30 days Series 3 by Zhang Kaihui

THE CLIMATE CHALLENGE

Opportunities from collaboration between Australia and China

2022

KING&WOOD MALLESONS
金杜律师事务所

Australia China Business Council
澳大利亚中国工商业委员会

FOREWORD

KING & WOOD MALLESONS

Addressing climate change is the defining challenge of our time.

Across Asia, Europe, North America and the Middle East, our people are increasingly working with clients to help navigate the risks and seize the opportunities presented by the changing landscape.

The scale of the efforts needed is vast. We want to flip the narrative: from one of daunting prospects, to one of immense possibilities.

For Australia and China, the challenges are similar. Nurturing relationships, better understanding the respective economies and culture, and cultivating business initiatives carry benefits for both.

Many productive and constructive business collaborations are already underway between Australian and Chinese companies and institutions across multiple sectors.

We trust this report will stimulate conversations that lead to new and ambitious engagement between businesses, industry sectors and governments.

CLAIRE ROGERS

PARTNER, HEAD OF CLIMATE & ESG

FAN RONG (KATHY)

PARTNER

SCOTT GARDINER

PARTNER

SU MENG (MOLLY)

PARTNER

AUSTRALIA CHINA BUSINESS COUNCIL

It is with great pleasure that the Australia China Business Council presents this inaugural report, The Climate Challenge: Opportunities from Collaboration across Australia and China, under ACBC's landmark Green Channel initiative.

Green Channel is a multi-year, multi-sector platform that highlights the opportunities for Australian businesses arising from increased collaboration with China on outcomes addressing the climate challenge.

Produced in partnership with King & Wood Mallesons with contributions from our members, the report highlights the scale of the net zero challenge, reminds us of the fundamental importance of bilateral and multilateral trade and investment relationships, and explores those areas where there are practical and realistic opportunities for business collaboration.

While the report has been written primarily for the benefit of ACBC's 700-plus corporate members, we expect that it will have wider relevance to companies, governments and institutions that are increasingly engaged with climate change issues, from ground-level operations to boardroom strategy and policy development.

The challenge is a global one and we can't do it alone.

Together we can make a real difference.

Net zero. Faster, together.

DAVID OLSSON

NATIONAL PRESIDENT

ANTHONY COLES

CHAIR, NET ZERO WORKING GROUP

ALISON AIREY

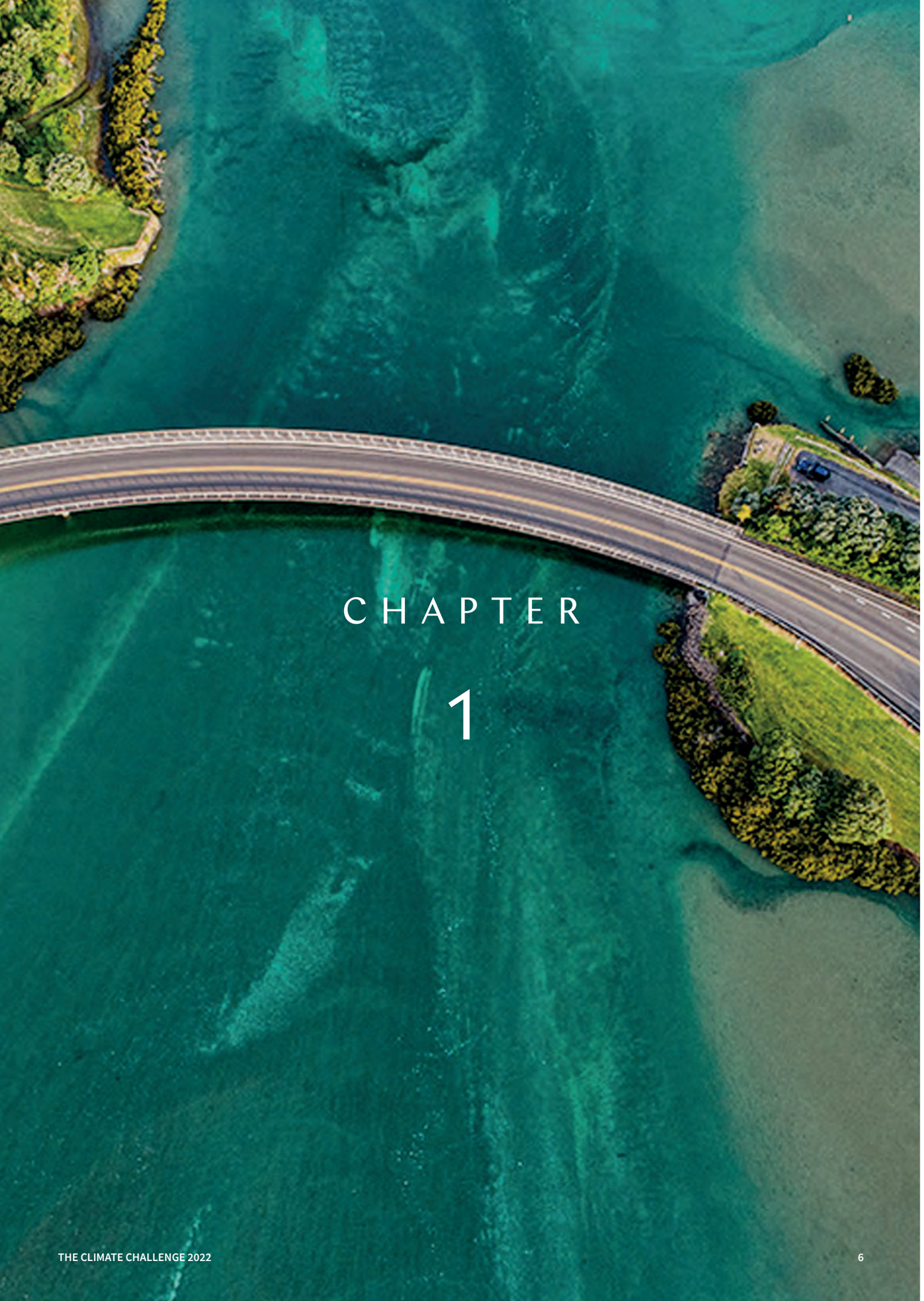
NATIONAL EXECUTIVE OFFICER

COLLABORATIVE PATH TO NET ZERO

In this report, we explore opportunities for Australia and China to work together and share knowledge to achieve net zero. We shine a light on examples to inspire and inform others.

This report is not seeking to comprehensively cover what is a vast and ever-evolving landscape. We have chosen to inspect sectors that have among the most immediate and largest impacts on climate change. We aim to plant seeds for ongoing conversations about what is needed and what is possible.

* This report is not intended to be legal advice.
*Any reference to “Hong Kong” or “Hong Kong SAR” shall be construed as a reference to “Hong Kong Special Administrative Region of the People’s Republic of China”.



CHAPTER

1

TARGETS AND WORKING TOGETHER

Five decades have passed since Australia and China formalised diplomatic relations. Overwhelmingly it is a relationship marked by strong trade bonds that have adapted and changed over time.

Today, amid the dislocations arising from the pandemic and geopolitics, the governments and businesses of both nations are looking to a sustainable recovery.

There is a growing recognition that China's role in climate change mitigation globally is critical to achieving net zero goals. By leveraging strong economic and trade complementarities, Australian and Chinese businesses are well positioned to unlock new opportunities and deliver a greener future.

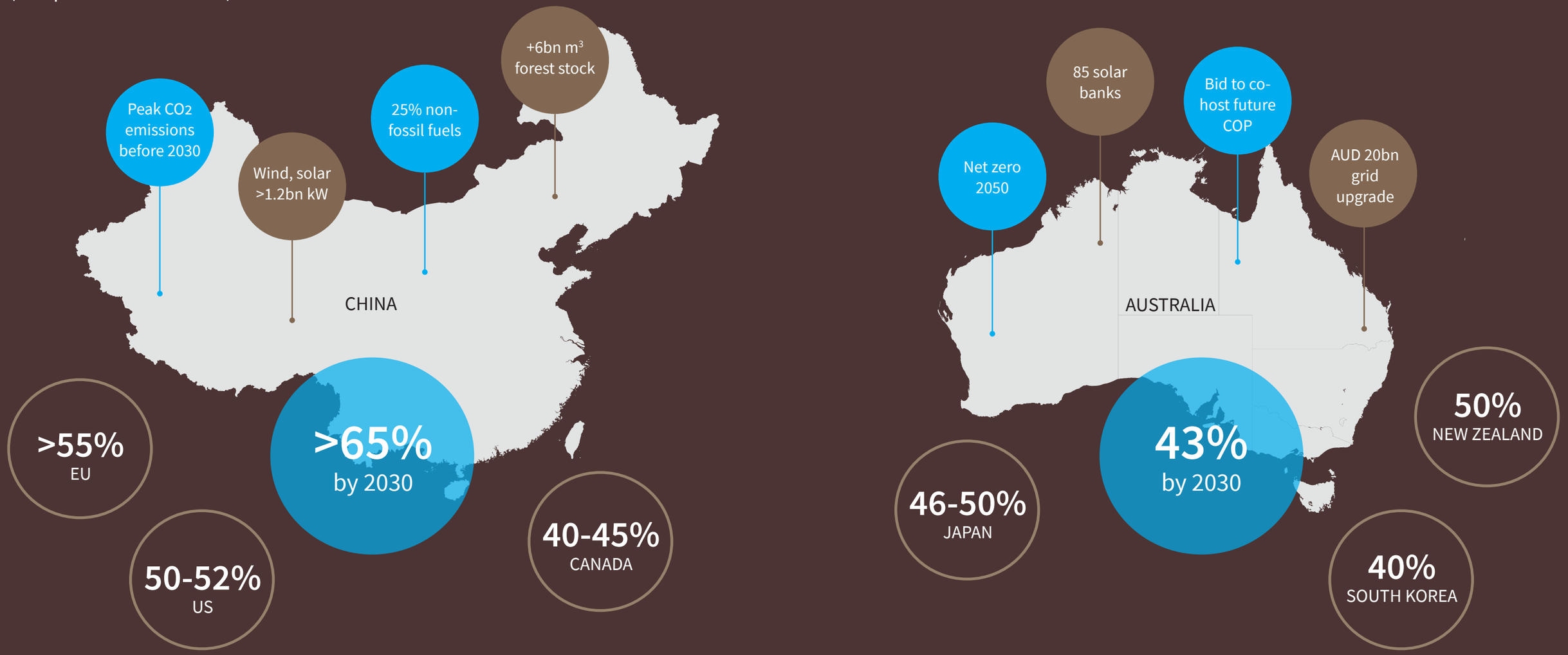
Momentum for a sustainable net zero future

At a national level, Australia and China have made significant commitments on carbon emissions reduction and are actively pursuing more sustainable models of economic growth. Australia has adopted a net zero by 2050 target, while China is aiming to have CO_2 emissions peak before 2030 and achieve carbon neutrality before 2060.

Globally, the need to transition to a net zero economy and to do it collaboratively is at an historic high. The 2021 UN Climate Change Conference in Glasgow **(COP26)** culminated with agreement by all parties on a Climate Pact to drive action on climate mitigation, adaptation, finance and collaboration, as well as an acknowledgment that much more is needed. This ambitious new landscape requires innovative and unprecedented global collaboration.

Australia and China were among more than 40 countries which agreed to the Breakthrough Agenda at the conclusion of COP26. The Breakthrough Agenda aims to make low-emissions solutions the most affordable, accessible and attractive in emitting industries including power, transport, steel and cement. Measures taken in line with this commitment will provide opportunities for investment and innovation.

Net zero in sight: targets to reduce emissions by 2030
(compared to 2005 levels)



COP26 outcomes included

- New 2030 net zero emissions targets from 153 countries
- Pledges to phase down coal power by 190 countries
- Commitments to reduce deforestation, fund adaptation, speed EV transition, cut methane
- Commitments covering 90% of global GDP

Source: UNCC, UK Government, COP26: The Glasgow Climate Pact (November 2021)

CHINA: PROFOUND TRANSFORMATION AHEAD

Amid the growing wave of net zero emission targets, China's is arguably one of the most significant. The country is the world's largest energy consumer and carbon emitter, accounting for one-third of global CO_2 emissions. The pace of China's emissions reductions will be an important factor in international efforts to limit global warming to 1.5°C.

China has had laws in place for many years regarding environmental protection[1], pollution[2] and renewable energy[3], and established a carbon emissions trading scheme in 2021[4].

The programs and policies have attracted strong participation at both private and public levels, due to consistent messaging and clear standards particularly through China's Five-Year Plans. The current 14th Five-Year Plan (2021-25) outlines the overall vision for a carbon neutral China, including goals of increasing the share of non-fossil fuel energy to 20% by 2025, establishing a modern energy system and improving forest coverage. It is supported by a comprehensive package of national, provincial, sectorial and technology plans.

China has made enormous strides in renewable energy. It is home to the largest share of the world's solar photovoltaics **(PV)** and wind turbine manufacturing. More recently it has invested in the full stack of battery supply chain. According to the International Energy Agency **(IEA)**, most electric vehicle **(EV)** batteries are made in China, accounting for 70% of the world's manufacturing capacity.

China's leadership in clean energy production has contributed significantly to the falling unit costs for wind and solar PV. Now, the same is occurring in the production of hydrogen-producing electrolysers.

The sheer scale of China's energy needs means that it must move quickly. The IEA has warned that carbon neutrality "demands a rapid and profound transformation of the energy sector" and will rely on China greatly accelerating its clean energy innovation.

China has the technical capabilities, economic means and policy experience to drive this transformation, but for these efforts to succeed, international collaboration is essential.

China's legal framework

Guiding Opinions on Coordinating and Strengthening the Work Related to the Response to Climate Change and Ecological Environment Protection

- Climate change and environmental governance, ecological protection and restoration
- Issued by the Ministry of Ecology and Environment in January 2021

Guiding Opinions on Accelerating the Establishment and Improvement of the Green, Low-carbon and Recycling Economic System

- Requires the strengthening of the legal and regulatory system to respond to climate change
- Issued by the State Council in February 2021

National Emissions Trading Scheme

- Covers energy generation, capturing 4.5 billion tonnes of CO_2 emissions annually
- Introduced July 2021 following regional pilots (which remain in place until phased out)

1. Environmental Protection Law, Law on Environmental Impact Assessment (PRC) Standing Committee on the National People's Congress, 29 December 2018.
2. Regulations on Administration of Pollutant Discharge Permits (PRC) China's State Council, 9 December 2020.
3. Renewable Energy Law (PRC) National People's Congress, 28 February 2005.
4. Measures for the Administration of Carbon Emissions Trading (draft instrument) (PRC).

AUSTRALIA: ACCELERATING THE TRANSITION

All Australian states and territories are committed to net zero emissions by 2050 and most have policies to foster investment and innovation in emissions reduction in a range of sectors including energy, transport, construction, urban design and agriculture. Almost all have implemented Renewable Energy Zones.

In 2022, the newly elected federal government set out a plan for what Climate Change and Energy Minister Chris Bowen called "the most dramatic economic transformation our nation has faced in our modern era". This includes becoming a major player in hydrogen and exporting clean energy, green steel and other industrial products, as well as critical minerals.

One key pre-existing federal policy measure is the Safeguard Mechanism. This requires companies to report on emissions associated with around 215 high-emitting facilities and maintain these emissions at or below a baseline. Companies can offset emissions above this baseline by purchasing Australian Carbon Credit Units (ACCUs). The government will gradually lower those limits, pending industry and community consultations on reform options to help cut emissions.

Australia also has its Emissions Reduction Fund **(ERF)**, providing funding to incentivise the adoption of technologies and practices which generate carbon credits. Current priorities of the ERF include clean hydrogen, carbon capture and storage, and integrated farming methods.

The Australian Renewable Energy Agency **(ARENA)**, a government body that financially backs renewable energy projects, includes within its strategic priorities the commercialisation of clean hydrogen, the transition to low emissions metals and scaling up carbon capture and storage.

CASE STUDY – ANU AND TSINGHUA UNIVERSITY

Bringing research and industry together

"Just about every aspect of decarbonisation could benefit from a bilateral exchange. There are parallels and complementarities in zero-carbon supply chains." Professor Frank Jotzo, Australian National University

Universities are increasingly working with industry groups in the energy game, providing a critical commercialisation link to cutting edge research.

Australia-China collaborations between universities are informal and built on longer term relationships of trust. The Australian National University **(ANU)** has hosted delegations on climate change and energy with senior participants including from Tsinghua University and other universities. Tsinghua University is working with industry associations as well as major companies with a presence in Australia.

ANU has worked with Chinese colleagues on energy, a field where Australia and China are grappling with similar issues. Vast swathes of remote areas bring high potential for renewable energy including for heavy industry and the production of hydrogen.

Academics, analysts and industry experts are also coming together to exchange knowledge in the green iron and steel space. Demand for low-carbon products from importers, plus a relative cost advantage, will ultimately drive the establishment of a green steel industry. Which parts of the value chain will be located in Australia, China and other countries respectively remains an open and economically important question.

ANU is convening a number of decarbonisation roundtables, in association with ACBC's Green Channel in 2022.

SURGE IN PRIVATE SECTOR TARGETS

Voluntary net zero commitments are increasingly common across Australia and China, although more work is needed to ensure that these are scientifically supported and aligned with the Paris Agreement which aspires to limit global warming to 1.5°C.

A December 2021 study in China by the United Nations Development Programme and PwC found that over 75% of surveyed companies were undertaking low-carbon initiatives. Almost 38% had calculated their carbon inventory and a third had set carbon targets.

This was evident at ACBC's 2021 business roundtable Green Channel event, "Collaborations towards net zero". Many of China's most prominent companies in high-emission industries, including SOE's Shandong Energy, Baowu Iron and Steel, PetroChina and Sinopec, shared their respective immediate actions on decarbonisation on the way to 'Peak Carbon' by 2030.

In Australia, a 2021 study by KWM found that net-zero commitments were widespread among the 50 largest ASX-listed companies: 54% targeted net-zero by 2030, 2040 or 2050, while 18% had committed to (or had already achieved) carbon neutrality.

Only four of these companies had set targets verified by the Science Based Target initiative as sufficient to meet Paris Agreement standards, while another four had made commitments to do so.

Reporting on climate risk against the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) and in line with guidance from regulators is now market standard for large ASX-listed Australian companies. Companies must measure and report on progress towards these targets.

"It was striking how committed to outcomes the companies sharing with us were. There is a huge industrial transformation underway in China. Companies that had investments in Australia were already active with their decarbonisation initiatives. All wanted a path to peak emissions by 2030, with many determined to show results against new 14th Five-Year Plan targets by 2025. It was eye-opening."

Anthony Coles, ACBC Net Zero Working Group Chair

WHERE TO FROM HERE?

SHARED COMMITMENTS TO TRANSITION TO NET ZERO ARE CLEAR.

What is missing are stronger bridges between Australia and China as they forge that path. This is particularly critical for Australia's future-facing industries as they prepare for the energy transition: there is a need to reach out to those that have demonstrated not only how to do it, but how to do it relatively quickly.

The unit costs of several low-emission technologies have fallen continuously since 2010 thanks to the scale and efficiencies of China's manufacturing ecosystem.

Australia has an opportunity to establish itself as an influential contributor towards an international framework for a sustainable, decarbonised net zero world. This includes piloting new green capital products, acting as a green funds source and user, and showcasing and commercialising new technology.

Innovative policies can support the shifts. Further, improvements to climate governance can help to avoid emissions creep and increase investment in low-emission technology and infrastructure.

In the following chapters, we explore the feasible and effective solutions that can assist in reducing emissions in the energy, industrial, construction, transport and agricultural sectors. We also look at how we might fund those solutions.

Achieving these solutions will require cooperation across national borders and industries. COP27 takes place in Egypt in November 2022. Priorities are likely to include strengthening climate resilience, growing green finance contributions, accelerating action on net zero and strengthening accountability and trust on commitments.

Continuing to strengthen cooperation across business, government and academia will help Australia and China to achieve net zero faster, together.

"The transformation in how the world produces, distributes and consumes energy will drive trillions of dollars in global investment. Opportunities include the electrification of transport, the commercialisation of hydrogen, and financing energy efficient buildings."

Shayne Elliott, ANZ CEO in Blue Notes

CASE STUDY – UNIVERSITY OF SYDNEY

The power of collaboration: "we need to know each other"

"For many important reasons, we need to know each other and foster strong network connections - not only to generate IP but, ultimately, to develop collaborative, global solutions that address the greatest challenges of our times." Professor Jun Huang, University of Sydney, School of Chemical and Biomolecular Engineering

In 2018 the academic heads of Zhejiang University and the University of Sydney agreed: there was a need for a better, more global approach in the sustainability field. Efforts stalled due to COVID-19, but now the academic institutions are reinvigorating their connection.

A joint sustainability lab launched in late 2021 brings together their best minds to focus on areas such as renewable energy, carbon neutralisation, data, environmental pollution and ecosystem restoration. By connecting scientists to the vast manufacturing capacity in China, the joint lab accelerates the commercialisation process.

The partnership is about more than scientific breakthroughs – addressing global environmental challenges requires collaboration. The goal is to ensure there are regular interactions between the next wave of scientific talent across Australia and China, to help them to understand and respect their cultures and know how to work together.

The universities do not share intellectual property – ownership remains where it otherwise would have. Regular seminars involving researchers from similar fields across the universities will begin in late 2022, bringing opportunities to build connections and share innovations.

Professor Jun Huang leads the University of Sydney's side of the arrangement. Among the ground-breaking projects his team of more than 20 researchers are working on are:

- using sea water to produce hydrogen
- upgrading power grids to accommodate renewable energy during peak loads
- carbon capture and conversion: artificial synthesis to transform carbon into zero-emissions fuels like hydrogen
- converting wastes to products: waste plastics to high value materials, sea food wastes to health food additives.

CHAPTER

2

POWERING A NET ZERO WORLD

Despite impressive growth in renewables over the last decade, fossil fuels remain firmly part of the energy mix in both China and Australia. In 2020, 85% of China's primary energy needs were met with fossil fuels and 72% in Australia.

This is the base from which China and Australia must transform their energy generation and use.

The energy sector will need to fundamentally reshape itself from being the biggest emitter to a nil net contributor.

At the same time, there are fundamentally challenging aspects to the clean energy shift; in particular, the need for a significant amount of firming technology to deal with the intermittency of renewable energy, including dispatchable storage, and congestion-battling new transmission infrastructure.

