way to accelerate hydrogen technology development while simultaneously supporting relationship building. The joint focus must be on translating research into commercial projects, to ensure both countries are at the forefront of market developments. Australia and Korea are natural partners, with Australia an existing and reliable energy exporter to Korea.

In their respective strategies, both the Australian and Korean governments identify each other as critical to realising their goals and there are several examples of cooperation across many different aspects of the value chain.

Feedback from AKBC members indicates that there is high interest in members developing stronger links with Korean industry, government and research institutions for the purposes of building partnerships, knowledge exchange, and development of best practice frameworks.

5.1 Government

The Australian and Korean Governments signed a Letter of Intent for Hydrogen Cooperation in September 2019, demonstrating commitment at the government level.

The AKBC would welcome any joint initiatives between the governments of Australia and Korea for a senior trade delegation to further strengthen the commitment to and willingness for collaboration between our two countries in developing the hydrogen economy.

5.2 Industry

Supporting this, several industry partnerships between Australia and Korea exist, including:

- Australian Hydrogen Council & H2 Korea MoU, signed in November 2019.
- ATSE & National Academy of Engineering of Korea (NAEK) joint workshop of Hydrogen Futures in March 2020.

- Jemena, Coregas & Hyundai Motors Australia MoU in August 2020 for supply of green hydrogen to Hyundai's Macquarie Park hydrogen refuelling station.
- Woodside, Hyundai Motor Group & KOGAS. Woodside has invested in the Korean Hydrogen Energy Network (HyNet) consortium, which is led by KOGAS and Hyundai Motor Company.
- Hyundai Motor Company, CSIRO and Fortescue Metals Group (FMG) signed an MoU in August 2020, to collaborate on innovative hydrogen production technology including technology relating to an ammonia cracker which would provide a solution for the large-scale transportation of hydrogen overseas.
- Santos and SK Group signed an MoU which provides a framework to jointly investigate zero emissions hydrogen, including potential to export and supply hydrogen to overseas markets, including Korea as well as future carbon abatement projects including CCS projects.
- POSCO and FMG agreed to collaborate on a green hydrogen production project in December 2020. POSCO will increase its iron ore purchases from FMG to make its corrosion-resistant steel product, PosMAC, and FMG will look at using the PosMAC steel product to build its solar energy facilities in Western Australia.
- POSCO and Origin Energy signed a MoU in March 2021 to cooperate on producing and supplying green hydrogen to Korea.
- LH2 Energy Pty Ltd is an Australian start-up, collaborating with LATTICE Technology in South Korea to export Green Liquid Hydrogen from Darwin to Korea, with estimated first shipment in 2027.
- As mentioned at the 2020 AKBC-KABC Joint Meeting, POSCO is currently seeking partnerships for joint development of ammonia steam reforming technology for hydrogen production and other areas for joint research include hydrogen liquefication, hydrogen extraction, electrolysis and carbon capture and storage.

Korean companies are also investing heavily in R&D:

- Hyundai Motors Group (HMG) is strongly committed to the hydrogen economy. HMG was the first company to mass produce FCEVs and with the production of the NEXO they have been committed to the sector. Hyundai estimates investment of 7.6 trillion won in 2030 with applications of the fuel cell beyond passenger cars, expanding into other vehicle applications such as train rolling stock and forklifts. HMG is committed to investing in the whole supply chain, beyond just mobility applications including production (including LNG reforming, liquefied hydrogen production), storage and delivery, refuelling (including business models for commercial FCEVs such as buses and trucks) and application.
- Hyundai Heavy Industries Group (HHIG) plans to establish a new unit that handles the production of hydrogen and the use of it onshore and offshore by 2030. The shipbuilding group will also develop hydrogen fuel cell-powered ships and speed up the development of hydrogen carriers.
- Doosan Fuel Cell signed an MoU with Korea Offshore & Shipbuilding Engineering (KOSE), a shipbuilding holding company of HHIG for the joint development of a green, MW scale Solid Oxide Fuel Cell (SOFC) systems for ships and agreed to carry out joint R&D in the shipbuilding and offshore fields.
- POSCO has set targets to reduce its reliance on fossil fuels and transition to renewable energy sources. POSCO plans to establish a hydrogen business and collaborate with research agencies at home and abroad to develop related technologies and meet the growing demand for the clean energy source and foster new growth drivers. POSCO aims to scale up its hydrogen production capacity to five million tons in the next three decades and reduce its carbon emission to net-zero by 2050.
- Hydrogen is high on the agenda for SK Holdings with a newly established hydrogen business team comprising some 20 energy experts from relevant subsidiaries SK E&S, SK Innovation and others to report directly to the CEO. It also plans to start mass-producing liquefied hydrogen from 2023.
- Hanwha Solutions expanded its Hydroelectric Technology Development Team into the Hydrogen Technology Research Centre to strengthen its green hydrogen business. It is also planning to secure green hydrogen mass-production capabilities earlier by recruiting outside experts.