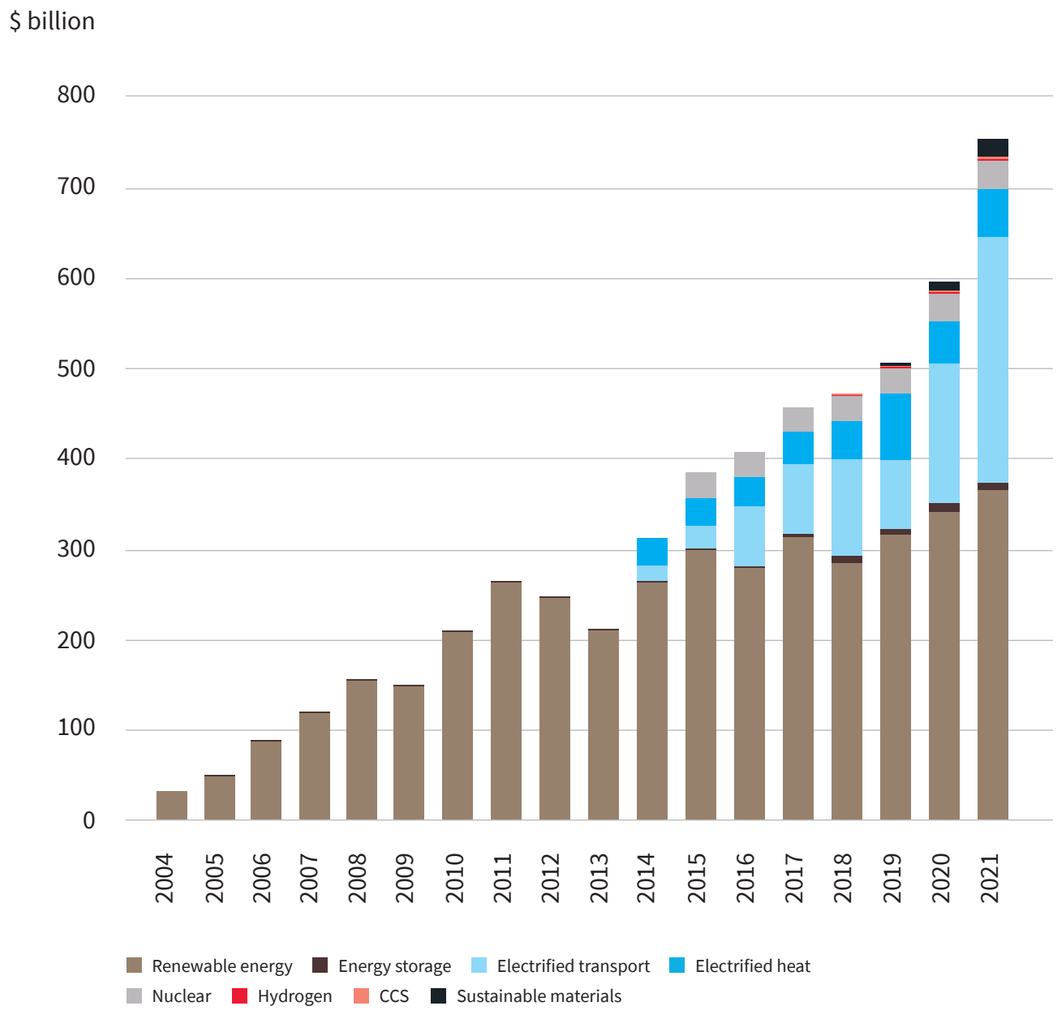
There are rich veins of opportunity for collaboration between China and Australia in this transition. China is the world's leading renewable technology manufacturer and investor and has built out the largest energy grid utilising innovative new high-voltage direct current **(HVDC)** infrastructure. Australia's innovation heritage and early-adopter status, as shown by the pioneering work on PV cells, positions it as a key contributor to new technology development.

THE CASE FOR OPTIMISM

Investment in a decarbonised electricity sector is increasing almost exponentially, and China is at the forefront of this wave.

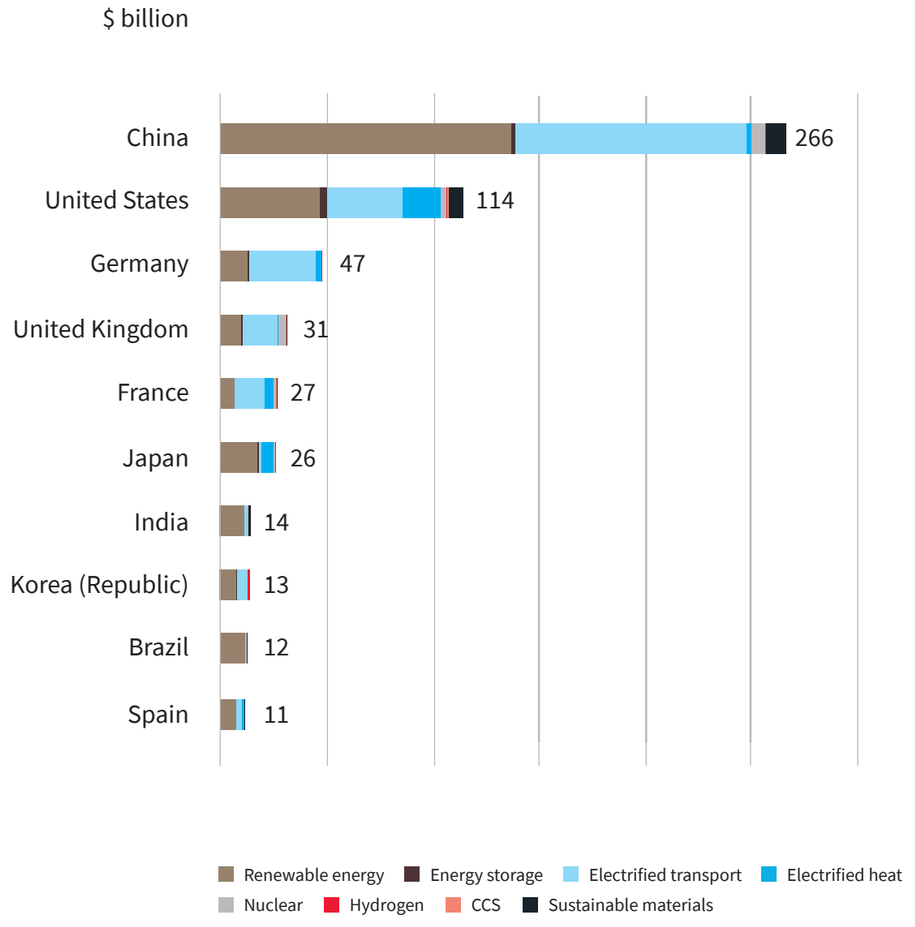
In 2021, a **record USD755 billion was spent** on the deployment of low-carbon technology worldwide, 26% up on the previous year. More than a third - USD266 billion - were investments in China.

Global investment in energy transition by sector, 2021



Source: BloombergNEF

Global investment in energy transition by country, 2021



Source: BloombergNEF

The cost imperative: renewables are becoming cheaper

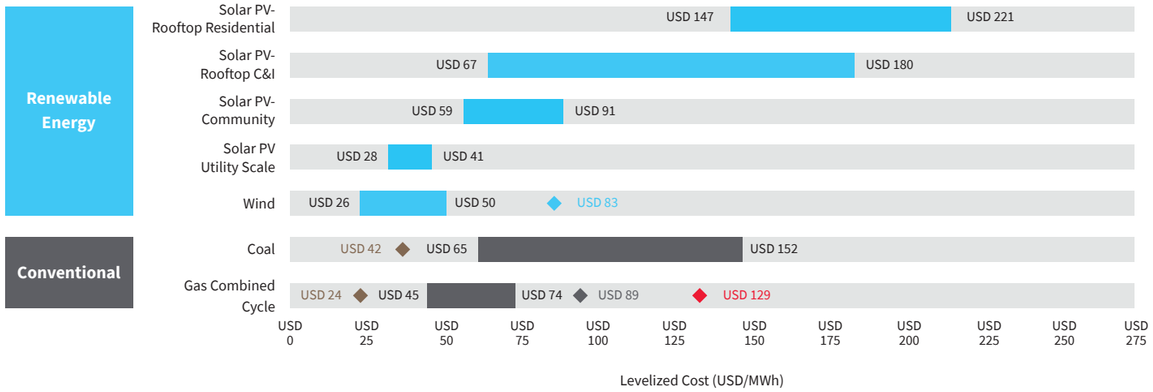
China and Australia have already reached the first tipping point in the race for economic viability of renewable power: energy from new wind and solar is cheaper than energy from new fossil fuel plants.

Thanks mostly to China's pace of change in its industrial ecosystem, in a little over a decade, the levelised cost of solar PV plummeted from USD248/MWh to as low as USD28/MWh. Wind similarly declined from USD124/MWh to as low as USD26/MWh. These are globally-averaged numbers.

China and Australia will soon reach the second tipping point: energy from new wind and solar becomes cheaper than energy from *existing* fossil fuel plants.

Levelised cost of energy comparison - unsubsidised analysis

Selected renewable energy generation technologies are cost-competitive with conventional generation technologies under certain circumstances



Source: Lazard Estimates, Levelized Cost of Energy Analysis (LCOE 15.0)

The security imperative: sustainable growth

Other factors are influencing the energy transition beyond the drive for net zero. For many countries the recent events in Ukraine have highlighted the importance of energy security. Chinese energy security will benefit from a renewables-dominated energy sector rather than reliance on imported fossil fuels.

Similarly, Australia has a dependency on imported oil for its transport sector. Given its rich abundance of solar irradiance and onshore wind, Australia has an economic driver to shift towards renewables. These resources have become increasingly valuable as renewable capex costs decline.

Australia and other Western countries have identified a need to manage risks of supply chain independence for future renewable energy materials. Given China's vast experience, it remains an attractive partner when it comes to looking at ways to increase Australia's domestic manufacturing capacity.

The challenge: managing a renewables-dominated grid

The intermittency of renewable power brings with it grid management issues. This highlights that options beyond renewables will play a critical role, including hydrogen, methanol, carbon capture and pumped hydro.

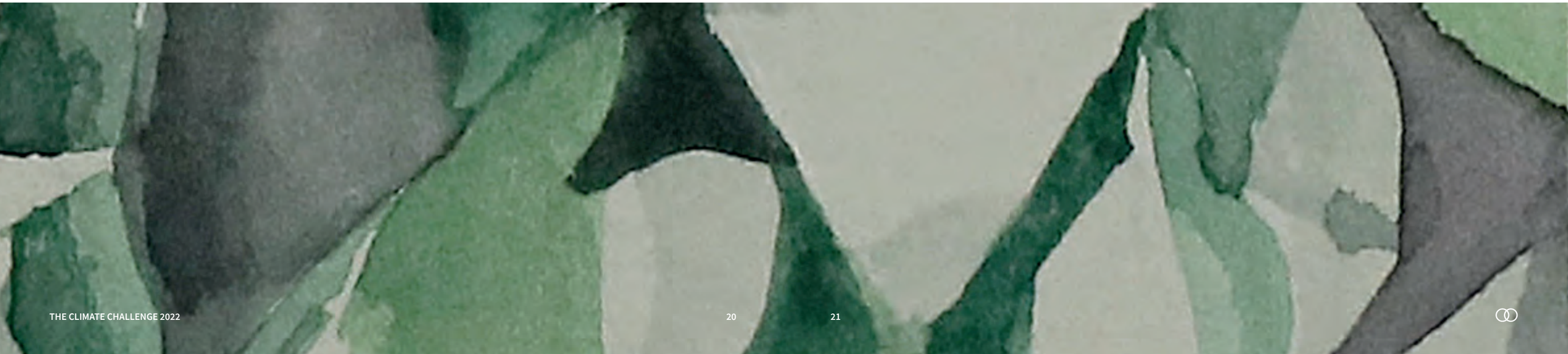
When it comes to securing a renewables-dominated grid, batteries are essential and they figure prominently in new-build investments in both Australia and China.

South Australia's Hornsdale Power Reserve was the world's largest lithium-ion battery when installed in 2017. The utility-scale battery storage capability – initially 100MW and expanded to 150MW in 2020 - was built to help buffer intermittency from the state's heavy renewable penetration. Since then, Victoria has developed the 300MW Big Battery project which can store enough energy in reserve to power more than one million homes for over half an hour.

In New South Wales five Renewable Energy Zones are planned to help overcome the issues associated with intermittent generation and grid access, as set out in the government's Electricity Strategy and Electricity Infrastructure Roadmap.

A similar model could assist with the development of Chinese grid infrastructure for renewable development. Chinese authorities have grappled with similar challenges to those faced in Australia.

This presents an opportunity to share lessons learned by way of a structured knowledge exchange between network operators.



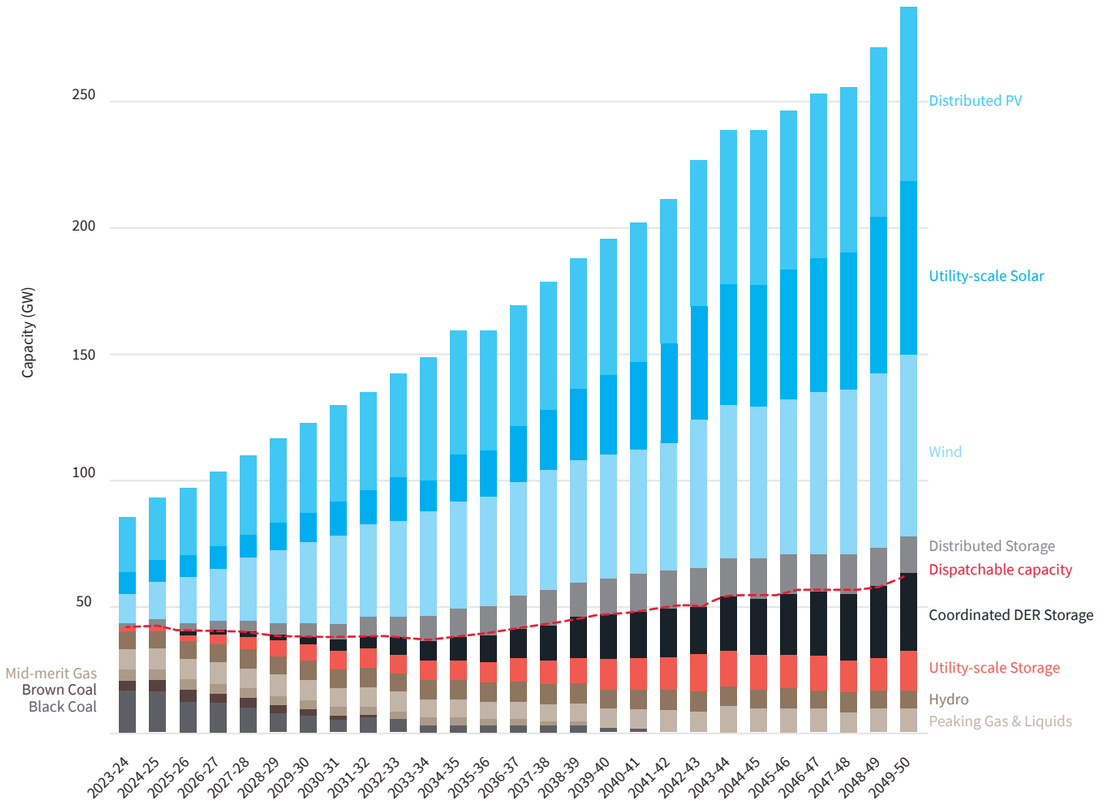
THE MAMMOTH TASK AHEAD

China recently approved 455GW of wind and solar PV projects for implementation by 2030, located in desert regions to the north of China.[5]

This, together with its installed base of 635MW of utility-scale wind and solar capacity and distributed renewable projects, will take China to its 1,200GW renewable target. A HVDC grid build-out of a similar scale will bring this power reliably to China's east coast load centres.

For its part, Australia must significantly increase the pace of its energy grid decarbonisation to meet its 2050 net zero target.

Forecast Australian electricity market capacity to 2050, step change scenario



Source: AEMO, 2022 Integrated System Plan for the National Electricity Market

The proportion of the Australian energy load serviced by renewables has increased from negligible amounts in 2010, to nearly 62% in the summer peak hours on 15 November 2021.

More renewable energy in the grid is a given, and onshore wind and solar will not be the only solution.

5. Hanyang Wei, 'China to lay out Gigawatts of Renewables on its Deserts', BloombergNEF (online, 7 March 2022).

Opportunities offshore

According to ACBC Green Channel partner Energy Iceberg, China connected more offshore wind generation capacity last year (16.9GW) than the rest of the world installed in the last five years. With a cumulative installed capacity now of 26.4GW, this extraordinary growth is expected to continue through to 2025 with another 60GW in the planning of provincial governments, on the way to 150GW by 2030.

In Australia, the Offshore Electricity Infrastructure Bill passed by the federal government on 25 November 2021 represented an important first step in the development of an offshore renewable energy sector.

The legislation, which came into effect on 2 June 2022, saw Australia join Japan, Vietnam, South Korea and China in establishing new policy frameworks, chasing a now burgeoning European and US markets. The economics are different; Australia's prominent solar sector sets a relatively low comparative cost and any possible social costs associated with offshore wind are yet to play out. Still, as a country with abundant offshore wind power resources, the sector shows promise and is attracting investment.

Gippsland, along the south-east coast, contains among the strongest wind resources in Australia and could become the location of the first declared area under the laws. Consultation on declaring offshore wind areas in Gippsland opened in August, and five further areas will follow.

The emerging opportunity is for Australian firms to work with Chinese firms that have accumulated experience, to develop Australia's capacity to manufacture equipment domestically, accelerate wind power development and unleash significant investment potential for new industries.

There is clear potential from working together in this space.

CASE STUDY – BEIJING ENERGY INTERNATIONAL (AUSTRALIA)

Community partnership the key to success

"The electricity market is very different in Australia, and we knew we needed local partners to help us navigate the regulatory system. That was crucially important to us. We are taught by community people and technical experts and are ready to listen and follow instructions if necessary. Collaboration between China and Australia is woven into our operations at every level, but we have been able to extend this spirit to work with communities, schools and industry partners as our business has grown." Weiwei Shi, Beijing Energy (Australia) General Manager

When Beijing Energy Group entered the renewable energy market in Australia in 2014 through its clean energy division Beijing Energy, the general manager of its Australian subsidiaries, Weiwei Shi, had two key priorities: cooperation and community.

Beijing Energy's first investment was a 75% stake in the 165.5MW Gullen Range Wind Farm (NSW), acquiring sole ownership of the asset in 2018.

Key to Beijing Energy's strategy is finding local partners and gaining a deep understanding of the market and the community. All of the company's activities are overseen by an expanding team of locally-based professionals – headquartered in Sydney but with project-based employees recruited from their local communities.

In 2016 the company bought Gullen Solar Farm (NSW) with an installed capacity of 10MW alternating current (MWac), supported by a grant from ARENA. The plant began operating in 2017.

The company's goal of building a 1GW portfolio of operating electricity generating assets moved closer with the acquisition of the 110MW Biala Wind Farm in 2018. As of July 2022, the project was in the final stages of commissioning.

It also has government-approved plans to build a 280MWac solar project in the Mudgee area of NSW.

In 2018 Beijing Energy was nominated as a finalist for the Clean Energy Council's Business Community Engagement Award. Shi says that further demand exists for investment from international companies to help Australia continue its transition to a cleaner energy future.

CASE STUDY – LONGI SOLAR

Innovation and co-operation key to new decarbonisation solutions

"The company won't be shy to offer its hydrogen electrolysers given that opportunities and needs arise, which they will. Australia has a large number of innovators and investors with a keen eye to develop larger projects that leverage its climate conditions and geographical location, which in turn will open the door to many more opportunities in solar, hydrogen and other forms of green energy." LONGi Solar

Since 2017, LONGi Solar Australia - a subsidiary of Chinese solar PV manufacturer LONGi - has provided the Australian solar industry with PV modules with the latest technology and quality, totalling over 1.2GW of capacity installed and currently under construction.

More than 5% of the company's revenue is invested in R&D, innovating and developing even more efficient solar cells and other technologies. In 2021, LONGi announced the establishment of its hydrogen business unit followed by the launch of its first alkaline water electrolyser. At the beginning of 2022, LONGi had achieved a capacity of 500MW of electrolysed water hydrogen production equipment.

Over the years LONGi has carried out in-depth cooperative research with well-known institutions around the world, including the University of New South Wales and the China Electric Institute. The aim is to develop technologies and solutions that cater for the different needs from users across the globe. Diverse climate conditions, applications and scenarios call for the adoption of diverse testing methods during the module design stage.

Partnering with some of the major solar distributors, but also taking part in major developments, the company intends to be an essential contributor to Australia's decarbonisation. One of the main objectives is to support large mining enterprises electrifying their remote operations using solar especially in Western Australia. Cooperation and education have already started and are expected to grow over the next few years.

THE HYDROGEN HOPE

Renewables-powered green hydrogen opportunity

Despite the hope surrounding, and substantial investments in, green hydrogen, it is not a panacea. There are significant logistics and regulatory hurdles to it becoming a mainstream energy carrier.

Nonetheless, Australia and China have ideal conditions for green hydrogen.

Hydrogen features in China's latest Five-Year Plan as one of "six industries of the future", but its use is earmarked for transport. The Australian government has announced an AUD1.4 billion investment in building a hydrogen industry. The plan under Australia's National Hydrogen Strategy is to grow this industry and position Australia as a major player by 2030.

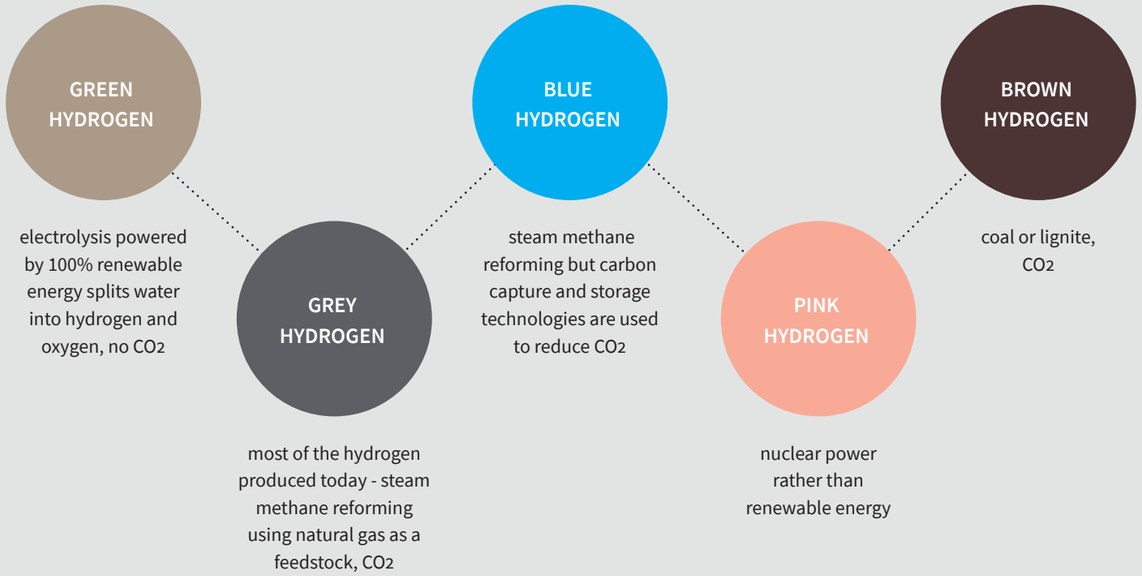
There is an evolution in how the hydrogen promise is perceived, beyond a pure replacement for fossil fuel energy towards its potential as an output from the production of excess renewable energy. This is particularly the case for solar power in Australia and for wind farms inland in China, where insulation rates and wind speed are higher and grid connections are generally sized smaller than the maximum output of a plant's renewable power, leaving additional capacity to feed into an electrolyser.

Today's hydrogen production volumes are very small. It is generally used in petroleum refining and fertilizer production and produced from traditional fossil fuel energy sources.

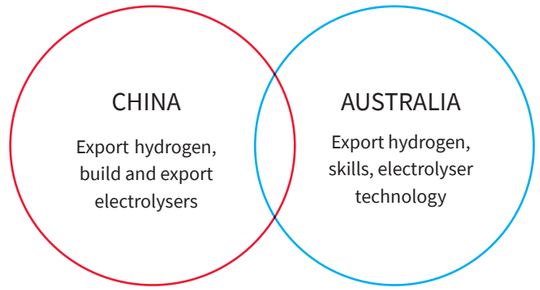
The potential for green hydrogen is driving much of the new infrastructure planning in Australia. The China market provides an opportunity to trial and demonstrate new technology, attract capital and scale it commercially.

Among key hopes for the green hydrogen economy is its use as a zero-carbon fuel where batteries are uneconomical and in other forms of long duration energy storage.

Hydrogen by colour



Opportunities for collaboration: playing to strengths

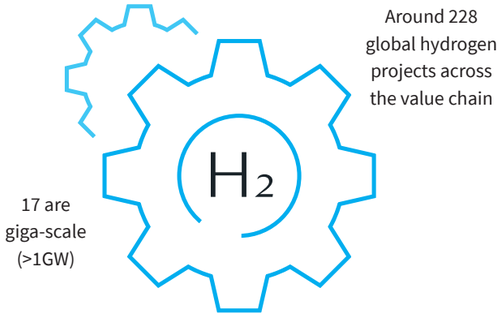


The race to price-competitive green hydrogen

The cost of renewable power is one of two key cost drivers for green hydrogen. Electrolyser price is the second, with China managing to achieve significant cost reductions when coordinating supply chain elements into an efficient industry eco-system. Solar PV and batteries are two examples.

BloombergNEF projects green hydrogen benchmark prices falling in some countries to around USD2/kg by 2030, and, in most countries, to under USD1/kg by 2050.[6] China could see competitively priced green hydrogen (compared to blue) as soon as 2023; in other countries with rich renewable resources this is expected to happen between 2026 and 2028.[7]

Hydrogen production and projects



Spread of production and projects

Every month around three to five new hydrogen projects emerge in China, according to industry analyst Yuki Yu from Energy Iceberg. By the end of May 2022, Energy Iceberg was tracking more than 131 renewable hydrogen projects in China.

The 2025 target of just one autonomous region of China, Inner Mongolia, is 500,000 tonnes per year. This is more than double the curiously modest national target of 100,000 to 200,000 tonnes by 2025 as part of China's hydrogen plan released in March 2022. The modesty belies the scale and number of credible Chinese electrolyser projects announced.

The race to competitively priced green hydrogen presents opportunities for both Australia and China to innovate and collaborate.

6. Martin Tengler, ''Green' hydrogen set to get cheaper than natural gas', BloombergNEF (online, 7 April 2021).
7. Martin Tengler, 'Green hydrogen to start undercutting blue by mid-2020s', BloombergNEF (online, 18 November 2021).

CASE STUDY – PERTH AND PEEL HYDROGEN CLUSTER

How to build a hydrogen industry: collaborative 'clusters' accelerate growth

"We need a far more coordinated way of developing Australia's hydrogen capabilities and capacities, as well as promoting these to domestic markets and, importantly, to potential global customers." NERA

The city of Perth and the region of Peel stretching south of the Perth metropolitan region is home to one of 18 hydrogen clusters that have emerged across Australia since February 2021. The Perth and Peel Hydrogen Cluster aims to help facilitate the establishment of a hydrogen ecosystem, bringing together hydrogen producers, service providers, government and industry bodies and academics to fast-track innovation and development.

Its 15 members include Murdoch University, the City of Mandurah, hydrogen producer ATCO, energy solutions provider Balance and engineering consultant BMT. Another is ASX-listed technology developer Hazer Group, which is developing a low-emission hydrogen process backed by ARENA.

The cluster is also investigating the potential use of renewable hydrogen in green steel and metals production in nearby heavy industry areas, including in the emerging battery metals industry.

It is currently undertaking a proof-of-concept study into the potential establishment of a WA Hydrogen Innovation Precinct. The precinct would enable the co-location of national and international industrial research and development providers, hydrogen start-ups and small-to-medium enterprises to undertake research, testing, demonstration and early-stage commercialisation of their hydrogen technologies and products.

The cluster does not currently directly collaborate with Chinese counterparts; it feeds its regional observations and learnings into the national group which then connects globally. However, it has presented to trade commissioners ahead of postings offshore, including to China, and supported hydrogen start-ups with an interest in foreign investment.

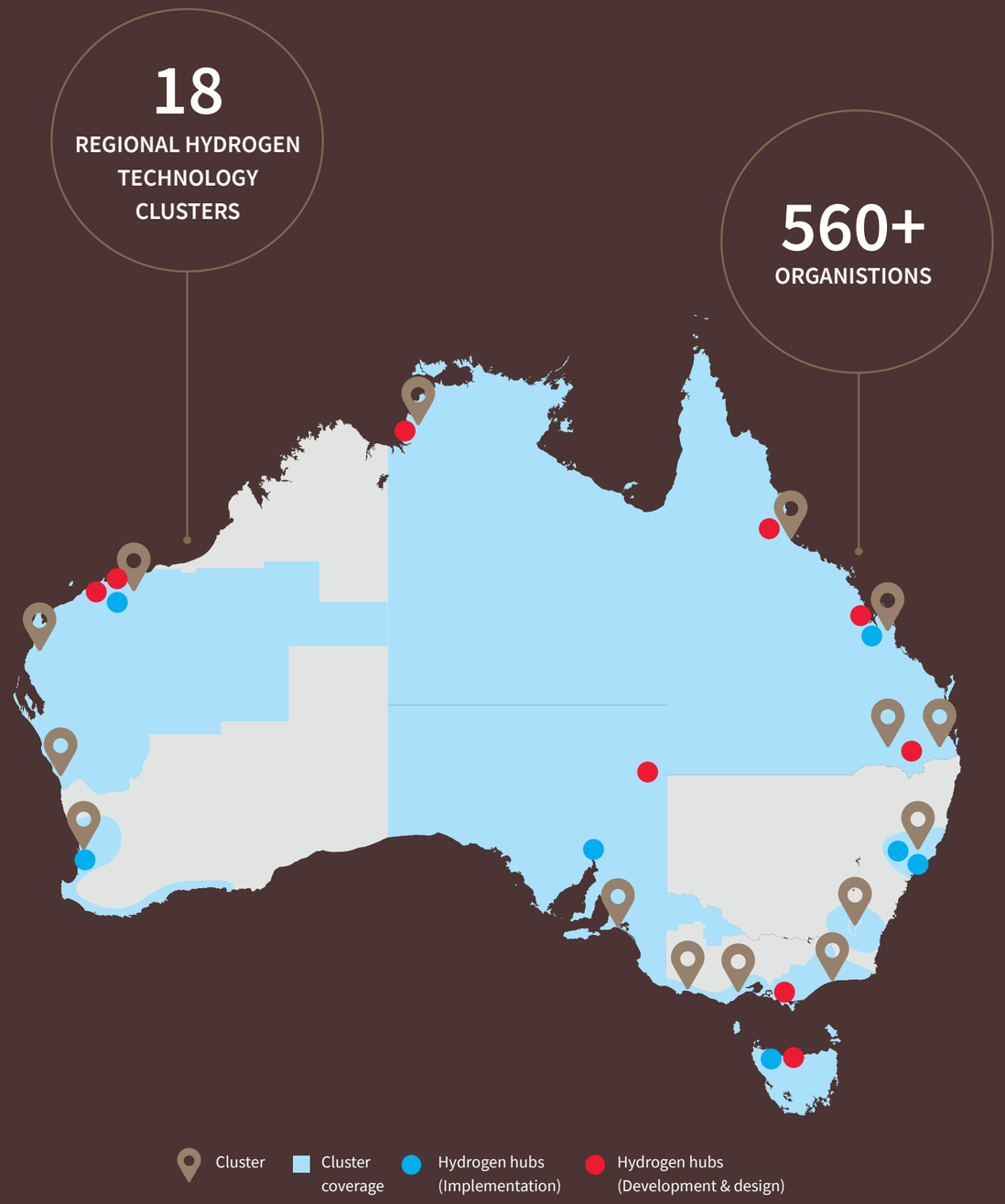
The hydrogen technology clusters are driven and seed-funded by National Energy Resources Australia (NERA), which is focused on supporting Australia's energy transition across the value chain.

There is a higher purpose for the clusters, and it speaks to Australia's broader ambitions: not only exporting hydrogen molecules, but also knowledge, skills and technologies. The clusters are exploring collaborative projects offshore, including with the hydrogen industry in Germany, Norway, France and the UK.

There are hydrogen clusters globally, including in Europe (via the European Cluster Collaboration Platform). China has several, including the Beijing-Tianjin-Hebei region fuel cell vehicle (FCV) city cluster led by Beijing Municipal Government. The cluster aims to build a globally significant hydrogen demonstration region, creating an industrial value chain of over 10 billion yuan per year.

THIS PRESENTS THE CHANCE FOR NATIONS TO DO MORE, TOGETHER.

Building one coordinated network across Australia: NERA's H2TCA



Source: National Energy Resources Australia (NERA), 2022

IS THERE A ROLE FOR CAPTURING CARBON?

Coal and gas fired power plants still supply most of the energy in Australia and China. Even in some of the more aggressively-renewable modelled scenarios, gas and coal continue to form part of the energy mix up to and beyond 2050.

To achieve net zero emissions within that timeframe means that both countries will not only need to shift to cleaner sources of energy and improve efficiency but take active steps to remove emissions as well. This makes carbon capture, utilisation and storage (CCUS) technology an essential part of the solution. CCUS is the process of capturing CO_2 from industrial activity before it enters the atmosphere, then transporting and storing it, typically in deep geological formations, or potentially using it.

Investment in CCUS **accounts for less than 0.5% of global investment** in clean energy annually, but renewed enthusiasm has emerged in China, Australia and elsewhere as national policy moves in its favour. This is despite the cost of retrofitting a coal-fired power station to capture carbon (around USD45 per tonne, globally averaged) and unsolved technical issues including the unproven sequestration of carbon in geological formations for long periods of time.

There is only one commercially operational facility in each jurisdiction: the Jilin Oilfield CO_2 project in China and 4MtCO2 Gorgon project in Australia.

This looks set to change. A post-combustion CCUS facility in Jinjie is approaching commissioning and Sinopec has begun constructing China's first 1 Mtpa CO2 project in Shandong Province. **Hebei Iron and Steel plans to build CCUS** demonstration projects at its steel mills. In Australia, **Glencore's CTSCo Project plans to store CO_2** from the Millmerran power station underground.

Utilising captured CO_2 as an option, or supplement, to long-term storage can also play a role in the transition to net zero. It can enhance oil recovery to create synthetic fuels for chemicals, displacing fossil fuels in the short term and providing an additional revenue stream to support the commercialisation of carbon capture.

The key challenge lies in creating conditions to support substantial investment in large scale CCUS. Initiated as a means to reduce the carbon footprint of fossil fuel power plants, the longer-term hope is its potential in removing carbon from the atmosphere.

CASE STUDY- DIMER TECHNOLOGIES

Hydrogen processing and CCUS for heavy industries

"We have to showcase this in a real factory, showing not only a technology in the lab. That's commercialisation. We have to make it industry ready and commercially wise." Dr Ming S Liu, DIMER Managing Director

Gas technology company DIMER (a scientific term referring to the combination of two molecular units) was spun out from Australia's CSIRO and universities in 2012. Its Melbourne and Tianjin based teams work on a range of projects, including tail-gas treatment, hydrogen production and processing, carbon capture and utilisation, and the development of renewable power-to-gas co-generation 'smart' microgrids.

However, it is its solution to capture CO_2 for conversion into useful chemicals that Australian co-founder and scientist Dr Ming Liu hopes will create the biggest ripple effect industry-wide.

DIMER has developed a state-of-the-art gas technologies for the capture of greenhouse gases, hydrogen recovery and processing and power-to-gas. By adding hydrogen, captured CO_2 can undergo a chemical reaction to produce methane (widely used including to make fertilisers, fuels and plastics) or methanol (used in the production of chemicals such as formaldehyde and aromatics).

The challenge for DIMER in Australia has always been finding corporate partners to apply the technology to real industry settings. In 2015 it found that partner in China through Sinopec, the world's largest oil refining, gas and petrochemical conglomerate.

At Sinopec-Tianjin Refinery, DIMER has successfully demonstrated the industrial hydrogen processing and carbon capture technologies. Now it is working with Sinopec to design and build two hydrogen recovery and CO_2 capture plants for the treatment of about 20,000Nm3/h tail-gas, as part of Sinopec's flagship blue hydrogen and CCUS projects.

Through this collaboration, DIMER is helping SINOPEC reduce emissions and create hydrogen-based clean energy. DIMER has also started working closely with other petrochemical and chemical companies including one of the largest manufactures of alcohol-ether products globally, the coal-chemical subsidiary of China Energy Group.

CHINA'S CARBON-FREE NUCLEAR POWER AND AUSTRALIAN URANIUM

Unlike Australia, China has a mature, well-accepted fleet of nuclear power projects.

China plans to spend USD440 billion on 150 new build nuclear projects in the next 15 years, more than the rest of the world has built in the last 35 years.[8]

China's new fleet will likely take the form of fourth generation, small modular reactors (SMRs). SMRs can generate **up to 300MW each**. By contrast to larger, older reactors, they are capable of prefabrication for on-site installation. Their safety systems also rely more on passive systems than the active systems of older reactors. No human intervention or external power is required to shut them down.

These units also use an innovative new spherical ceramic-coated fuel cell delivered as part of an air-cooled pebble-bed reactor.

China **activated the first demonstration SMR units** in Weihai, Shandong Province in December 2021 under a China Huaneng, Tsinghua University joint venture.

Australia has around **one third of the world's uranium resources** and is the world's third ranking producer. There is obvious potential for research and collaboration on the value-added production of pebble-bed fuel cells and finding incremental export markets, like China, for Australia's extensive reserves of uranium.

WHAT NEXT?

The transition from fossil-fuel to renewables in the energy generation sector is well underway. Renewables - especially solar and wind - will carry much of the shift to net zero, but they cannot do it alone. A burgeoning green hydrogen industry and a multitude of scientific endeavours to turn captured carbon into productive goods or store it long-term are all part of the complex landscape.

Transmission, distribution and storage will also play critical roles.

While technology will enable the energy shift, it cannot carry the burden alone. Policy must support and drive change, facilitate investment, incentivise research and foster innovation lowering the relative costs of alternatives.

For this reason, innovation in policy – not just technology – requires consideration. There are already examples of this, including China's guidelines requiring storage capacity in renewable energy projects of between at least 5% to 20% depending on the province.

Strengthening cooperation to bring commercial and environmental benefits the region

The Chinese and Australian energy transitions are each of global importance and in different stages of development. There is no shortage of opportunities to capitalise on Australia's rich natural and renewable resource endowments to play a key role in the clean energy transition.

What is increasingly clear, however, and what is being demonstrated in many current projects, is that both countries have much to learn from each other.

A bilateral dialogue on climate change and energy would make a worthy starting point. This could cover renewable energy policy development, investment guidelines, joint research in cutting edge technologies and innovation, knowledge transfer and supporting other countries in the region to adopt similar measures.

A government-to-government green economy agreement in some form with China could form a solid foundation for greater collaboration across all aspects of the economy.

8. Dan Murtaugh & Krystal Chia, '**China's Climate Goal Hinge on a $440 Billion Nuclear Buildout**', Bloomberg (online, 3 November 2021).

CHAPTER

3

MINING AND FUTURE-FACING INDUSTRIES

Surging demand for exports of iron ore, coal and minerals over the last three decades, much due to China's growth, has brought significant wealth to Australia.

That demand continues apace but there is a growing realisation that Australia must increase export sophistication.

Adding value to extractions, mining the future-facing minerals needed for clean energy and electrifying mining operations are all part of the sector evolution. The production of critical materials like steel and cement is undergoing a low-carbon transformation.

Australia's brightest opportunities are in developing new industries, knowledge, services, products and production methods to serve a net zero world.

The mining sector remains one of the most significant drivers of the trade relationship between China and Australia. Combining forces to reduce the carbon footprint of the ultimate outputs offers potential for productive collaboration.

There is no ignoring the geopolitical context in which decisions are made around investment, capital allocation, technology sharing, joint research and collaboration. Yet there is a need to balance this with the recognition that one of the biggest single challenges to achieving our net zero ambition is the coordination of effort.

In this chapter, we highlight opportunities for collaboration in the mining and resources sector's global decarbonisation efforts, and in moving Australia's economy up the complexity ladder.

THE TRANSITION TO FUTURE-FACING MINERALS

FUTURE-FACING MINERALS

including copper, nickel, cobalt, lithium and potash

EMERGING TECHNOLOGIES

including EVs, renewable energy products, low-emission power sources and decarbonising technologies use future-facing minerals as inputs

DEMAND IS RAPIDLY INCREASING

placing intense pressure on supply chains

China produces 70% to 80% of the world's future-facing minerals. It is also the dominant supplier of a range of technologies which use future-facing minerals as inputs, including smartphones, EVs, rechargeable batteries, solar panels and computers.

For its part, Australia has some of the world's largest reserves of these minerals, including chromium, cobalt, copper, lithium, nickel and rare-earth minerals. Australia has a category one (high) resource potential in future-facing minerals based on Geoscience Australia's rating system.

Australia's 'shovel-ready' status and China's maturity in the future-facing minerals market raise substantial collaboration prospects between the two countries in the effort towards global decarbonisation.

By drawing on the skills, capital and advanced manufacturing practices in countries such as China, Australia has significant opportunities to convert its abundance of mineral reserves. This includes the domestic refining of future-facing minerals and manufacturing capacity for emerging technologies.

CASE STUDY – TIANQI LITHIUM

Bringing Chinese experience to lithium mining in Australia

"Tianqi's first-of-its-kind lithium hydroxide plant demonstrates Western Australia's capacity for downstream processing in the battery value chain. [We are] committed to making sure Western Australia capitalises on its potential to be a world-leading producer of battery-grade materials." Bill Johnston, WA Mines and Petroleum Minister

Tianqi Lithium Energy Australia (TLEI) is a joint venture between one of the world's top producers of lithium chemicals for EV batteries, Tianqi Lithium Corporation (51%), and Australian miner IGO Limited (49%).

TLEI established the first lithium hydroxide plant in Australia, which is now the largest processing plant in the world to be built and operated outside of China. The plant has a total capacity of 48,000 tonnes per annum and an operating staff of around 200 people.

In May 2022, almost a decade since the JV was established, TLEI produced its first batch of battery-grade lithium, marking the first-time that battery-grade lithium (lithium hydroxide monohydrate) has been produced in Australia in commercial quantities.

This was hailed as a significant milestone for Australian mining as the sector expands to meet rapidly growing demand for rechargeable batteries, primarily from the EV and renewable energy storage system industries. TLEI will export lithium hydroxide produced at the Kwinana Plant to customers around the globe.

DECARBONISATION OF MINING OPERATIONS

The mining sector also has a role to play in reducing emissions in its own operations. The mining industry is increasingly committed to a low-carbon future across the value chain and a shared sense of responsibility. Company-specific targets have accelerated industry action.

AUSTRALIA

50% of resource companies identified in a report had decarbonisation commitments aligned with net zero by 2050

- BHP, South32 and Rio Tinto have each set a target of net zero Scope 1 and 2 emissions by 2050
- Fortescue Metals Group Ltd (FMG) is targeting carbon neutrality in its operations by 2030 and net zero Scope 3 emissions by 2040

Source: ClimateWorks Australia with the Monash Sustainable Development Institute, Net Zero Momentum Tracker: Resources Sector, Dec 2020

CHINA

There are similar industry targets and a focus on reducing emissions in the steel making and aluminium sectors

- Steelmaker China Baowu has committed to carbon neutrality by 2050 with a target of peak emissions as early as 2023
- Steelmaker HBIS Group has committed to carbon neutrality by 2050 and peak emissions by 2022
- Aluminium Corporation of China Limited (Chalco) has committed to reducing carbon emissions by 40% by 2035 and is targeting peak emissions prior to 2025

SIGNIFICANT INITIATIVES AND PARTNERSHIPS:

Onsite solar farms and battery storage systems

- BHP has partnered with Canada-headquartered TransAlta to build two large-scale on-site solar farms and a battery storage system to help power its Nickel West mines
- BHP has a Power Purchase Agreement with China-based company Risen Energy for the production of solar energy at the Merredin Solar Farm and another with Enel Green Power for the production of wind energy at the Flat Rocks Wind Farm
- FMG's Chichester Hub operations are powered by a 60MW on-site solar farm following the completion of its Solar Gas Hybrid Project with Alinta Energy in late 2021

Shipping and 'green corridors' between ports

- Star Bulk Carriers Corp, Oldendorff Carriers, BHP and Rio Tinto have joined a Global Maritime Forum-led consortium to "assess the development of an iron ore green corridor between Australia and East Asia", to facilitate a net zero maritime future between major ports

Low-carbon processing

- China Baowu has partnered separately with both BHP and Rio Tinto to reduce its carbon footprint by, for example, looking at low-carbon steelmaking technologies, the use of hydrogen, and the potential for a CCS project at one of Baowu's largest production sites

Reducing reliance on diesel

Electrifying the haulage fleet or using hydrogen or biofuels has the potential to remove up to 40% of a site's emissions according to some estimates. Additional benefits would include significant reductions in diesel costs, the potential for better health and safety, and new jobs from transmission infrastructure, servicing and maintenance.