5. Australia-Korea research and development partnerships

5.3 University

The Australian Embassy in Seoul is currently working with the Korean Government to identify potential research and technology related collaborations between Australian and Korean Universities in hydrogen.

Australia, through its universities, research institutes and technology developers such as CSIRO are at the forefront of hydrogen related technology development. Collaboration with the Korean Government and private sector participants can provide an opportunity to accelerate this development. One way to achieve this could be by way of hydrogen education, research and training exchanges between Korea and Australia.

There are several Commonwealth-funded Cooperative Research Centres (CRCs) that support industry-led collaborations with universities for research and development that will have commercial uses. There may be opportunities for Korean companies and universities to collaborate with CRCs in hydrogen through the Future Energy Export CRC (FEnEx CRC), Future Fuels CRC and/or the Heavy Industry Low Carbon Transition CRC (HILT CRC).

5.4 Hydrogen hubs and pilot cities

In order to realise the hydrogen potential, both countries are seeking to create hydrogen hubs or pilot cities that are clusters of large-scale demand and will complement other areas of hydrogen use in transport, industry and gas distribution networks. In Korea, Ansan, Ulsan and Jeonju/Wanju have been named as the test cities and the Australian Government has recently announced it will create five new hydrogen hubs across the country, with possible locations including Bell Bay in Tasmania, the Pilbara region in WA, Gladstone in QLD, the La Trobe Valley in VIC, Whyalla in SA, the Hunter Valley in NSW and Darwin in the NT.

Separately, the Western Australian Government has indicated that it is looking to develop a hydrogen hub at a Strategic Industrial Area, such as the Oakajee Strategic Industrial Area. These hubs will provide opportunities for Korean participation, and investment, from conglomerates such as Hyundai and Hanwha Group who may be able to participate in several aspects of the value chain, such as power generation, mobility and logistics; and will ultimately allow both countries to leverage these partnerships to successfully develop commercial projects and technologies to aid in the advancement of the hydrogen economy.

The National Energy Resources Australia has launched 13 hydrogen technology clusters across Australia to build skills, capability and commercialisation opportunities in hydrogen, with many of these in strategic locations. Linking Korean industries and researchers into these clusters could help build mutually beneficial and long-term relationships between our two countries.

Australia-Korea intersections	
Short-term (2020-2025)	→ Australia and Korea to form industry partnerships and work together on research and development projects relating to the hydrogen economy. → Opportunity for Korean conglomerate participation and investment in Australian hydrogen hubs to assist in technology development and use of hydrogen. → Investigate the potential for Australian and Korean universities to collaborate on the development of high-quality hydrogen qualifications and supporting initiatives such as researcher exchanges. → Korea to establish pilot projects in Australia.
Medium-term (2025-2030)	→ Scale up pilot projects. → Strong ongoing partnerships between Australia and Korea.
Long-term (2030-2050)	→ Convert pilot projects into 'Smart H2 City/Precinct/Zone' that is coupled with advanced digital technologies (e.g. AI, Big Data, IoT, Blockchain).

IMAGE **Hyundai NEXO Fleet -** The Hyundai NEXO Fuel Cell Electric Vehicle (FCEV) has arrived – the first hydrogen-powered vehicle certified for sale in Australia.

Conclusion

As the hydrogen era beckons, the stage is being set for Korea and Australia to leverage their national strengths to transform their national economies, industries and energy grids.

The report is a small but important step to detailing how this might occur, by detailing the opportunities for bilateral cooperation across power generation, transportation, industry energy and feedstock, export, and research and development.

With increased bilateral engagement, stable investment conditions, positive government direction, and private sector innovation, these intersections are likely to become some of the pillars of our two-way commercial and trade relationship. Importantly, as research and development expands and matures, there will certainly be many more areas for collaboration between the two countries, creating a stronger and more secure foundation for the bilateral relationship.

Acknowledgements

The AKBC would like to kindly thank the following for their support and feedback in developing this report:

- Altor Capital
- Ark Energy
- Australian Gas Infrastructure Group
- Herbert Smith Freehills
- LH2 Energy Pty Ltd
- Macquarie Group
- Melbourne Energy Institute, University of Melbourne
- QIC
- The Embassy of the Republic of Korea in Australia
- The Government of Western Australia
- Woodside Energy

For further information

AUSTRALIA - KOREA BUSINESS COUNCIL

Please contact:

Liz Griffin,
Executive Director
Australia-Korea Business Council

lgriffin@akbc.com.au
www.akbc.com.au

COVER **Hyundai Rotem -** Ulsan Metropolitan City (a southeastern city in Korea) and Hyundai Rotem Company (HRC), part of the Hyundai Motors Group, signed a Memorandum of Understanding in 2020 for Korea's first hydrogen electric tram demonstration project. HRC will produce and test the country's first hydrogen electric tram on a currently unused 4.6km line, and also construct and install a new depot and hydrogen charging station.


H2
HYDROGEN
ENERGY
STORAGE
H2

akbc.com.au