The development of advanced technologies and an increasing willingness of mining companies has resulted in promising projects and collaborations in the transition to EVs such as CORE Innovation Hub. Australia's first co-working technology and innovation hub, CORE is focused on the energy and resources sector and is providing start-ups, SMEs and industry partners with a platform to collaborate and connect on challenges and opportunities across the industry.

- Major Chinese construction machinery manufacturer, XCMG, successfully delivered 12 100-tonnage electric drive dump trucks to Australia in 2019, the first of their kind designed for mining
- Inner Mongolia North Hauler Joint Stock, a major Chinese mining truck manufacturer, began shipping large-scale battery-electric mining trucks out of China to Yancoal in Australia in May 2021. Approximately nine out of a planned 28 vehicles have been assembled at the Mount Thorley Warkworth coal mine and are undergoing commissioning tests

CASE STUDY – CHARGE ON INNOVATION CHALLENGE

Mining industry's collaborative push for solutions

Diesel-powered haul truck fleets are responsible for up to 80% of a mine's emissions. Electrifying them requires charging systems capable of delivering energy at unprecedented power levels during operations.

This problem prompted the Charge On Innovation Challenge. Launched by BHP, Rio Tinto and Vale in 2021, the challenge aims to accelerate commercialisation of effective solutions for charging large electric haul trucks. It simultaneously demonstrates the desire to collaborate and an emerging market for these solutions in mining.

The challenge invited vendors and technology innovators from around the world and across industries to work with the mining industry on novel electric truck charging solutions.

Initiatives include Ampcontrol and Tritium (Australia) working on a battery swap solution and 3ME Technology on safe, scalable, remotely monitored, reliable battery systems.

The innovators are collaborating with interested mining companies, original equipment manufacturers and investors to accelerate the technology development to support the future roll-out of zero-emissions fleets.

"As the transition to clean energy accelerates, we'll need huge quantities of critical minerals – the minerals needed to electrify transport, build batteries, manufacture solar panels, wind turbines, consumer electronics, and defence technologies. That's where Australia can help. Compared to other major critical mineral suppliers such as China, we're lagging."

Mohan Yellishetty, Monash University
Associate Professor, in Monash Lens

GREEN STEEL AND OTHER HARD-TO-ABATE INDUSTRIES

Producing arguably the single most important resource when it comes to infrastructure, the steel industry faces great challenges in balancing increasing demand against its drive to meet global climate goals.

Iron and steel represent 7% of emissions from the total energy system according to the IEA. This is more than global road freight emissions, and comprises the largest proportion of global CO_2 in the industrial production sector.

The global steel industry is aiming to reduce its emissions by at least 50% by 2050, with continuing declines towards zero-emissions.

The decarbonisation of steel is extremely difficult and costly. Blast furnace-basic oxygen furnace is the conventional carbon-intensive and most widely used steelmaking process. The Global Energy Monitor estimates the process is behind 60% of global capacity, yet switching from using metallurgical coal as a reductant to using zero-carbon electricity reduces emissions by only 7.4%.

The industry's decarbonising hope lies more in 'green steel': partially substituting metallurgical coal in the process with hydrogen.

The use of hydrogen can cut up to 21.4% of carbon emissions per tonne of steel. Together with zero-carbon electricity, this can abate up to 28.8% of carbon emissions.

Green steel is one of the most advanced net zero options for steelmaking that does not use CCUS. This and other new low-emissions steelmaking initiatives are emerging and maturing. If pilot and demonstration phases prove successful and projects reach commercial scale, the industry will shift closer to major decarbonising breakthroughs.

- BHP has signed a five-year Memorandum of Understanding (MOU) with China Baowu and a three-year MOU with HBIS Group to support the development and operation of low-carbon steelmaking technologies, including the use of hydrogen, blast furnace technologies, CCUS and direct reduction technologies
- FMG, through its Fortescue Future Industries (FFI) business, is moving towards the total decarbonisation of its operations by 2030 using products such as renewable green hydrogen and green ammonia
- Rio Tinto has partnered with the University of Nottingham's Microwave Process Engineering Group to progress its development and research of the use of sustainable biomass to replace coking coal in the steelmaking process. The project has moved into large-scale testing phases. If successful, there is potential for the technology to reach commercial scale

URGENCY NEEDED IN THE GLOBAL INNOVATION RACE

Innovation runs deep in Australia's mining, energy and resources sectors. Building on this DNA, Australia has an opportunity to establish itself as a leader in the future-facing minerals market and reduce its reliance on the export of bulk, largely unprocessed, commodities.

Recovery from the pandemic provides the opportunity for a transformative agenda that supports greater economic complexity and new export industries, fit for the challenges ahead.

Australia must base its efforts on its own capabilities and realities, but remain open to collaboration.

There are issues around supply chain resilience and sovereign security. However, as our case studies demonstrate, there remain mutually beneficial strategic partnership opportunities for Australian companies to work with established Chinese partners to secure sustainable, innovative and reliable technologies for a global clean energy future.

TRANSPORT AND MOBILITY

Transport is among the most emissions-heavy sectors. In 2019 the sector represented 23% of global energy-related emissions according to the 2022 Intergovernmental Panel on Climate Change (IPCC) Mitigation Report[9].

The vast majority (70%) came from road vehicles, another 11% from shipping, 12% from aviation and just 1% from rail.

Decarbonisation paths vary dramatically. For passenger and light-duty transport the consensus is clearest: electrification using lithium-ion batteries. For shipping and aviation, the longer asset life-cycles, longer distances and heavier loads create a challenge.

Opportunities to collaborate exist sector-wide. Australia can learn about operational structures, ownership and maintenance of electrification infrastructure at mass scale from world-leading China.

EVs and charging provide rich opportunities for China and Australia to work together, particularly as Australia prepares for new policies to accelerate take-up and build charging infrastructure. From manufacture and supply to managing a grid powered largely by variable renewable energy; via university-level information exchanges on new technology innovations and business partnerships.

Global supply chain issues pushing up prices of the critical minerals and metals that are inputs for EVs and other clean energy technology are only sharpening the need to collaborate. Batteries, vehicles, marine, aviation: all are industries undergoing change, bringing new opportunities to invest and lead in.

For heavy-duty and long-distance transport, there is a focus on the future potential of power sources such as green hydrogen, methanol and biodiesels.

“Transition to electric cars is not a car problem, it’s an electricity infrastructure problem. The biggest opportunity for collaboration in electrification is knowledge sharing and skill swaps on electrification infrastructure.”

Tim Washington, JET Charge CEO

9. M. Pathak, R. Slade, P.R. Shukla, J. Skea, R. Pichs-Madruga, D. Ürge-Vorsatz, 2022: Technical Summary. In: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.002

CASE STUDY – VIVA ENERGY

Biofuels, blends and beyond: The mixed fuel future

"We've always viewed it from a diverse fuel perspective. A lot of the technologies are not commercially viable at this stage. We strongly believe there'll be a mix of fuels and technology for the future. Customers need to know, whatever the drivers are that affect the production of that fuel, the fuel will be there. China has the population to drive demand and evolution." Sandra Lau, Viva Energy Alternative Fuels Manager

Viva Energy supplies roughly a quarter of the fuels used in Australia. Beyond fuels, it also refines and imports lubricants, solvents and bitumen.

Viva Energy has committed to reducing its Scope 1 and 2 emissions and has a number of initiatives in the new energies sector to supply lower-carbon fuels to the market in the future including a focus on hydrogen.

Geelong, the location of its 120,000 barrel-a-day oil refinery, is where Viva Energy is advancing its hydrogen refuelling infrastructure and vehicle deployment, taking concepts from demonstration to commercial applications. Partnering with the operators of significant fleets of heavy vehicles, such as Toll, Cleanaway, CDC and others in practical and commercial applications, Viva Energy's public hydrogen refuelling station in Geelong is the most ambitious hydrogen mobility project in Australia.

The New Energies Service Station is due to start operations by 2024 and is backed by ARENA. It demonstrates the practical application of hydrogen-powered heavy vehicles in commercial fleets.

THE ROAD AHEAD FOR DECARBONISED TRANSPORT

EVs offer a commercially available and economically viable path to decarbonise passenger and light duty transport. In many markets, EV technology and charging infrastructure are now mainstream.

Passenger EV global sales

Source: *BNEF, Global Electric Vehicles 2022 Outlook*, BloombergNEF

Another key driver is the drop in the cost of lithium-ion batteries. In the early 2000s, the cost of a lithium-ion battery was around USD1,000 per kWh. This fell to USD137 per kWh, tantalisingly close to the tipping point where the upfront price of EVs achieves pricing parity with internal combustion vehicles – estimated at USD100 per kWh. Much of this cost reduction is due to China's co-ordinated supply chain ecosystem and innovations in advanced manufacturing processes.

The IEA has called for a redoubling of efforts to improve efficiency, innovate and scale technology to avoid total costs rising. It launched its own initiative to help ensure reliable supplies and suggested considering extending EV incentive schemes.

Lithium is mined in Chile, Argentina and Australia and lithium processing and battery manufacture is dominated by China.

Australia can increase economic complexity by developing its own battery manufacturing ecosystem. Coming together to learn from the recent past is a simple first step.

Lithium-ion batteries have emerged as one of the key technologies on which the new electrified transport sector depends. The primary cathode material is lithium, but the batteries also contain nickel, cobalt and manganese.

Advantages over other battery types such as nickel-cadmium include energy density, cycle life, calendar life and cost per kWh.

Knowledge-sharing and skill swaps

Australia plans to establish a AUD500 million fund to build on the nation's nascent EV charging network and invest in hydrogen highways for heavy transport. Promised tariff and tax exemptions will bring down the ticket price of EVs, encouraging market expansion beyond the lacklustre 1% of total vehicle sales in 2020.

China's electric recharging infrastructure is already at mass scale and growing. The government's goal is to have EVs make up 40% of the vehicles sold in the country by 2030 and by 2025 to have in place charging infrastructure to meet the needs of more than 20 million cars.

Massive capital investment and heavy government intervention have played a crucial role in helping the Chinese EV market to flourish, but China's experience offers valuable lessons for Australia.

There is room for China and Australia to collaborate on EV charging from a grid powered largely by a variable, renewable electricity generation source. Information exchange on bidirectional charging and the ability of EV owners to offer grid support services could occur at the university level, along with direct and powerful knowledge sharing between businesses.

The hydrogen edge for heavy-transport

China has a significant head start on Australia in decarbonising its bus infrastructure, in both electrified and hydrogen-powered buses. Australia can look to China for lessons learned. As for decarbonising heavy-duty, long-haul trucking, both China and Australia have a long path ahead. There is room to collaborate on a shared solution to a shared problem.

For buses, there are merits to both hydrogen and electric. The bus fleet for the Beijing 2022 Winter Olympic games was hydrogen-powered. The duty cycle of a bus brings it back to a refuelling depot regularly, reducing the need for a widespread hydrogen refuelling network relative to a fleet of long-distance heavy-haul trucks. One hydrogen refuelling station can service many buses.

By contrast, several cities in China have heavily committed to electric buses, preferring the lower upfront costs and tolerating the longer recharging cycle (four to six hours). Shenzhen, for example, has completely electrified its public bus fleet of more than 16,000 vehicles.

For heavy-duty, long-haul trucking, the economics of competing recharging and refuelling infrastructures may tend towards the emergence of a dominant technology rather than the co-existence of both. In this heavy-haul context, hydrogen fuel cells may have the advantage over electrified batteries.

Heavy-haul duty cycles make electrification more challenging, with longer charging times and the need for higher capacity charging points. Hydrogen fuel cells, green methanol and renewable diesel have a shorter refuelling time. Renewable diesel is hydrogenated vegetable oil, which is close to a drop-in fuel for diesel engines. The logistics of establishing a refuelling network for a new fuel, particularly hydrogen, are significant but once established may have a compounding effect.

The Queensland, New South Wales and Victorian Governments have committed to developing a hydrogen highway along Australia's east coast, providing funding to build essential infrastructure for long-haul transport.

There is much to learn from China's policy support for the supply and demand side in the green hydrogen economy.

CASE STUDY – JET CHARGE

The need for scale: expanding Australia's charging infrastructure

"The biggest opportunity is knowledge sharing and skill swap on the infrastructure problem. There are thousands of bus and fleet depots around Australia. We should be talking to authorities across China and asking: how did you do it? Did you have to move depots? What does your ownership and maintenance structure look like? Have you got solar and batteries on site? China is decarbonising transport at a scale that nobody in the western world can imagine. We should learn." Tim Washington, JET Charge CEO

Shanghai-born Australians Tim Washington and Ellen Liang are two of three co-founders of EV infrastructure company JET Charge, which launched in Australia in 2013.

The company has evolved from installing EV infrastructure to distributing hardware and creating software solutions that enable the proper and cost-effective integration of charging stations into the wider grid.

Washington sees the growth of charging stations in China as inspiration for Australia. Cities like Shenzhen have moved to 100% electric buses and taxis. He wants to see information exchange in both directions, around bi-directional charging, mineral resources and extraction, decarbonising grids, battery recycling and more.

A former corporate lawyer, Washington's business began as an electrical apprenticeship of sorts: installing charging stations for Tesla alongside one of his co-founders, electrician Jay Robinson. The co-founders took their idea to vehicle manufacturers and have become the partner for all 21 brands importing EVs into Australia, from Volvo to Porsche to Jaguar.

Within five years of starting, JET Charge seized a gap in the market and co-founded Chargefox, Australia's largest EV charging network, including a network of ultra-fast charging stations powered by renewable energy.

To Washington, the transition to EVs is not a car problem – it's an infrastructure, energy and finance problem.

CASE STUDY – FOTON MOBILITY

Chinese technology deployed to solve Australian transport emissions

"Two hydrogen city buses arrived in Australia in July for a customer. There are more than 1,100 units running in China. This is a legacy of the 2022 Beijing Winter Olympics – it's the same one used in the Games. We are working with multiple universities, researching different topics, which will help the whole hydrogen industry move forward." Neil Wang, Foton Mobility Australia CEO

Since 2016, Foton Mobility Australia's CEO, Neil Wang, has worked to bring hydrogen-powered buses to Australia. Foton Mobility is the Australian licensee and importer of Chinese hydrogen bus technology.

Hydrogen buses take 10-15 minutes to refuel and their natural route returns them to the depot regularly, avoiding the need for a widespread hydrogen fuelling network. This makes them best suited to short travel windows, where there is back-to-base support – like city buses.

Depots can house their own hydrogen electrolyser, build a hydrogen gas storage station for delivered supplies, or refuel buses directly from a hydrogen supply truck. In each scenario, the hydrogen is delivered in gas form.

Foton Mobility uses its own control logic technology to draw power from fuel cells manufactured by a joint venture between Toyota in Japan and SinoHytec in China.

The co-benefits of hydrogen-powered buses include less air and noise pollution, but the economics must be sufficiently compelling to draw operators away from traditional diesel-powered buses.

Among the challenges for Foton in Australia is the shortage of labour and lack of familiarity with the hydrogen buses and their components. Education is another critical area of collaboration to meet future industry demand.

CROSSING THE OCEANS

More than a quarter of the world's container traffic moves through China's ports. Yet finding a carbon free path for shipping is not peculiar to China: it is a global challenge presenting many opportunities.

The International Maritime Organization (IMO) issued its greenhouse gas strategy in 2018. While riverine and short-distance coastal shipping might transition to electrification, long-distance shipping will need carbon-free liquid fuels like green hydrogen or green ammonia.

Ammonia and hydrogen are not 'drop-in' fuels that can be introduced to existing diesel-engine vessels. Ports would need to be equipped with ammonia- or hydrogen-storage facilities to refuel vessels. There are also barriers that ammonia will need to overcome before it can become a mainstream maritime fuel, such as its toxicity and NOx emissions. The world's first ammonia-ready vessel, a Suezmax tanker of about 160,000DWT was constructed at a Chinese shipyard and delivered in early 2022. But this is an outlier for now: in the near-to-medium term a large-scale switch from diesel engines in vessel fleets with long lifecycles seems unlikely.

Another alternative is green methanol, which does not have ammonia's challenges with safety and NOx emissions. Green methanol is based on green hydrogen and biomass, biogas or atmospheric CO_2 and is closer to a drop-in fuel than ammonia or hydrogen.

Decarbonising vessels

AMMONIA
- Not a 'drop-in' fuel
- Requires storage facilities
- Toxic
- NOx emisisons

HYDROGEN
- Not a 'drop-in' fuel
- Requires storage facilities

GREEN METHANOL
- Closer to a 'drop-in' fuel
- Based on biogas

LNG
- Not zero carbon
- Transitional fuel

CASE STUDY – ABEL ENERGY

Betting on green methanol as a future fuel and chemical feedstock

"Plastics, paint, pharmaceuticals, adhesives, textiles, carpet. If it's not metal or glass, it's typically made from hydrocarbons. We have to find a way of making these things without fossil carbon or gas, and green methanol is the ideal feedstock. It won't be a dark horse for much longer." Michael van Baarle, ABEL Energy CEO

Green methanol is a clean-burning fuel for shipping and industrial vehicles. Liquid in form, it's not hard to convert engines. Tanks holding it in ships can take any shape and only need filling three to four times a year. It is also an important industrial chemical.

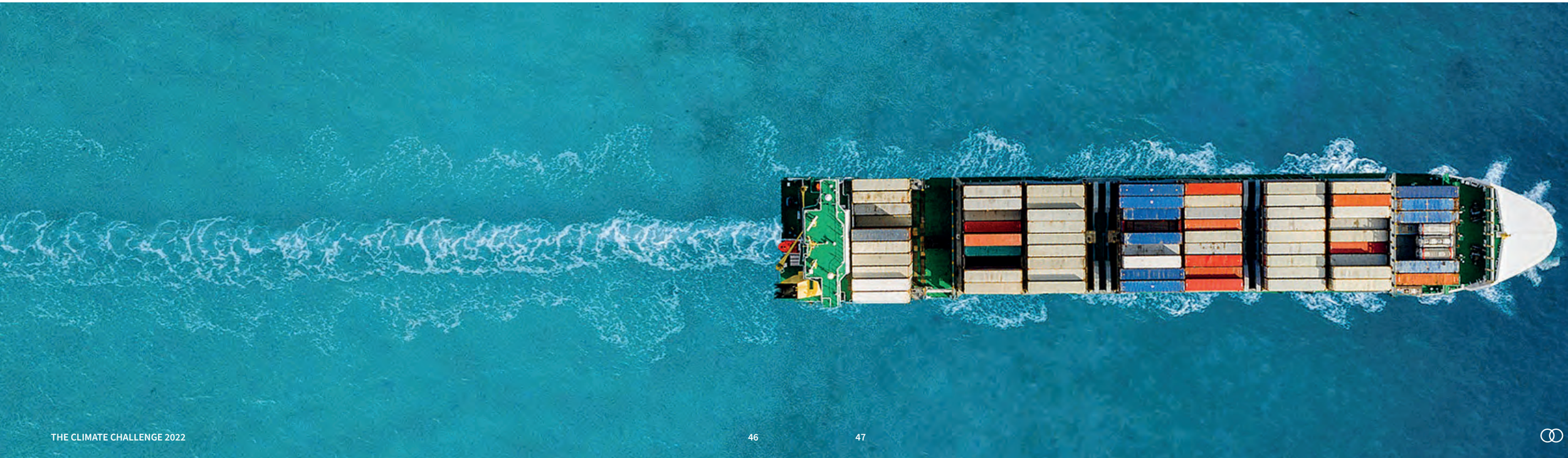
ABEL Energy is an Australian company focused on developing clean synthetic fuels; chiefly green methanol but also green hydrogen and other hydrogen-derived fuels.

Demand from the shipping industry is driving ABEL Energy to advance the production of green methanol as quickly as possible. Collaborating with manufacturers of engines, fuel cells and turbines, ABEL Energy is building its first green hydrogen and methanol project in Tasmania, using hydro and wind power. The goal is to produce roughly 200,000 tonnes of green methanol per year from 2025, much of it destined for export markets. Some will go towards domestic use, including a small plant producing renewable dimethyl ether from methanol for the local LPG industry.

ABEL Energy is exploring taking it further: converting carbon dioxide from the atmosphere into green methanol rather than the conventional use of biomass or biogas. ABEL Energy is working with a local partner which has technology for direct CO_2 capture.

The potential benefits go beyond fuels for long-haul transport and mining machinery. When used as a feedstock to make hydrocarbons, green methanol reduces the greenhouse gas intensity of a vast range of things we rely on.

In China, the widespread use of conventional methanol has led to much related technology development and it is an area ripe for collaboration.



AVIATION IS ONE OF THE MOST DIFFICULT-TO-ABATE SECTORS.

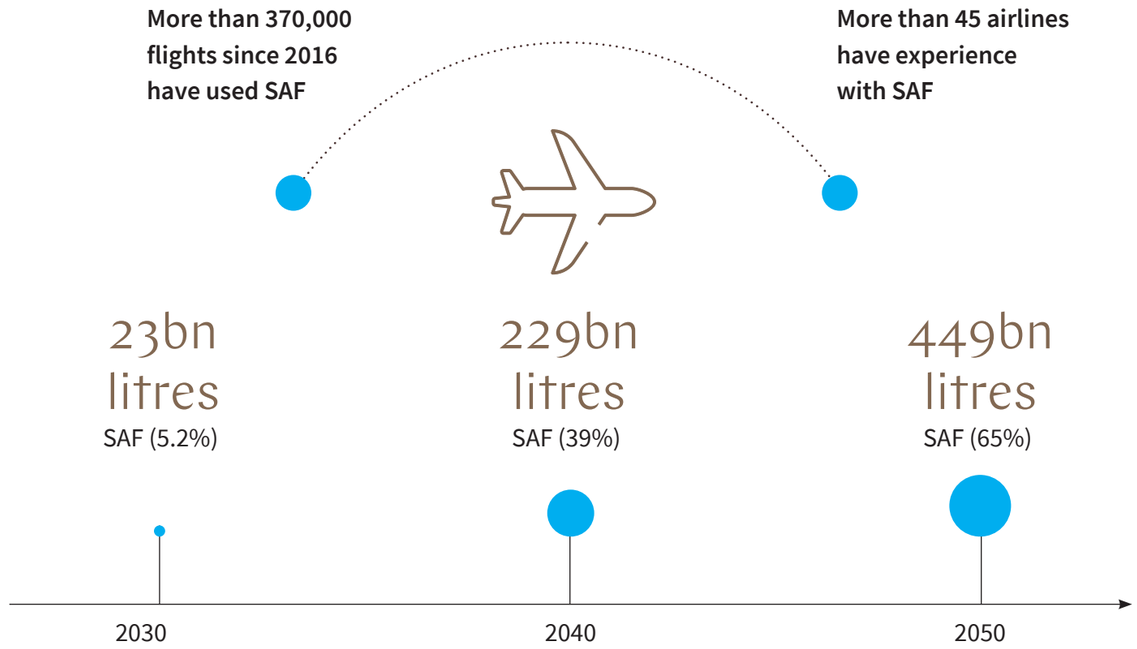
For short-haul flights, there is the prospect of battery electric planes. In China, this would need to work hard to compete with its over 40,000km high-speed rail network which has grown at an incredible rate using Australian iron ore. China is home to almost 90% of the new high-speed rail lines built over the past ten years, making up over 70% of the world's total today. Lines are being developed now through to Laos, Thailand, Malaysia and ultimately, Singapore, electrifying passenger and freight train transport.

For international, long-haul flights the solution is harder. There is a strong dependency on fuels that have the same high gravimetric and volumetric density as liquid hydrocarbons. Aviation airframes and engines have long lifespans, effectively 'locking-in' carbon intensity until the fleet is recycled with lower carbon solutions.

The more immediate focus is on switching to Sustainable Aviation Fuels (SAFs). Certified blends involve mixing traditional aviation fuel with bio-based SAFs derived from feedstock such as cultivated crops, waste fats and municipal wastes.

These bio-based SAFs are currently up to 3 times the cost of kerosene-based aviation fuel, but airlines are betting their customer base will accommodate this higher-cost given the benefits. SAFs aside, there is an expected year-on-year reduction in emissions of about 1.3% due to engine and airframe manufacturers prioritising the reduction of fuel burn.

Moving towards SAFs

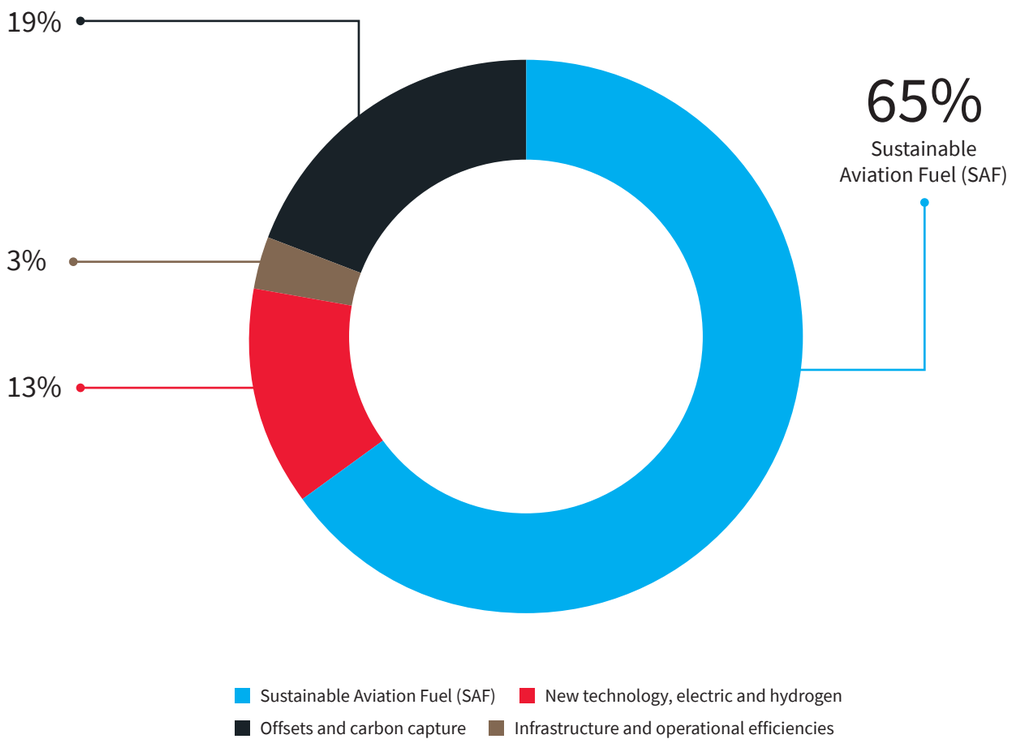


Source: IATA

In the longer term, SAF will need to occupy a much higher proportion of the fuel blend. BloombergNEF projects its use will need to reach 18% of total aviation fuel by 2030 and (depending on the energy mix) between 39% and 95% by 2050.

The aviation industry is tackling the challenge collaboratively. In October 2021, around 290 airlines that are members of the International Air Transport Association (IATA) committed to achieving net zero carbon by 2050 under the campaign 'Fly Net Zero'. Most of the gains are from the switch to SAFs, but new technology, operational efficiencies and offsets will also play a part.

How airlines will Fly Net Zero by 2050



Source: IATA

WHAT NEXT?

THE TRANSPORT AND MOBILITY SECTOR IS ONE OF DRAMATICALLY DIFFERENT PATHS.

There are some quick wins. The increasing electrification of passenger vehicles and the charging infrastructure to enable longer journeys. The hydrogen buses, which are already widely used in China.

There are also some slow and difficult wins which will carry significant logistics challenges. This is especially the case in long-haul trucking, shipping and aviation.

Australia can play a meaningful role by working on solutions over the coming decades. The abundance of renewable energy sources brings a competitive advantage to utilise the surplus to produce new fuels and address harder challenges.

Australia could also lead in the education space, training the world's best technicians and engineers across the sector.

What is critical is the need to re-engage in constructive dialogue about how Australia can contribute to the global challenge. Joining Australian innovation with China's scale and speed would bring much needed new solutions to market in both countries and the region.

CHAPTER

5

GREEN CITIES

More than half of the world's population lives in urban areas, a number projected to rise to 70% by 2050. The greening of our buildings and cities is critical in the pursuit of a net zero economy.

Urban centres generate around three-quarters of CO2 emissions of global final energy use. The 100 highest emitting urban areas contribute around 18% to the total global carbon footprint.

Consistent with these global trends, China and Australia have growing urban populations and a need to significantly reduce emissions to meet net zero targets. Modern major cities and economic development zones present opportunities for increased sustainability measures and outcomes, and new green city solutions.

Green cities exist on a continuum, ranging from purpose-built eco-cities to existing larger cities that are taking substantial steps towards ecological sustainability and intergenerational equity.

There is more to green cities than rooftops featuring plant life and beehives. Structure is important. Research indicates that co-located medium-to-high density housing and commerce, a high mix of land use and connectivity of streets are correlated with lowered greenhouse gas emissions. Urban infrastructure is similarly important, identified by the IPCC[10] as one of four systems requiring fundamental and transformative change to limit global warming.

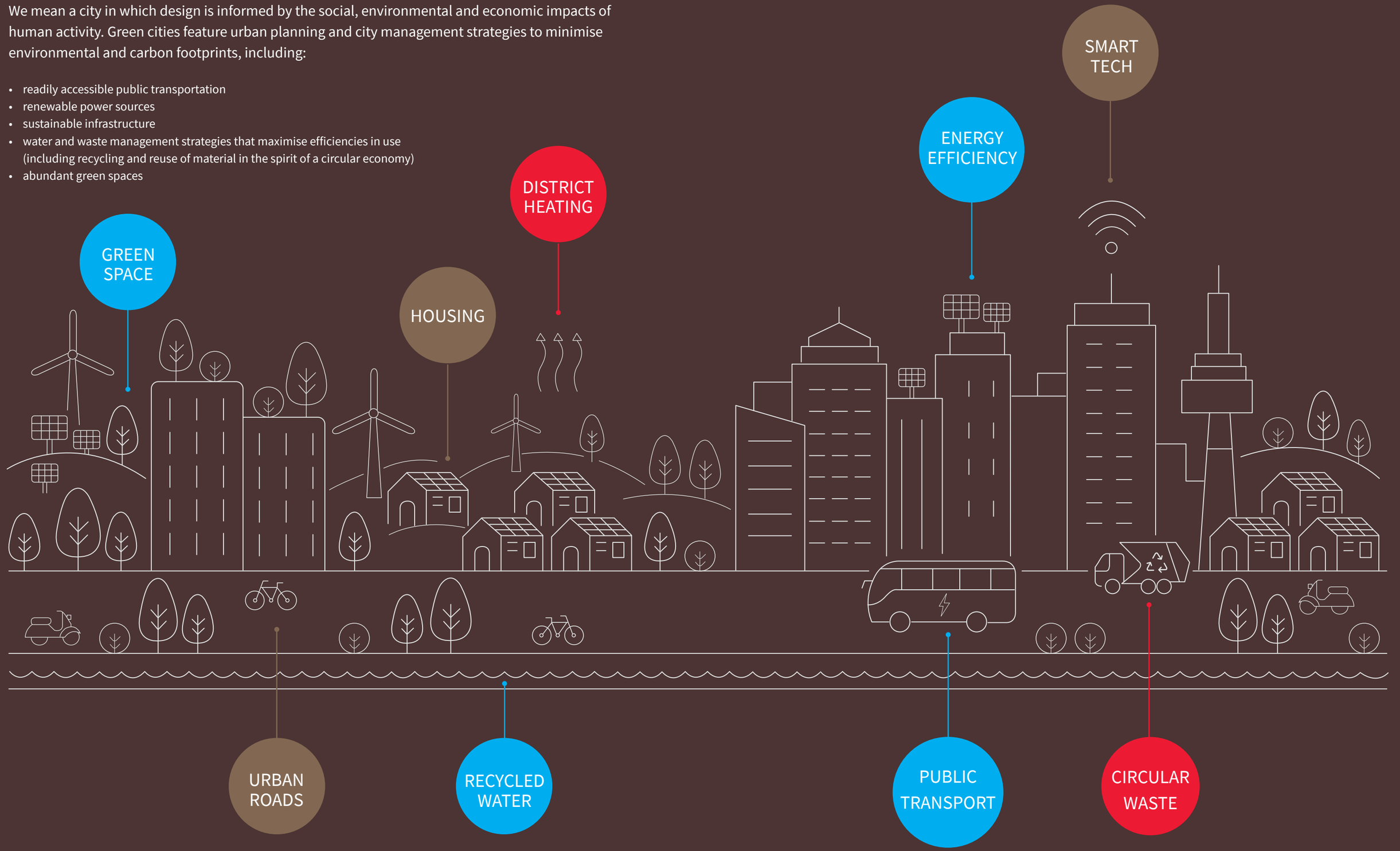
There is also more to it than the everyday functioning of our cities. The way significant events like Olympic Games are held brings an opportunity to introduce a step change in a city's infrastructure and venues – and to set an example for those to follow.

10. M. Pathak, R. Slade, P.R. Shukla, J. Skea, R. Pichs-Madruga, D. Ürge-Vorsatz,2022: Technical Summary. In: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.002

When we say ‘Green City’ …

We mean a city in which design is informed by the social, environmental and economic impacts of human activity. Green cities feature urban planning and city management strategies to minimise environmental and carbon footprints, including:

- readily accessible public transportation
- renewable power sources
- sustainable infrastructure
- water and waste management strategies that maximise efficiencies in use (including recycling and reuse of material in the spirit of a circular economy)
- abundant green spaces



CASE STUDY - DECIBEL ARCHITECTS + SHANGHAI CONSTRUCTION GROUP

Building to net zero in Shanghai

"The project represents a new way of building, of embedding technology and symbiosis in everyday thinking, and of celebrating life in this new and challenging century. The cultural depth in developing new ways of thinking and working with China brings fresh and innovative perspectives that deepen understanding and success in China, and around the world." Dylan Brady, Decibel dB(A) Lead Architect SCGZero+ Project

The globally significant SCGZero+ project commissioned by Shanghai Construction Group is China's highest-rated sustainable building. SCGZero+ is a showcase for collaboration with China on the climate challenge, and its first 'five zero' building: zero carbon, water, energy, waste and formaldehyde.

Decibel brought key learnings from its innovations in sustainable design from the Pixel building in Melbourne and aims to redefine the benchmark for sustainable buildings in China.

Lead architect Dylan Brady emphasises the importance of building and maintaining relationships as the foundation for their success in China – including government links, networks and collaborations that trade missions have helped to foster.

Due for completion in 2022, the SCGZero+ project officially broke ground on 6 January 2021 and is located in the Putuo District of Shanghai. The total project site area is 3422 sqm, with a construction area of 11509 sqm (4548 sqm of it below ground). Green concepts and technologies were applied in every aspect of the building's design & construction; these will apply to the operation and maintenance once built, minimising energy consumption and pollution.

Prefabricated construction methodologies and modular green building systems reduce site noise, exhaust and wastewater. All waste was classified to enable upcycling, reuse, recycling or reclamation.

Decibel will translate the management of the whole process into educational and demonstrational technical case studies for improving the systematic procedures in green construction for the future.

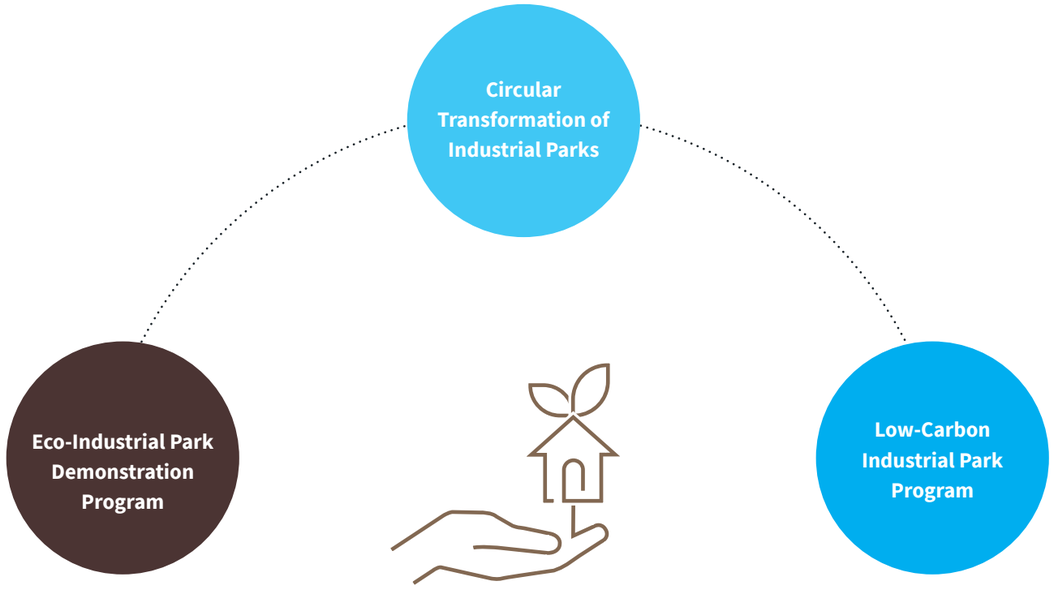
NEW CITIES BRING GREEN OPPORTUNITIES

China's Five-Year Plan includes initiatives capturing the transformation and creation of its cities. This brings opportunities for Australian businesses and organisations to offer technical expertise and resources.

One clear path is to draw upon existing relationships between cities, states and provinces. These 'sister-city' relationships, of which there are around 100, include Adelaide-Qingdao, Canberra- Beijing, Melbourne-Tianjin, Perth-Chengdu and Sydney-Guangzhou.

Many have existed for decades. They have shown measurable direct economic benefits, as well as providing cultural and people-to-people links. From this, it is a small step to sharing ideas around the design and implementation of net zero policies and projects.

Within many Chinese cities, industrial parks have encouraged foreign direct investment. A growing number are focused entirely on green development, with the China-Singapore Tianjin Eco-City among the earliest examples. In 2016 the Ministry of Commerce established the Green Partnership of Industrial Parks (GPIP), bringing together national-level industrial parks for green development. GPIP aims to facilitate international cooperation to achieve climate goals. Australia is yet to appear on collaboration party lists, but ACBC recently partnered with GPIP to showcase potential opportunities.



CASE STUDY – TIANJIN ECO-CITY

Chinese city, Singapore influence

Construction of the China-Singapore Tianjin Eco-City, a sustainable, planned city 150km from Beijing, began in 2008. The city is a collaboration between the Chinese and Singaporean governments. It was deliberately built on non-arable, polluted land to demonstrate sustainable urbanisation is possible in the face of stark environmental challenges. At a private level, a Singaporean Consortium and a Chinese Consortium each hold a 50% stake in the joint venture company developing the city.

Drawing on Singapore's township planning, Tianjin Eco-City has adopted an 'eco-cell concept' where public social amenities are co-located with residential estates and commercial buildings in 400 metre by 400 metre blocks. In addition, the 'green and blue network planning' used in the city endeavours to weave vegetated spaces and clean waterbodies throughout the eco-cells to enhance air quality, access to green spaces and the aesthetics of the neighbourhoods. Transport networks are also designed to favour pedestrians, non-motorised transport and public transport.

The city's water management systems are adapted from Singapore's systems. Urban wastewater such as sewage, industrial wastewater and rainwater undergoes purification and filtration to become usable recycled water for urban greening and daily use. The city was also approved as one of China's second batch of sponge city pilots, meaning that green land, permeable road materials and water storage modules are used to improve conservation of water.

The Chinese and Singaporean governments have put in place policies to incentivise green investment in the city. For example:

- it is a pilot for a voluntary foreign exchange settlement initiative facilitating business for foreign-funded enterprises registered in the city
- the city was named a 'National Green Development Demonstration Zone', meaning that low-carbon policies provide financial support to green industries
- Enterprise Singapore, a Singaporean statutory board, offers a range of incentives including grants and tax incentives, to assist Singaporean companies set up operations.

Tianjin Eco-city, before and after development
Provided by Sino-Singapore Tianjin Eco-City Investment and Development Co., Ltd.

GREENING EXISTING CITIES

New green cities represent the future of sustainable urban design, but they do not reflect the reality of the conditions experienced by most of the world's population residing in existing cities. Although the difficulties in 'greening' existing or new cities have strong parallels, distinct challenges face well-established cities which seek to retrofit elements of green cities into their fabric.

There is significant room for collaboration in relation to the next Chinese or Australian green city project.

The UN's 2030 Agenda for Sustainable Development nominated the creation of inclusive and sustainable cities as one of its development goals. The UN agenda focuses on the need for an integrated and cooperative response to urban growth and the environmental challenges presented, including using planning to create positive economic, social and environmental links between urban and regional areas.

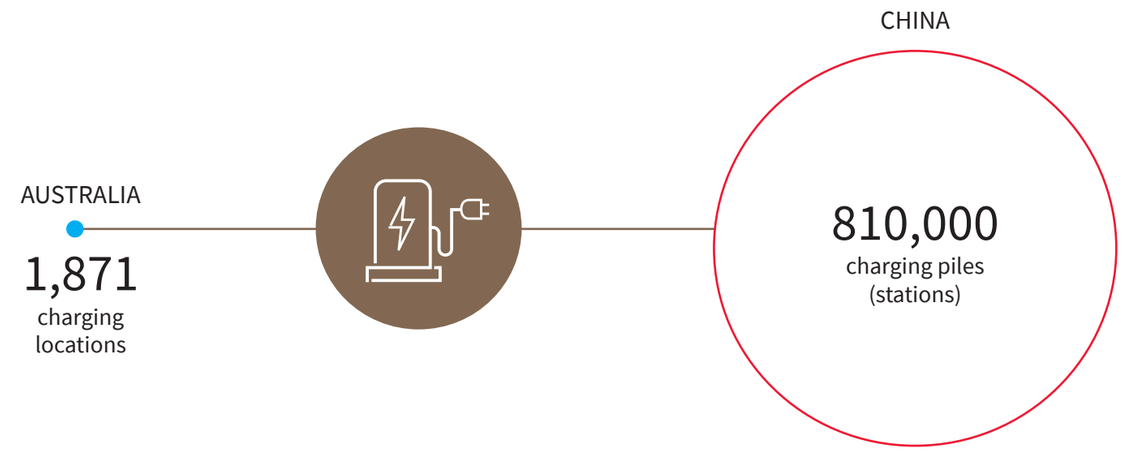
Looking ahead and seizing opportunities: Beijing, China and Sydney, Australia

In 2019, excavations took place on George Street in Sydney's central business district to build new light rail infrastructure. Cognisant that Sydney's water demand is predicted to increase 30% by 2030, the City of Sydney Council took advantage of the roadworks to install a recycled water network along the street. This involved knowledge and resource sharing across local government areas and collaboration with the state government and its statutory corporation, Sydney Water. The recycled water network can be used for tower cooling and park maintenance, which currently accounts for 40% of the city's water consumption. The city aims to reduce its daily water usage per person from 223L to 170L by 2030.

Beijing has similarly demonstrated the value of investing in a sustainable future through its heavy governmental involvement in the promotion of EVs. China has become the world's leading market in EVs with large subsidies for EV manufacturers, state sponsorship of research and development, direct investment into companies and public charging infrastructure. In 2018, Beijing saw an increase of 17,000 EVs, with a reported 130,000 charging points, 37,000 of them public. The figures dwarf those of large cities in other countries, including New York City which had fewer than 1,500 charger plugs and 120 fast charger plugs in 2020 (although the city plans to dramatically increase these figures to 40,000 and 6,000 respectively by 2030).

The contribution of transport electrification is further discussed in chapter 4, but the theme is clear: Beijing is investing heavily in decarbonising urban road transport. In a city like Beijing, the extent to which electrification of transport will clean the nearby airways depends on the extent to which the generation of the electricity is clean.

Beijing charges ahead with EV power



Source: Electric Vehicle Council (Jan 2022), PRC State Council (Jan 2022)

CASE STUDY – GREATER SPRINGFIELD

Australia's first privately built city

Greater Springfield, located south-west of Brisbane, is the world's tenth largest master-planned community. Construction began in 1992 as a collaboration between the Queensland government and Springfield City Group.

Costing a projected AUD85 billion, the city features a host of innovative and sustainable technologies, including digitised substations, hydrogen-fuelled buses and a data centre which can withstand natural disasters. More than 30% of the city is designated as green space and there is a 3.5km^2 man-made public swimming lagoon.

In 2010, Greater Springfield was named the world's best master-planned city by the International Real Estate Federation. Greater Springfield has a 24ha green spine at its centre to connect residential and commercial districts with waterside and recreation areas.

This modern paradigm of mixed-use zoning and green centres represents a significant shift from the traditional design of cities centred around a central business district and urban sprawl.

In December 2018, Greater Springfield partnered with multinational energy conglomerate Engie (which has also partnered with Singapore, Paris and Barcelona on similar green city initiatives) to create a 50-year strategic alliance to invest in renewable energy generation and storage infrastructure. The strategic alliance action plan includes a targeted reduction from 1.98 to 0.8 cars per household while ramping up EV charging infrastructure, hydrogen-fuelled green buses, bioclimatic building design and 100% renewable energy usage (including PV solar panels on every available rooftop).

CASE STUDY - SPONGE CITIES

Sponge Cities are designed to do precisely as the name suggests: absorb water. Initially introduced to address the floods devastating modern cityscapes, benefits flow to water supply, biodiversity and greener urban spaces.

Beijing, Shanghai and Shenzhen are among 30 cities allocated between RMB400-600 million as part of a pilot initiative to transform them into more permeable spaces. By 2030, China wants at least 80% of municipal areas to have sponge city elements. This drove China to scour the world for best practice in sponge city techniques, which in turn led to Australia, facilitating significant cooperation between Australia and China.

Monash University and the University of New South Wales entered an agreement in 2017 with Chinese development company Jiangsu Easthigh Environmental Holdings to help advance urban water technologies. This established a Sino-Australian Centre on Sponge Cities.

The South Australian Department of Water and Environment has engaged with Chinese cities since the initiative began in 2015, connecting the state's vastly experienced water sector with China's fast-moving cities. South Australia's water industry alliance brings together around 150 local water companies with a goal of accessing national and international markets.

In Australia, innovation in the space is referred to as water sensitive urban design. The first collaboration project involved advice from six South Australian companies to Jinan, the 7 million-population capital city of the Shandong Province, on capturing stormwater and replenishing the city's natural springs. This work prompted Hohai University in Nanjing to reach out on a program to improve water management and quality in the Taihu Basin, an industrial-heavy pocket which has more than a third of the nation's textile manufacturers.

South Australia is now seeing interest in its methodologies from other parts of the world, including India, Malaysia, Indonesia and New Zealand, as identified at the Dubai Water Expo in 2021.

GREENING BRISBANE'S OLYMPICS

In 2032 Brisbane will host the world's first "climate positive Olympics". The city is contractually obliged to be climate positive - as will all host cities from 2030.

Brisbane's Olympic Games represents an opportunity for Australia and China to collaborate in applying learnings from Beijing's 2022 Winter Games, where all venues were powered by renewable energy for the first time at an Olympics. Hosting the Olympics poses significant emissions challenges, from the amount of travel and transportation of equipment involved, to the construction of billions of dollars of infrastructure.

Transport infrastructure constructed for the Beijing Games cost USD6 billion; double the amount spent on the games itself. The permanent nature of the infrastructure and increased transport linkages associated with hosting an Olympics increases the potential to embed sustainability beyond the event.

One area with distinct potential for collaboration is the use of renewable energy to power Olympic venues and cities. Beijing constructed the world's first flexible HVDC power grid in Zhangjiakou, facilitating the transmission of renewable energy. That project led to the investment of over USD8.5 billion in wind and solar power generation and can deliver 14 billion kilowatt-hours of clean electricity every year, sufficient to meet the power needs of 26 Beijing Olympic venues.

Australia is yet to implement flexible DC power grids at significant scale. The Brisbane Games present an opportunity to spur the broader construction and integration of DC power grids within extant power transmission systems. The Brisbane Games plans to implement a "solar rim" in the Metricon Stadium, a ring of solar panels around the roof which can supply 20% of the stadium's electricity needs.

At the other end of the carbon lifecycle, in preparation for the Beijing Games, Beijing and neighbouring Zhangjiakou planted 80,333 hectares of forest, generating approximately 1,100,000 tonnes of CO_2 bio sequestration.

Similarly, the Queensland government plans to plant trees in Brisbane and encourage non-motorised transportation by building broader sidewalks.

There is also potential for the Brisbane Games to undertake bio sequestration or other eligible carbon offset projects by participating in the Queensland Government's Land Restoration Fund or the Emissions Reduction Fund facilitated under Australia's carbon credits regime.

WHAT NEXT?

Urban spread has removed permeable surfaces, reduced biodiversity and dropped water levels in aquifers. Climate change has heightened the frequency and intensity of floods and water pollution. More than 20 provinces across China, including Henan, and areas along the east coast of Australia, including Brisbane and Sydney, experienced severe flooding in 2021 and 2022.

In 2018, NASA revealed novel satellite observations showing freshwater availability changing everywhere on earth, making wetlands wetter and dry areas drier. A recent UN report also indicated about 80% of climate change adaption responses will be water-related by 2050. Efforts worldwide to address water outcomes for cities including water security, scarcity, urban amenity and combatting extreme weather events is predicted to become a USD1 trillion market by 2024.

For Australia, there are clear opportunities to export knowledge, whether from water sensitive urban design or from master-planned communities such as Greater Springfield in Queensland. There are also opportunities to use homegrown research and learnings from experiences abroad to accelerate green building and infrastructure planning, embrace electrification and decarbonise public transport.

The challenges in addressing climate change reach beyond cutting carbon. Changing our cities carries health and safety benefits, from reducing air and water pollution to mitigating the effects of natural disasters.

It presents an opportunity to materially affect the lives of the majority of the world's people.

CHAPTER

6

GREEN FINANCE AND CARBON MARKETS

According to the United Nations' financing roadmap to net zero, the lion's share of the USD32 trillion of funding needed for decarbonisation efforts in the next decade must come from the private sector.

Some experts, like UN Special Envoy for Climate Action and Finance Mark Carney, predict two to three times that amount is needed between now and 2050 to reach the requisite scale.

Public funding is vital for the transition, but it will not be enough. For China, the UN estimates that government financial resources can only meet 10-15% of the country's green investment needs.

This presents an enormous opportunity for Australian and Chinese private sector investors and borrowers. Green finance markets are developing at a dramatic pace. In China, the green loans market is already at USD2.5 trillion, the largest globally.

USD2.5 trillion green loans

for Chinese borrowers (2021)

USD95 billion green bond

market in China (2021)

China's ability to achieve carbon neutrality by 2060 relies on (among other things) the continued growth of the domestic green bond and green loan markets, as well as the expansion of cross-border investment structures and access to private capital in the international capital market.

"We need an energy transformation on the scale of the industrial revolution at the speed of the digital transformation. And therefore, we need a revolution in finance."

Mark Carney, UN Special Envoy for Climate Action and Finance, speaking at Davos

Green investment is firmly embedded within China's 14th Five-Year Plan (2021 – 2025) which has propelled China as a leading force within green financial markets.

But the funding challenge (and opportunity) is broader than debt markets and carbon trading. An OECD report led by Secretary-General Mathias Cormann points out that net zero goals will also require "international progress to support an effective carbon price" to ensure the efficient allocation of resources in financial markets. In his foreword, Cormann flags the opportunity for market participants to encourage greater transparency and support the "reallocation of capital towards greener alternatives, while discouraging capital flows to carbon intensive projects".

Many countries have started developing financial products and mechanisms to mobilise their financial sectors. Government authorities, regulators, corporates and consumers are playing a significant role – including by developing carbon trading markets.

Yet given the enormous funding deficit, much more is needed, providing opportunities for greater collaboration between financial market operators and participants in Australia and China.

"China will benefit greatly from [Western countries'] experiences with synergizing financial policies, building institutions and facilitating product innovations to promote green investment."

People's Bank of China & UNEP Green Finance Task Force, 2015

EU
Early leader

The EU has led on environmental protection policies and financial regulations in the last decade, driving changes in financial markets and trade policy

China
Fast follower

China has dramatically upgraded policies and worked with the EU on emission trading system trials

China and the EU are working together on new 'common ground' green financial taxonomies

Australia
Significant growth

Australia is the world's eighth largest market in terms of total number of loan and bond issuances with green and sustainability-linked terms, following 15 years of significant growth in finance

Sources: *IPSF, Common Ground Taxonomy Instruction Report, 2021*

The year 2021 was a landmark one in the international green finance arena, with the finalisation of the Article 6 rulebook for the development of carbon markets (see below). There is now a clear roadmap to guide financial institutions, companies and governments over the next few years. Priorities include improving the interoperability and consistency of sustainable finance standards (including developing common taxonomies), building a robust transition finance framework, embedding sustainability into credit risk assessments, and adopting green finance tools and instruments to achieve net zero emission goals.

Green finance milestones of 2021

COMING TOGETHER FOR CHANGE

G20 release Sustainable Finance Roadmap and 2021 Synthesis Report

COP26 states agree on implementation rules under the Paris Agreement

China and EU jointly publish the Common Ground Taxonomy (CGT) – Climate Change Mitigation

Over **450 financial sector members** form the Glasgow Financial Alliance for Net Zero **(GFANZ)**

110 banks are members of UN-convened Net-Zero Banking Alliance **(NZBA)** (part of GFANZ)

UN-backed group brings together six sector-specific initiatives:

- NZ Banking Alliance
- NZ Asset Managers Initiative
- NZ Asset Owner Alliance
- Paris Aligned Investment Initiative
- Net zero Insurance Alliance
- Net zero Investment Consultants Initiative.

- National Australia Bank, Australia and New Zealand Banking Group, Commonwealth Bank of Australia and Macquarie Bank are among the 43 founding banks.
- Underpinned by UN Environmental Programme Finance Initiative's 'Guidelines for Climate Target Setting for Banks'
- Represents c.40% of global banking assets
- Targeting net zero by 2050
- Intermediate targets set for 2030 or sooner.

Sources: G20 Sustainable Finance Roadmap, US-China Joint Glasgow Declaration on Enhancing Climate Action in the 2020s, IPSF Common Ground Taxonomy Instruction Report 2021

Financial institutions are forming and joining global alliances to find solutions in increasing numbers. There are more than 450 financial sector members of the Glasgow Financial Alliance for Net Zero working on common approaches to sustainability infrastructure and best practice guidelines.

The UN-convened Net Zero Banking Alliance (NZBA), which aims to provide a structured forum to support banks and financial institutions to achieve 2030 emissions targets and transition to net zero by 2050, was launched by 43 founding members in April 2021. It has since grown to 110 members including Australian banks National Australia Bank, Australia and New Zealand Banking Group, Commonwealth Bank of Australia and Macquarie Bank. These NZBA-aligned banks represent about 40% of global banking assets.

As of August 2022, no Chinese banks were members of NZBA. This presents an opportunity for further collaboration. Chinese banks are, however, involved in the Alliance for Green Commercial Banks, a 2019 initiative of the World Bank's International Finance Corporation and the Hong Kong Monetary Authority. The alliance brings together institutions to develop and build capacity for climate-related investments. The first regional chapter is in Asia with cornerstone members including the Bank of China and HSBC. The alliance aims to bring in non-financial institution 'green' industry companies in the future.

China also participates in a range of multilateral green finance initiatives including the Central Banks and Regulators Network for Greening the Financial System, the Common Ground Taxonomy with the EU, and the World Bank's Sustainable Banking Network which facilitates dialogue and knowledge sharing with leading authorities on the development of the global green financial industry.

There remains an opportunity for greater collaboration between Australia and China, building on these forums.

BUILDING TOMORROW'S TAXONOMIES

The reason 'taxonomy' matters, and why it has become something of a buzz word, is that it helps establish standards that allow financiers and investors to assess the sustainability credentials of projects and financial products on a consistent basis.

Greater standardisation of green-related financing terms and criteria to assess performance against green metrics will build the confidence of borrowers, financiers and the broader public that financial markets play a key role in delivering green outcomes. Green taxonomy is designed to help minimise greenwashing, where green credentials are misleading, inaccurate, inflated or unsubstantiated.

In July 2020, the EUand China initiated and co-chaired a working group on sustainability-related taxonomies. Referred to as the 'Common Ground Taxonomy', its objective is to comprehensively compare existing taxonomies for sustainable investments and identify the commonalities and differences in their respective approaches, criteria and outcomes.

The first green bond issued under the Common Ground Taxonomy, published jointly by the People's Republic of China (PRC) and the EU in November 2021, marked a milestone in identifying the similarities and differences between the green taxonomies of each.

By contrast, Australia's participation at the international level on sustainable finance taxonomies remains limited. Australia's Council of Financial Regulators has indicated it is considering global taxonomies but expressed concern that they do not differentiate between the impact that climate change has in different parts of the world or take into account the different structures of national economies or other local considerations.

PERSPECTIVE – ASIFMA

How one industry group is taking on 27 taxonomies

"There are 27 taxonomies around the world, all looking at different ways to describe what is green and sustainable. We are trying to coordinate efforts and raise awareness among different stakeholders within the wider community to drive interoperability of the systems. It's a global problem, it's not possible to address it country-by-country." Diana Parusheva-Lowery, ASIFMA Sustainable Finance Lead

The Asia Securities Industry & Financial Markets Association (ASIFMA) is an industry group with the mission of promoting liquid, deep and broad capital markets across Asia. ASIFMA brings together voices from across business and professional services, to collaborate and act as a force for positive change.

The topic of sustainable finance has developed quickly both from a business and regulatory perspective. Major economies across Asia have already made official commitments in line with the Paris Agreement and are now implementing their national carbon reduction targets by requiring action from industry and financial sectors.

As a result, in the past two years ASIFMA has witnessed a spur of governmental and business initiatives, standards and regulations relating to sustainability.

ASIFMA has a very broad membership base across the buy-side, sell-side, service providers, data providers and other firms across the spectrum of the financial sector, making it ideally positioned to coordinate the exchange of information and aspire to drive a unified agenda and direction.

One of the most critical pathways to achieve net zero, according to ASIFMA, is to put a price on carbon. Yet most countries currently do not have one.

CATCHING THE GREEN FINANCE WAVE – GREEN LOANS & BONDS

Transactions in the green and sustainable financial markets have grown exponentially over the last decade. They offer financiers investors an opportunity to invest in a way that conforms to their respective sustainability principles and priorities, and for borrowers with strong sustainability credentials they offer a wider source of capital and a lower cost of funds.

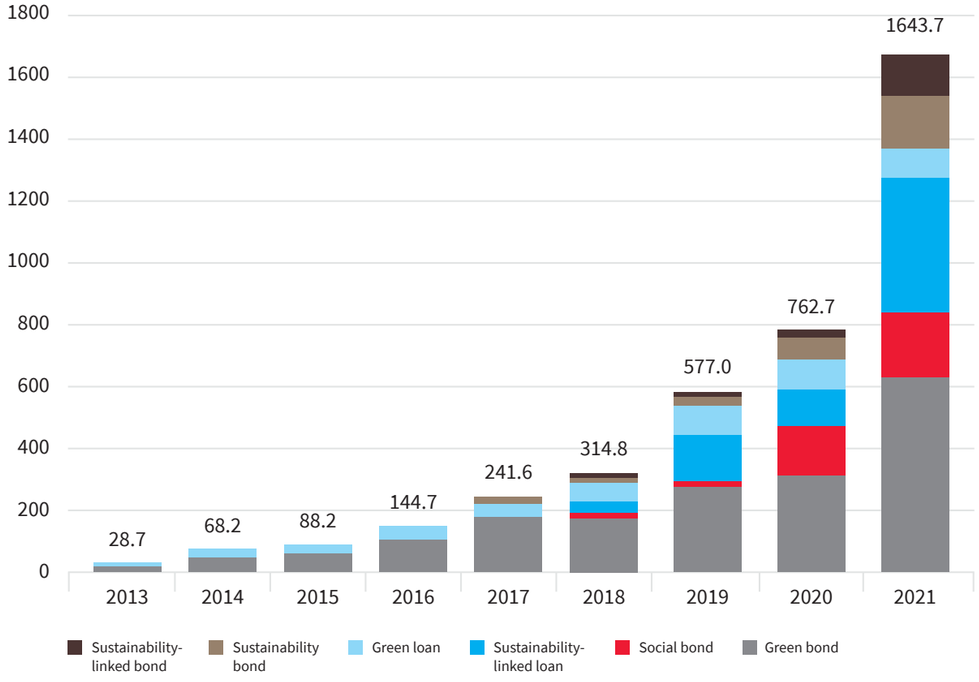
In China, green finance must mobilise significant private capital to facilitate the net zero transition and has become a key policy tool for macroeconomic regulation. Key themes for onshore green investment include transport, energy generation, infrastructure, city-planning, water security, conservation and biodiversity and the reduction of consumption-based carbon emissions.

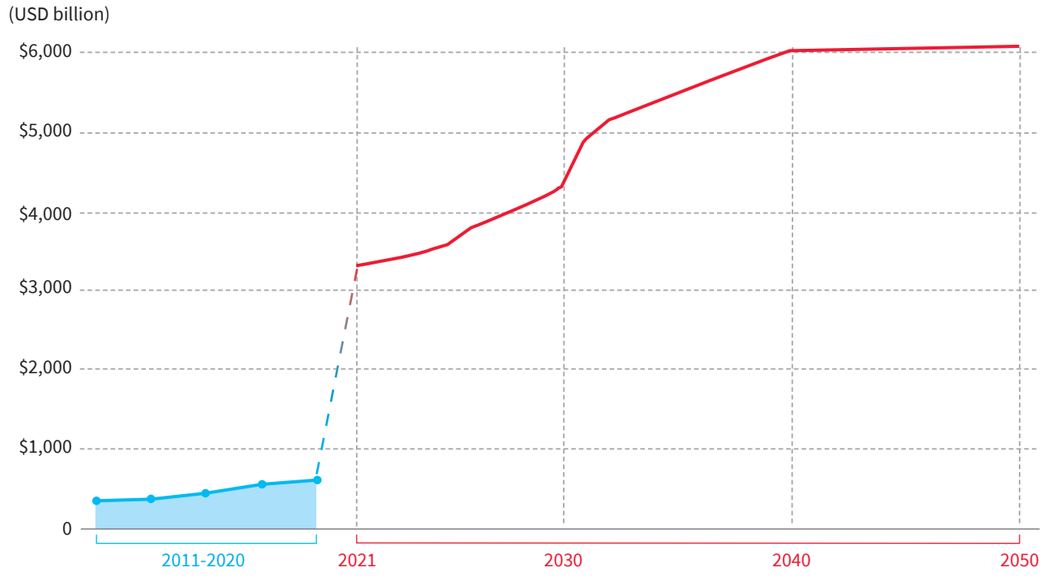
Much of this private capital will need to be competed for and won in the international capital market. China is aware of the importance that international green financial markets place on transparent and regular disclosure as well as third-party opinions and is moving from self-assessment towards independent verification of green credentials and mandatory disclosure relating to emissions and other key environmental metrics by 2025.[9]

"Up to four-fifths of decarbonisation technology investments could be better value than conventional, emissions-intensive alternatives."

UN Financing Roadmap prediction for 2030

Sustainable debt annual issuance





11. Notice by the Ministry of Ecology and Environment of Issuing the Plan for the Reform of the Legal Disclosure System of Environmental Information (People's Republic of China) Ministry of Ecology and Environment, Order No 43, 24 May 2021.

Source: *Bloomberg NEF and Bloomberg LP*

GREEN LOANS

The development of green loans - steady since the PBOC's inaugural green policy publication in 1995 – has accelerated in recent years.

This presents an enormous opportunity for Australian and Chinese private sector investors and borrowers. Green finance markets are developing at a dramatic pace. In China, the green loans market was already at approximately USD2.5 trillion by the end of 2021 according to the PBOC; a 33% increase from 2020 levels. The utility, transport, warehouse and renewable energy sectors were among the principal beneficiaries.

The market-based tools for the macro-regulation of onshore loan capital at all levels are the Green Credit Policy issued by the PBOC and China Banking and Insurance Regulatory Commission (CBIRC), and the Green Credit Guidelines of the CBIRC.

Chinese banks have access to low-cost funds via a carbon emission reduction facility launched by the PBOC in 2021. This requires financial institutions to promote the flow of funds towards green projects and away from environmentally harmful projects. There are disclosure requirements and green incentives, including PBOC preferential rates which could help 2,817 companies cut carbon emissions by approximately 28.76 million metric tonnes.

The Green Credit Guidelines identify how Chinese banks should address sustainability related issues at board and senior management levels and integrate environmental and social considerations into lending policies. Chinese banks that have a higher proportion of green loans and have issued green bonds receive higher scores which are linked to performance evaluation of senior bank executives.

Together, these tools allow Chinese authorities to track the green performance of individual banks and assess the level of green loan provision to the Chinese economy. They drive the development of a unified green finance system that incorporates enhanced incentives for lending to green and transition projects, harmonised standards, and reporting and disclosure requirements.

From 1 June 2022, the Green Finance Guidelines require Chinese banking and insurance institutions to support a low-carbon economy in a material way. The guidelines impose obligations to mobilise green capital, improve their own as well as their respective clients' ESG performance, and decarbonise asset portfolios. Innovation is encouraged.

In China, green loans have generally performed better than conventional loans with a default rate over the past five years in the region of 0.7% lower than non-performing loans as a whole. This is driven in part by the financial market's perception that green loans are intrinsically lower risk. Contributing to this trend is that much of this green lending relates to infrastructure projects, which are generally considered stable and lower risk.

GREEN BONDS

Chinese green bond issuances aggregated some USD94.8 billion in 2021. Growth in 2022 is projected to reach as high as 80% from 2021 levels as more issuers enter the market following government initiatives to expand investment in green and transition projects.

Significantly, the current edition of China's Green Bond Catalogue no longer includes 'clean coal' projects as eligible for finance through the issue of green bonds. Published by the key regulatory bodies for green bonds - the PBOC, the China Securities Regulatory Commission and the National Development and Reform Commission (NDRC) – the catalogue was last updated in May 2021 and contains an exhaustive list of eligible projects and eligibility criteria for the issuance of green bonds.

In the past five years, China's green bond indexes have outperformed fixed income and submarket indexes by a range of 50 - 120 basis points, in part driven by the PBOC's relaxation of monetary policy and the financial market's perception that issuers of green bonds have greater credit strength.

As market capitalisation of green bonds grows, Chinese issuers are becoming increasingly sophisticated, with instruments incorporating both green and sustainability linked features.

In Australia, the green bond market has experienced exponential growth since the World Bank in 2014 issued its first green Kangaroo bond (Australian-dollar bond issued in a domestic market by a foreign issuer).

In 2021, Australia was the world's ninth largest market in terms of the total number of loan and bond issuances with green and sustainability-linked terms (40 in total and trending up). Recent green bond issuers include Fortescue Metals Group, NSW Treasury Corporation, Lend Lease and the University of Tasmania demonstrating the depth and diversity of the market.

Green bonds moving the dial

CHINA

- **China Development Bank USD11.65 billion** *Transport, wind, solar*
- **ICBC USD4.19 billion** *Wind, solar, transport, water, conservation*
- **ICBCIL USD750 million** *Onshore wind*
- **GD Power USD280 million** *Renewables*
- **Jinneng Group USD80 million** *Wind, solar*

AUSTRALIA

- **Queensland Treasury Corporation AUD3 billion** *Transport, solar, renewables, water infrastructure*
- **Treasury Corporation of Victoria AUD2.5 billion** *Solar homes, renewable zones, household upgrades, Metro trains*
- **Wesfarmers AUD1 billion** *Renewables, emissions cuts*
- **Oversea-Chinese Banking Corporation AUD500 million** *Wind, green buildings*
- **National Housing Finance and Investment Corporation AUD343 million** *Sustainable housing*

1995

Green Policy

Notice on Credit Policy for Environmental Protection
PBOC

2007

Green Credit Policy

Opinions on Implementing Environmental Protection Policies and Regulations to Prevent Credit Risks
PBOC & China Banking Regulatory Commission (now CBIRC)

2012

Green Credit Guidelines

CBIRC

2016

China hosts G20 Summit in Hangzhou; introduces guidelines for establishing the green financial system

Significant expansion of green loan offerings follows

2021

World #1

Outstanding green loans worth RMB15.9 trillion (USD2.5 trillion)

2022

Green Finance Guidelines

Obligations on banking & insurance to mobilise green captial to improve their own & client's ESG

Hong Kong's role in China's green finance market

Hong Kong's role as one of world's top international financial cities, and a key city in China's Greater Bay Area, is well known. Perhaps less well known is Hong Kong's ambition to capitalise on its unique position in driving global capital flows with a view to developing into a regional carbon trading centre and green finance hub.

Hong Kong is using its financial and legal frameworks to develop green finance regulations, reporting and disclosure standards, and certifications. Supported by government investment, public sector resources and private sector expertise (including from many Australian firms and businesses based in the city), Hong Kong is developing a fast-growing suite of green products and services. These include green and sustainability-linked bonds, loans and funds, buoyed by market appetite from retail and institutional investors in the local, Mainland and regional markets.

A Green and Sustainable Finance Cross-Agency Steering Group was set up in May 2020 to co-ordinate the management of climate and environmental risks to the financial sector, accelerate the growth of green and sustainable finance in Hong Kong and support the government's climate strategies.

Hong Kong creates a corridor for investment opportunities into China. Various 'connect' schemes such as the Shanghai-Hong Kong Stock Connect initiative, introduced in 2014, have enhanced trading and clearing fluidity between the mainland and Hong Kong. This presents an opportunity for Australian funds and asset managers, wealth and professional advisers.

In addition, the GBA Green Finance Alliance was established in September 2020 by Hong Kong and the mainland of China. The alliance supports investments that capitalise on the demand for green finance in Guangdong and Shenzhen along with the capabilities and talent in Hong Kong and Macau.

Projects backed by the alliance include one seeking to establish a cross-border carbon marketplace, akin to the Shanghai-Hong Kong Stock Connect. A feasibility study conducted by the Securities and Futures Commission in 2022 highlighted the need for Hong Kong to "develop market structure and regulatory models to link up international investors with the mainland's carbon markets".

The complexity of solutions and portfolios that banks and advisors must offer will demand expertise – including from Australia.

CASE STUDY – MA CHINAAMC EQUITY FUND

Investing in the future

"Given the size of China in terms of GDP, and being the second biggest equity market, we think it's only natural that investors would want to allocate part of their portfolio to that market. We've been in discussions with ChinaAMC for some time and our team have done exhaustive due diligence. The fundamentals, I think, are compelling." Andrew Martin, MAF Head of Asset Management

Established in 2009 and now with AUD6.9 billion in assets under management, MA Financials' (MAF) Asset Management oversees institutional, wholesale and retail investments across real estate, credit, hospitality, private equity and venture capital. The team also manages traditional asset classes such as cash, bonds and listed equities.

As investors reassess their approach to investing in Chinese equities, the Australian financial services firm has adapted its asset management offerings.

In partnership with Beijing-based ChinaAMC, MAF launched the MA ChinaAMC Equity Fund, providing Australian wholesale investors access to mid to large Chinese companies. Founded in 1998, ChinaAMC is one of the largest asset managers in China and a market leader. The fund invests in stocks listed on both Chinese onshore (A-shares) and offshore markets.

Highlighting its strategic commitment to the region, MAF's China team totals 50 staff and stretches across Shenzhen, Shanghai and Beijing. MAF is heavily invested in maintaining local messaging for its Hong Kong and the mainland of China markets, including an official WeChat microsite.

ChinaAMC is one of the largest asset managers in China with USD271.7 billion (RMB1.72 trillion) in assets under management as of year-end 2021, 82,400 institutional clients and 188 million retail customers providing a full range of services to retail and institutional investors.

"Hong Kong's pivotal role in connecting vast amounts of global capital with the mainland market, together with its adoption of a climate reporting standard, will help significantly advance green and sustainable finance development regionally and globally. We will continue working closely with our fellow regulators, the government and the industry to ensure that Hong Kong continues to develop as a leading international sustainable finance hub."

Ashley Alder, then-HK SFC CEO, in Hong Kong Monetary Authority press release 2021

CARBON MARKETS

One of the key developments coming out of COP26 was an agreement between world leaders on a new set of rules for regulating carbon markets. This will settle the final outstanding element of the Paris Agreement, known as Article 6.

This outcome has set the upscaling of carbon markets as a primary objective of the world's governments.

There is a need to better understand the shape and structure of China's carbon markets, to collaborate and explore avenues of access with relevant authorities and stakeholders in the mainland and in Hong Kong, and to strengthen cross-border institutional, industry and business relationships.

China's national emissions trading scheme, launched in July 2021, is expected to become the world's largest carbon market by trading volume and value. A growing number of foreign investors are turning their attention to China's rapidly developing market and we anticipate it will ultimately open to foreign investors.

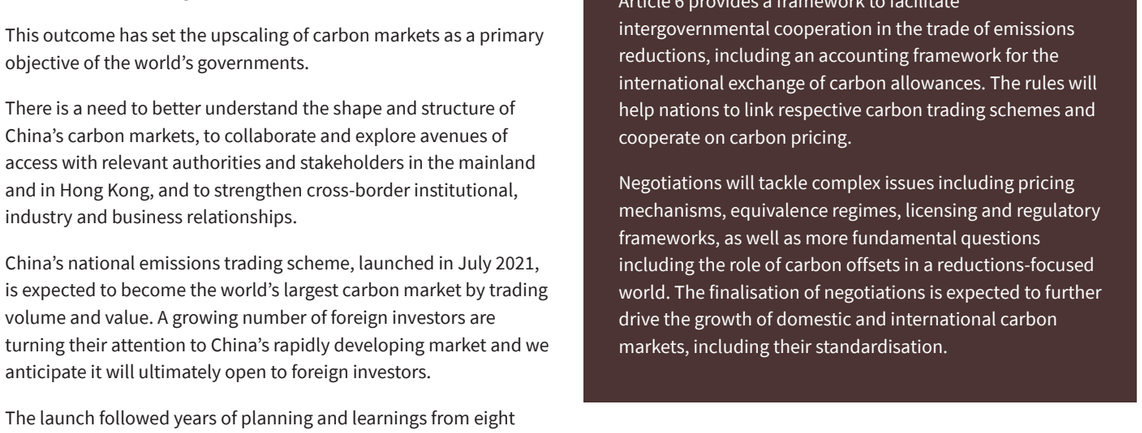
The launch followed years of planning and learnings from eight regional pilot schemes introduced across China, as well as foreign markets such as the EU's emissions trading scheme. The regional schemes were introduced over 2013 (in Beijing, Shanghai, Shenzhen, Tianjin and the Guangdong province), 2014 (in the Hubei province and Chongqing) and 2016 (Fujian province). They continue to run in tandem, but the national scheme is expected to absorb them as it matures and expands to capture more sectors beyond power.

The regulated, compulsory market is a 'cap and trade' scheme. A cap is set on the total amount of emissions covered entities can produce; the excess or shortfall is traded.

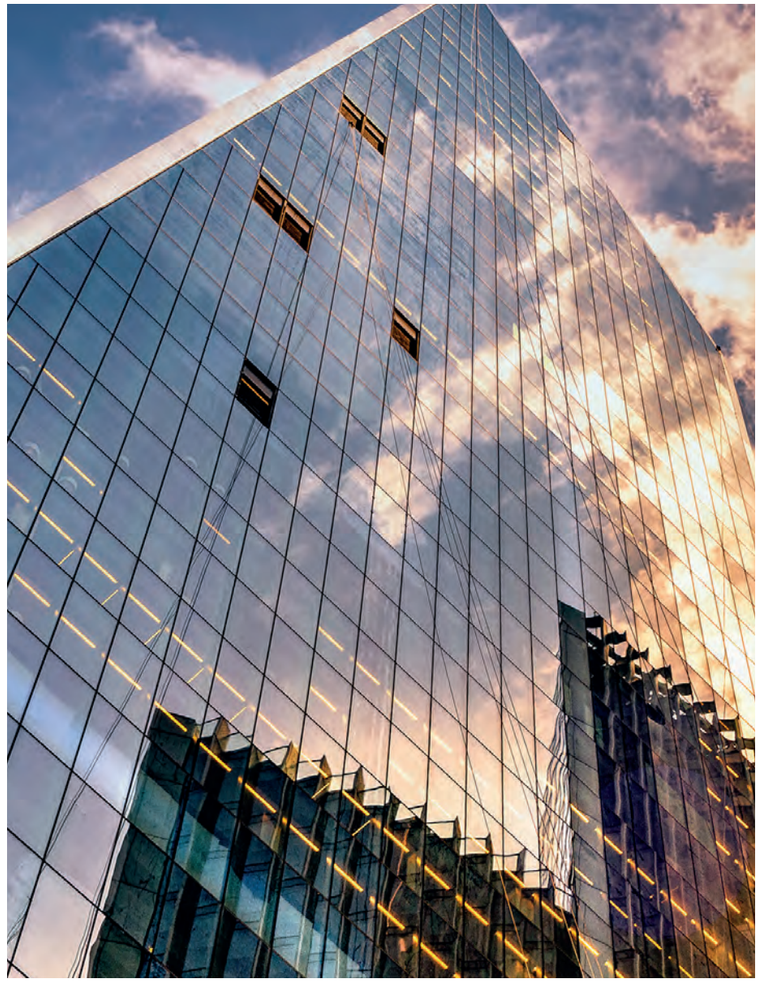
Carbon markets in the spotlight with Article 6

Article 6 provides a framework to facilitate intergovernmental cooperation in the trade of emissions reductions, including an accounting framework for the international exchange of carbon allowances. The rules will help nations to link respective carbon trading schemes and cooperate on carbon pricing.

Negotiations will tackle complex issues including pricing mechanisms, equivalence regimes, licensing and regulatory frameworks, as well as more fundamental questions including the role of carbon offsets in a reductions-focused world. The finalisation of negotiations is expected to further drive the growth of domestic and international carbon markets, including their standardisation.



Source: Energy Innovation.



Carbon markets offer a way for companies to meet their compliance obligations and manage climate risk in a cost-effective way. Companies that can reduce their emissions beneath their compliance limit can sell their remaining carbon credits (subject to the rules of the applicable scheme). Companies that exceed their emissions limit can buy credits by way of offset (again, subject to applicable rules).

The same principle applies to the voluntary carbon markets. Companies that can reduce or remove emissions cost-effectively earn credits to sell to companies that want to achieve a lower carbon footprint than they would be otherwise able to readily or cost-effectively achieve.

AUSTRALIA'S CARBON EXCHANGE

By contrast, Australia has had a rocky political road when it comes to managing carbon emissions. The ERF is a voluntary scheme administered by the Clean Energy Regulator, supplying Australian Carbon Credit Units (ACCUs). Similar to other carbon credits, ACCUs represent one tonne of CO_2 equivalent stored or avoided by a carbon reduction project, such as revegetation, plantation forestry and capture and combustion technologies.

The Clean Energy Regulator is developing an Australian Carbon Exchange to make trading ACCUs and potentially other carbon units simpler. Expected to launch some time in 2023, the exchange is anticipated to cut transaction costs and support increasing supply and demand across the corporate sector.

Australia will need to consider whether its financial institutions and investors can meaningfully engage in the global carbon markets including participation in the world's largest, in China (when access to foreigners becomes possible).

At a sovereign level, the Indo-Pacific Carbon Offsets Scheme (IPCOS) - a partnership between the Australian government, Indo-Pacific countries, private and non-for-profit sectors to develop a regional carbon market - will align with Article 6 of the Paris Agreement.

WHAT NEXT?

For financial institutions, the work towards meeting net zero targets including changing planning, infrastructure, risk appetite and portfolio mix is already underway. Clients now commonly raise sustainability issues as part of their funding requirements. CEOs will have a critical role to play in leading new and ambitious net zero strategies.

International banks are considering how to access the Chinese green finance and carbon markets and Australia has a chance to position itself at the epicentre of this growth.

To scale the rapidly developing sustainability markets efficiently and effectively the international community must cooperate on a cross-border basis to address key issues including integrity, interoperability and harmonisation of standards.

Both Australia and China have a significant amount to offer.

Australia had early learnings from its nascent carbon markets in the 2010s. There is an opportunity to reassess introducing a carbon market, following the introduction of China's national emissions trading scheme and the drive for an international carbon market as a result of COP26.

One key opportunity for Australia's finance sector is in its more active participation in the greening of infrastructure in the Asia-Pacific region.

Australia can reclaim its respected role in global green capital exchange through closer engagement with global programs, such as UNEP's initiative to boost funding towards Sustainable Development Goals, and participation with China and others in key regional trade programs like the Regional Comprehensive Economic Partnership (the Asia Pacific's free trade agreement).

AUSTRALIA IS WELL PLACED TO BECOME A REGIONAL GREEN FINANCE AND PROJECT MANAGEMENT HUB.

Companies move beyond participant

Eight international financial institutions – including National Australia Bank - have joined forces to develop a new trading platform for voluntary carbon markets in Australia. Carbonplace is a settlement platform open to companies, financial institutions, exchanges, marketplaces and registries.

Enabled by Distributed Ledger Technology, the goal is to build a 'strong ecosystem for the voluntary carbon market' featuring high-quality carbon credits and risk management tools.

CHAPTER

7

CLIMATE-SMART FOOD AND AGRIBUSINESS

Agriculture is both affected by climate change, and a contributor to troubling emissions. Governments around the world will not meet their climate goals without major changes to food production and consumption.

New generation technologies will help to mitigate emissions, but with growing global demand and competition for scarce resources the entire food system will need to transform and become much more resource efficient.

"Agritech is fundamental to the growth and transformation of Australia's agricultural sector, an incredible export opportunity, and it will power sustainability, drought resilience and the transition to a low-carbon economy."

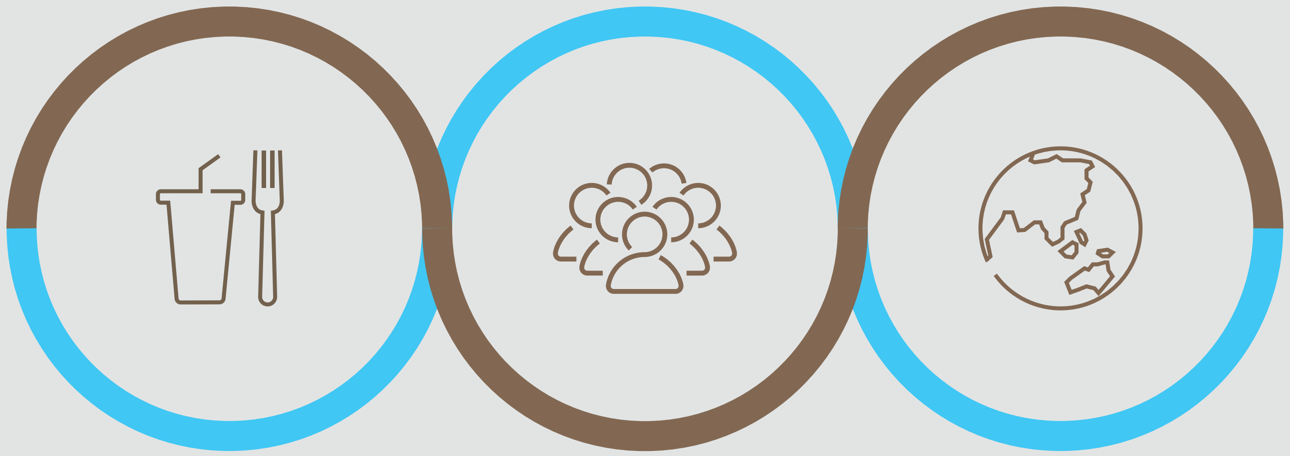
Tracey Martin, Australian Agritech Association CEO , in CEO's Message to Members

By 2050 the world will need to produce 56% more food to meet demand while reducing environmental impact. Greenhouse gases are emitted into the atmosphere at every stage from paddock to plate, amounting to an **estimated 14% of the global total.**

Farming releases significant amounts of methane and NOx, two powerful greenhouse gases. Methane is produced by livestock during digestion due to enteric fermentation and is released via belches, stored manure and organic waste in landfills.

In Australia, methane emissions from livestock alone make up nearly 10% of total emissions. This makes Australia's livestock the third largest source of emissions after electricity and transport. NOx emissions are an indirect product of organic and mineral nitrogen fertilisers.

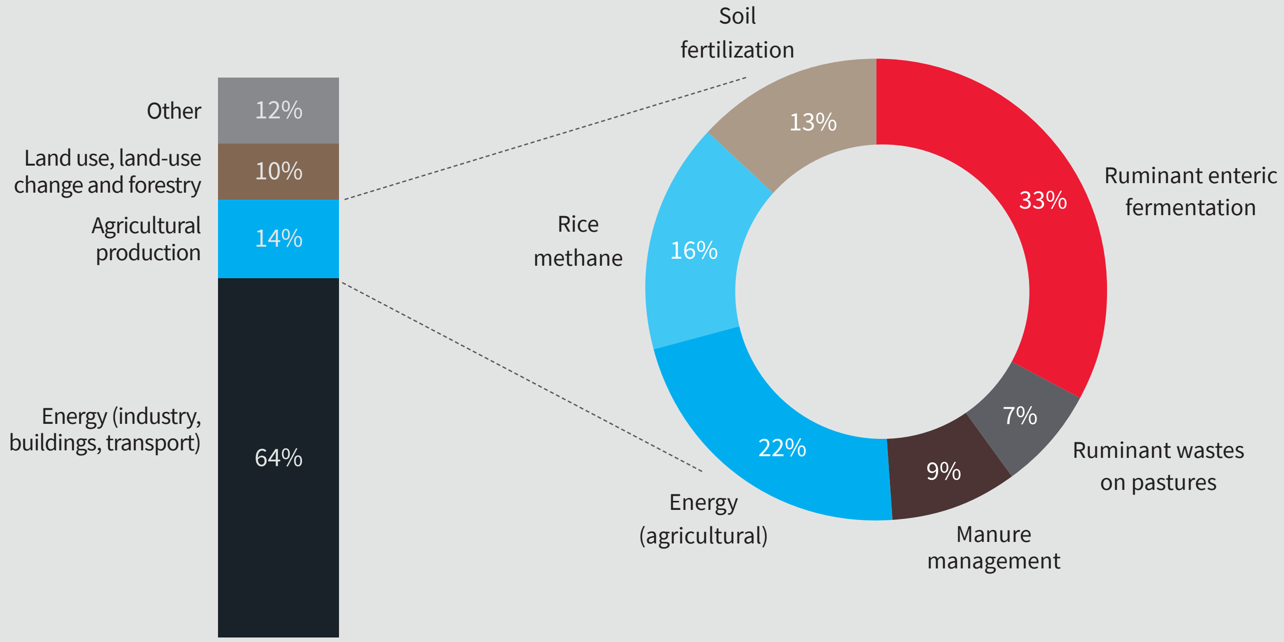
Path to a sustainable food future



56% MORE FOOD	TO FEED 10 BILLION	USING THE SAME LAND
By 2050 over a baseline of 2010 production	The equivalent of adding one city of 1.5m every week	50% of the world's vegetated land is already used for agriculture

100% = 49.1 GT CO_2e
Total GHG emissions

100% = 6.8 GT C02e
Agricultural production emissions



Source: https://research.wri.org/sites/default/files/2019-07/WRR_Food_Full_Report_0.pdf

> *"There is a clear desire for collaboration with Australia in these challenges as well. We just need to focus the resources to work together with our largest trade partner to achieve the best outcomes for Australia."*
>
> *Anthony Coles, ACBC Net Zero Working Group Chair*

As nations with economies deeply connected to agriculture and with a long history of collaboration, there is significant potential for Australia and China to collaborate to reduce emissions linked to food production.

Today, there is an opportunity to pursue a suite of eco-agriculture aligned initiatives. Australia and China remain natural partners as they tackle issues around drought, water resources and natural disasters. Industry members and groups across both nations are working hard on solutions, from disclosures and the use of blockchain to enhance traceability and transparency, to decarbonising farming infrastructure and equipment, to soil carbon storage.

Calls for the resumption of a roundtable dialogue are growing. At an agribusiness summit convened by ACBC in May 2022, Australian industry and business participants highlighted the importance of cooperation.

At that summit, China Chamber of Commerce of Foodstuffs and Native Produce's vice president Yu Lu, joining from Beijing, emphasised the symbiotic nature of China's market development with Australia's agricultural sector and the opportunity for closer collaboration on decarbonisation initiatives across the food production, distribution and global trade sectors.

In a similar manner, China Meat Association's Michelle Hu spoke about the extensive reforestation projects underway in South America, reflecting a recognition within China of the impact of its demand on global supply chains and the environment.

1984 → **2012**

TREATY-LEVEL AGREEMENT

Australia-China Agricultural Cooperation Agreement: enhance cooperation across industries, develop trading relationship, exchange scientific information

REPORT

Joint Australia-China Report: Strengthening Investment and Technological Cooperation in Agriculture to Enhance Food Security

CHINA'S AGRICULTURAL EVOLUTION: CARBON FIX IN SIGHT

China's agricultural policy objectives have evolved over the last three decades, reflecting the changing role of agriculture at different stages of the nation's economic development. An emerging strong focus on carbon neutrality presents opportunities to collaborate.

Agricultural policy objectives were initially focused on boosting food production to satisfy a growing population, but have evolved to ensure food safety, boost farming income, increase competitiveness and improve environmental performance. Today, there is a sharp focus on advanced technology, high quality and self-sufficiency.

There is no single law specifying carbon neutrality in agriculture, but its growing importance is highlighted in China's 14th Five-Year National Agriculture Green Development Plan (2021–2025) **(Agriculture Plan)**, released in September 2021.

The Agriculture Plan identified the following priority development tasks as key goals to achieve over the next five years

improving the efficiency of fertilizer usage, land management and carbon sequestration

pollution control

promoting recycling of animal waste

developing low-carbon agricultural industrial chains

The Agriculture Plan itself was a collaborative effort, jointly issued by the Ministry of Agriculture and Rural Affairs (MARA), the National Development and Reform Commission (NDRC), the Ministry of Science and Technology (MOST), the Ministry of Natural Resources (MONR), the Ministry of Ecology and Environment (MEE), and the State Forestry and Grassland Administration (SFGA).

Around China, provincial authorities, state-owned enterprises and businesses are shaping their own plans to achieve the goals set out in the Agriculture Plan. New regulations clarify targets and mechanisms to measure progress.

The emphasis on a low-carbon, self-sufficient agriculture sector points to the need for both access to the latest information and technology, as well as massive investments in upgrading farming operations and production lines.

The importance of this Agriculture Plan to Australia's agricultural sector cannot be underestimated. There are clear and emerging opportunities for cooperation for Australian providers of agricultural technologies and know-how, smart agriculture, organic and sustainable agriculture, advanced food industry and food safety administration, cold-chain and logistics along the food value chain.

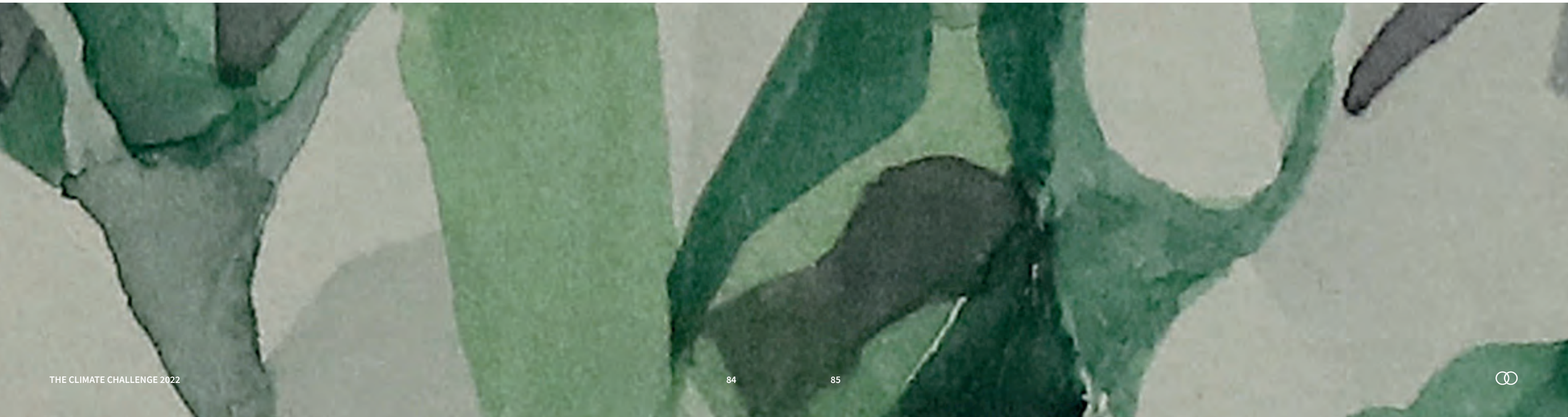
By sharing experiences in reducing carbon emissions throughout supply chains, there is a chance to accelerate the pace of change sector-wide.

How farms are changing and challenging the status quo

Two hours north of Beijing in the Bashang Grasslands, the organic dairy farm of Yuantianran Dairy Co has rejuvenated the land and is challenging the traditional competitive advantage of Australian, New Zealand and European milk producers.

The vertically integrated producer is implementing new environmental management processes into the feed and cleaning of the dairy.

Additional innovative initiatives with local communities are addressing the new policy guidelines towards modern manufacturing, eco-agriculture and rural rejuvenation.



Australia’s agritech roadmap

The vast majority (72%) of Australia’s agricultural production is exported, and Asia is the fastest growing destination.

Asia demand for Australia’s produce

UP 27%
in the 20yrs to 2020-21

53%
of total agricultural, fisheries & forestry exports 2020-21

China is the largest at
AUD12 BILLION
3 times the value in 2001-02

AUD28 BILLION
Australian exports to 8 largest markets in Asia

Source: ABARES Insights 2022, Department of Agriculture, Water and the Environment

“The Australian red meat industry has already made big inroads towards CN30. Net greenhouse gas emissions have fallen 57% since 2005, representing by far the greatest reduction by any sector of Australia’s economy. However, continued progress is vital.” Jason Strong, Meat & Livestock Australia Managing Director,

The Australian Red Meat Industry’s Carbon Neutral by 2030 Roadmap

In Australia, many farms have adopted sustainability practices including cutting reliance on pesticides and fertilisers (65%), grazing management systems (61%) and retaining crop stubble (85%).

Reshaping the agricultural industry and using innovative ways to become a net zero contributor is a strong focus in Australia’s Long Term Emissions Reduction Plan. Key policies and pivotal focus areas include collaborative research (in Australia and internationally), the development and scaling up of new agricultural technologies, using agritech to reduce methane emissions and adopting land-based solutions to store carbon in the soil.

An example of the way in which this plan is being activated is the Australian Red Meat Industry’s Carbon Neutral by 2030 Roadmap (CN30 Roadmap). The CN30 Roadmap, released in November 2020, describes the technologies and practices required for Australia’s agricultural industry to thrive in a carbon neutral future. This includes a target of 50% renewable farm energy sources by 2030.

At the recent ACBC Agribusiness Summit, Meat & Livestock Australia Managing Director Jason Strong shared the long journey to sustainability the Australian meat industry has taken since 2016, now guided by the CN30 Roadmap agenda.

The CN30 Roadmap provides industry stakeholders the opportunity to understand and use relevant information to inform current and future decision making and action. It is increasingly used in discussions with Chinese counterparts and businesses with a view to creating collaboration opportunities to support industry’s transition to a carbon neutral position.

HOW AGRITECH WILL UNLOCK POTENTIAL

China is the largest livestock producer in the world and the sector is growing - as are emissions. Methane emissions from livestock are the highest in the world. Policymakers in China are increasingly concerned with how to curb the environmental impacts of livestock and are reaching out to other nations for assistance.

This is an opportunity for Australian agritech businesses to engage with Chinese farming groups to deploy Australian methane-reducing agricultural technology on a very large scale in the China market.

The Australian government has identified that emerging livestock feed technologies and supplements will play a key role in reducing methane emissions and is providing funding to support a Methane Emissions Reduction in Livestock program over the next six years. Promising livestock feed technologies include feed supplements in grazing systems, alternative forage feeds and genetic selection and breeding of low methane traits in livestock.

The ability to communicate and verify practices will become increasingly important. The National Farmers' Federation in Australia is developing an Agricultural Sustainability framework, backed by the government. This will improve assurance measures for export markets.

Using certification and blockchain for digital traceability and consumer confidence

Traceability and proof of provenance are essential in ensuring food has the sustainability credentials claimed.

Blockchain is set to play a significant role, allowing participants along a supply chain to record and check the path produce has taken. This can start from the source – farms and producers – carrying through to transport and logistics, manufacture, distribution and retail. It will also provide a record for regulators.

Certification further empowers consumer demand to drive change and gives confidence to the entire value chain. Rigorous third-party verification programs for claims and carbon accounting ensures integrity.

By way of example, FutureFeed is building a digital traceability program on blockchain technology to enable quality control and aggregated data, taking into account various factors including life cycle assessments. This will form part of the seaweed dry feed producer's certification.

CASE STUDY – FUTUREFEED

Cutting methane from meat and dairy production worldwide

"We aspire to see this program expand and grow to include the opportunity for consumers to scan their items and see the methane reduction path that was taken to get their steak on the plate or milk in their coffee." FutureFeed

FutureFeed was born out of a collaboration between CSIRO, James Cook University and Meat & Livestock Australia to develop a cost-effective dried seaweed feed ingredient.

Asparagopsis, a type of seaweed native to Australia, dramatically cuts methane emissions in the digestive processes of ruminant (herbivorous & hooved) livestock. Less than a handful of dried seaweed per animal per day is required.

Collaboration led to the discovery of FutureFeed's seaweed solution and is key to its rapid acceleration. Now, the company of the same name - FutureFeed - is commercialising the IP.

FutureFeed's science is currently applicable in the feedlot or feedyard, and in dairy systems, where animals are consuming a total mixed ration. A plan is underway to extend the use case into grazing in the medium term.

INCEPTION

Scientists from Australia's national science agency CSIRO worked with James Cook University and Meat and Livestock Australia

INVESTORS

CSIRO is **one of five investors** in its spin-off, alongside GrainCorp (produces stockfeeds and livestock supplements), Andrew Forrest's Harvest Road Group (aqua / agriculture), national supermarket retailer Woolworths Group and AGP Sustainable Real Assets-Sparklabs Cultiv8 Joint Venture

SCALING

Collaboration is one of the five values of FutureFeed

Significant collaboration between the seaweed, meat and dairy industries, government and end users (chefs, restaurants and retailers) towards scaling to a commercial level

STANDARDS

Standards Development Group brings together representatives from across the value chain to create a practical guide to the way the technology is delivered in market

Adopting 'open licensing' to encourage scaling

Crucial to the expansion of the technology is its licensing model that seeks to have seaweed grown in markets all around the world. There is high demand for the technology, but Asparagopsis seaweed had not been commercially cultivated prior to the discovery so increasing supply remains an opportunity. There are currently seven licensees globally: three in Australia, two in the US, one in Canada and one in the EU.

The next licensing frontier for FutureFeed is engaging with long-standing, experienced aquaculture operators. Certification (FF-CTM Product Verification) is expected in the near future and is designed to validate the use of Asparagopsis and the resulting methane abatement, including supporting claims on the voluntary carbon markets.

Asparagopsis grows abundantly in oceans around the world and can be cultivated in tanks

Around 5 grams of FutureFeed's solution per kilo of dry feed lowers emissions by over 80% (other seaweed can cut 10%-20% of methane)

Eliminates methane (below detection) production from rumen digestive processes (the first & largest of four stomach chambers) in the lab

Redirects feed energy otherwise lost as methane emissions into microbial metabolism beneficial to the animal

FutureFeed

LAND-BASED AGRICULTURAL SOLUTIONS

Increasing the capacity of soil to absorb CO_2 (sequestration) is gaining traction around the world. As well as playing a central role in food security, healthy soil can change agriculture from being one of the major contributors to climate change to becoming one of the major solutions.

Capturing, securing and storing carbon from the atmosphere in the soil can offset emissions, provide additional income for farmers and improve agricultural productivity and soil resilience.

Storing carbon in soil is a significant policy objective for China. Australia is **exploring the potential to utilise its landmass** to reduce emissions. There is an opportunity for dialogue between agricultural sectors in China and Australia on land management techniques and soil sampling and measuring to optimise soil carbon storage.

CHINA'S INTEGRATED ACTION PLAN

Forests, grasslands, soil and farmland ecosystems are important carbon sinks in the agricultural context.

Current policies in China cover the protection of forests, grasslands and soils, as well as the integrated conservation and systematic management of ecosystems, which have played an important role in promoting the growth of carbon sinks.

FOREST RESOURCES

A comprehensive plan to promote the high-quality development of forestry and grassland

Outline of the 14th Five-Year Plan for Forestry and Grassland Protection and Development (2020)

GRASSLAND RESOURCES

Proposing to establish a grassland protection and restoration system by 2025

Several Opinions on Strengthening Grassland Protection and Restoration (2021) State Council

FARMLAND RESOURCES

Main technologies related to agricultural carbon emission sources and carbon sinks; focus on promoting technology demonstration projects for carbon reduction and sequestration

Special Plan for Agricultural and Rural Science and Technology Innovation (2017) Ministry of Agriculture

This recent legislation is predated by efforts going back almost 50 years. Since 1978, China has planted trees under its Great Green Wall project in a bid to stop the Gobi Desert from expanding and eroding its land. As for farmland, conservation tillage constitutes the main path to increase carbon sequestration. Since 2005, the central government has made the development of conservation farming an important part of agricultural policy. These policies have been supplemented by agricultural science and technology innovation.

In October 2021, the State Council set out a comprehensive deployment plan for the major work of carbon peaking and carbon neutrality. This includes an action plan for agriculture, which proposes to promote carbon sequestration in agriculture and rural areas. The plans are contained in the *Working Guidance for Carbon Dioxide Peaking and Carbon Neutrality in Full and Faithful Implementation of the New Development Philosophy and the Action Plan for Carbon Dioxide Peaking Before 2030.*

Australian farmers' shifting practices

Soil carbon storage is a key focus in Australia's Long Term Emissions Reduction Plan, identified as a new frontier in the emerging carbon economy.

Farmers in Australia are changing land management practices, in turn increasing the living and decomposing organic matter in soil. Practices include shifting from crops to pastures, rotational grazing and retaining native vegetation.

While soil carbon storage provides Australia an opportunity to reduce emissions, the cost of sampling and measuring soil carbon is a barrier to wider uptake. The greatest challenge Australia has in unlocking the full potential of soil carbon storage is measuring the carbon in the soil. The government is accelerating funding toward research and development in this area, specifically seeking to develop technologies to lower the costs of soil carbon measurement.

China and Australia are already collaborating in this space, with leading agritech drone suppliers World of Drones and XA building a solid business in Australia's farming community.

Conservation farming, which forms part of China's Agriculture Plan, is an area that Australia has spent decades deploying and presents useful ground for collaboration between China and Australia's agricultural industries.

Indigenous knowledge

Indigenous Australians have cared for their land for thousands of generations. Australian Indigenous programs to heal land, and thereby increase its carbon storage potential, with native, strategic revegetation, are world-leading.

There is much to learn from Indigenous programs such as Carbon Positive Australia.

"Collaboration is absolutely necessary because you are talking about a 'global commons' problem and one that is in a real sense a zero-sum game. Yes, countries and regions can move the dial very significantly alone, but they can't by any means solve the problem. Collective action and collaboration are more efficient because each participant can feed back on the innovations and discoveries made by others."

Paul Jefferiss, UK National Committee on China Sustainability and Climate Lead, ex BP Global Sustainability & Climate Lead

WHAT NEXT?

The synergies and similarities of the challenges and opportunities faced by China and Australia bring an extraordinary chance to work together.

The agricultural industry is undergoing a transformation that takes in the supply chain in its entirety, from food production to waste.

Two mature sectors in Australia and China have an historical opportunity to combine knowledge, expertise and hard-won experience to forge a sustainable food future.

As the climate challenge moves nations beyond transactional relationships of bi-lateral agreements, there is an opportunity to engage in deeper, more impactful partnerships that can address global issues while strengthening domestic capacity.

By working more closely with its largest agribusiness customer, Australia can improve the performance of its world-leading sustainable agriculture sector and move into markets with new green products produced to meet the needs of a regenerative circular economy, a more demanding consumer and a tighter global regulatory regime.

CHAPTER

8

BEYOND COLLABORATION: THE HEART OF THE CHALLENGE

The issue of a global climate challenge and agreed emission targets by definition crosses borders. Confronting it requires international cooperation.

Partnerships and collaborations between governments, industry, the private sector, universities, multilateral institutions and civil society are essential to ensure nations meet their Paris Agreement targets and other international commitments.

Working together is no longer optional - it is an imperative.

Encouragingly, there is a transition underway towards new models of cross-border collaboration to tackle the climate crisis. They will drive the innovation and understanding needed for meaningful change.

As this report highlights, Australia and China have a track record of innovative collaboration across multiple sectors and industries. This is a solid base from which to work together.

KEY THEMES & OPPORTUNITIES

Themes emerged as we met with various experts through the course of producing this report.

There was a strong thread of opportunities to share insights and combine complementary strengths. As stated up front, the resulting report is by no means complete in its industry sector coverage. There are many other areas deserving inspection. Rather, it is a conversation starter.

Powering the Transition

Critical learnings emerge from the accelerated penetration of new variable renewable energy generation into the electricity grid, particularly in South Australia.

New wind, large-scale solar and domestic residential roof-top solar have powered a rapid rise in renewable energy; new jobs follow them.

Most (80%) of the renewable components (wind turbines, solar panels, batteries) are imported from China, and the new hydrogen economy is tracking the path of solar PV. For Australia there is value in leveraging China's expertise in building local factories fast, positioning it to become a regional renewables hub.

There is a need for new standards and education to prepare for jobs of the future.

Just as Australia's cities and towns grew on the abundance of resource exports, new wealth will emerge from the industries and capacities of the low-carbon energy future.

The potential needs a plan, supported by policy.

Mining & Future-Facing Industries

There is a new respect industry-wide for environmental limits of traditional mining practices and the need to decarbonise industry.

A refocus on new future-facing mineral resources (including gold, copper, magnetite, zircon, graphene and zinc) creates opportunities for new industries further up the value chain.

New ports and infrastructure are in development as we move to new low carbon industrial practices.

Local value-adding to extractions is an important capability and Australia will need experienced insights to build the smart factories to produce batteries, EVs and new processing plants.

A new corporate governance will emerge from powering that industry, managing its water use and living within the limits of Scope 3 responsibilities.

How can Australia and China work together to innovate?

Transport and Mobility

New fuels, refuelling systems, sales and service infrastructure are the market opportunities of the future for Australia.

There is enormous scope for Australian businesses to learn from China's lead in industrial transformation at scale and opportunities for technological innovation.

There are wealth creation opportunities from Australia's future industries.

Powered from an abundance of renewable resources and distributed through efficient HVDC or storage-supported distributed grid infrastructure, Australia's role as a regional refuelling hub could challenge traditional hydro-carbon exporters in the Middle-East and South-East Asia. A decarbonised future provides tremendous scope for Australia to build its sovereign capacity and reposition itself in the global trends around new, green economy markets.

Capital and capability are still keys to success and Australia must evaluate the pros and cons of working with, rather than against, the scale and demonstrated capacity in China.

With a fresh approach to knowledge-sharing and people-to-people exchange, Australia can fast-track its participation in AI, robotics, advanced manufacturing and sustainable development that is already occurring in China and increase economic complexity for security and prosperity in the region.

Green Cities

Urbanisation is a global trend driving the growth of cities, often with adverse environmental outcomes and health implications.

Green cities and buildings present an enormous opportunity for Australia to bring together knowledge and ingenuity.

China and Australia have a great deal in common and are uniquely placed for opportunities to design new, and regenerate existing, cities.

China's accelerating efforts to 'green' its cities through policy settings and pilot projects provide opportunities for Australian service providers and technology innovators to find new markets.

China's ambitions to create 'sponge cities' presents opportunities for Australian cities and businesses to share experiences in water sensitive urban design.

Collaborations on the application of Australian technology in China, and piloting innovations in Australia, provide a platform for wealth creation and solutions to the new green economy of the future.

Information exchange between China and Australia in terms of lessons learnt will have a considerable impact.

A 'green' Olympics in 2032 could act as a catalyst.

Funding the Transition

Australia is a capital constrained economy and the scale of transformation requires foreign investment and advanced manufacturing capabilities.

China carries the potential to become one of the greatest sources of capital to the region, funding green projects and generating green jobs; yet there is some hesitancy in Australia to source funds from China.

Australia has an opportunity to lead the way in regional green economy investments.

Australia can have a role in standards setting, allocation management and policing of green finance projects, particularly in the Asia Pacific region.

Agriculture

The future of food is green.

There is an opportunity to engage with Australia's First Nations people and ensure their participation, benefiting from their extensive history in and knowledge of land management.

For Australia there is a chance to learn how to scale and grow new innovations in an era of eco-agriculture and new alternative proteins.

China's agriculture sector is investing in sustainable agriculture, global EMS standards and AI monitoring and processing.

Australia has led the way in sustainable agricultural practices, building original product differentiators via standards and reporting requirements. Efforts to apply rigour to sustainability measures must accelerate.

Landowners and farmers are already maximizing yields through more efficient, sustainable farming practices integrating agritech from local and global innovators.

How can China and Australia work together to solve tomorrow's water, food and fibre challenges in the green circular economy?

COLLABORATION: THE HEART OF THE CHALLENGE

If there was an overarching approach that emerged in preparing this report, it was one of open-mindedness and eagerness.

Innovation and adaptation are widespread – whether global, national, regional or local. Yet the role any technology will play in five to ten years' time is hard to predict. Policy settings and political support, the scale and nature of investors, and local conditions all play a role.

This is why collaboration is a critical focus regardless of the sector or setting. Not only engaging in projects, but also sharing insights and innovation. The all-pervasive challenge draws stakeholders from across the economy. Governments must work within and across their borders to get the foundations right and allow business to take the lead.

PERSPECTIVE – CLEAN ENERGY COUNCIL

With complexity and pace comes a need to combine forces

"Collaboration is fundamental. We're now in an environment where the pace of change is extraordinary. Particularly for the energy sector and system, the levels of complexity and uncertainty have increased. This old idea that one organisation knew the answer – the reality is there's no individual with a monopoly on ideas and the future." Kane Thornton, CEO, Clean Energy Council

Whatever the precise future mix of renewables, Clean Energy Council CEO Kane Thornton highlights a significant challenge for Australia: the congested grid. The regulatory settings are complicated, including a mix of state-based electricity safety rules and federal pricing oversight.

It showcases how the big challenges and opportunities lie in the integration of technology, consumers, suppliers and markets. To Thornton, that means bringing people together for solutions. He points to inverter technology as one example. With an inverter on the side of Australia's 3 million solar-rooftop homes, Thornton says there's a need to better understand and utilise the sophisticated technology.

From a regulation perspective, the Clean Energy Council wants to see a new market framework to allow generators to "trade their way around congestion" (for example, a wind farm could send its power to a nearby battery for a price, rather than adding it to the grid). Better information flows between generators, network service providers and market bodies would accompany the market, to drive efficient and low-cost outcomes.

The industry group, representing more than 1,000 members across clean energy, put its argument to the Energy Security Board in its June 2022 submission on reform consultations. The Energy Security Board itself explicitly championed the need for "high levels of understanding, trust, and cooperation" and working together "in new ways" to deliver its planned reforms to the outdated system.

CONTINUING THE CONVERSATION

This report has explored the foundations for the conversations we need to have. Not just about the relationship between Australia and China, but their respective roles in this new era of decarbonisation.

Australia and China share mutual visions for future prosperity and taking a leadership role in a global transition.

Important conversations are happening within and across borders. To reach ambitious but critical goals, they are conversations we can all join in the vigorous and tireless pursuit of net zero.

AS WE LOOK TO COP27 AND BEYOND, WE WELCOME YOU TO THE TABLE TO DISCUSS.

CONTRIBUTORS

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