DECARBONISING WESTERN AUSTRALIA AND OUR TRADING PARTNERS

PORT HEDLAND INDUSTRY COUNCIL | MAY 2025

WESTERN AUSTRALIAN
TREASURY CORPORATION

Financial Solutions
for the Benefit of All
Western Australians

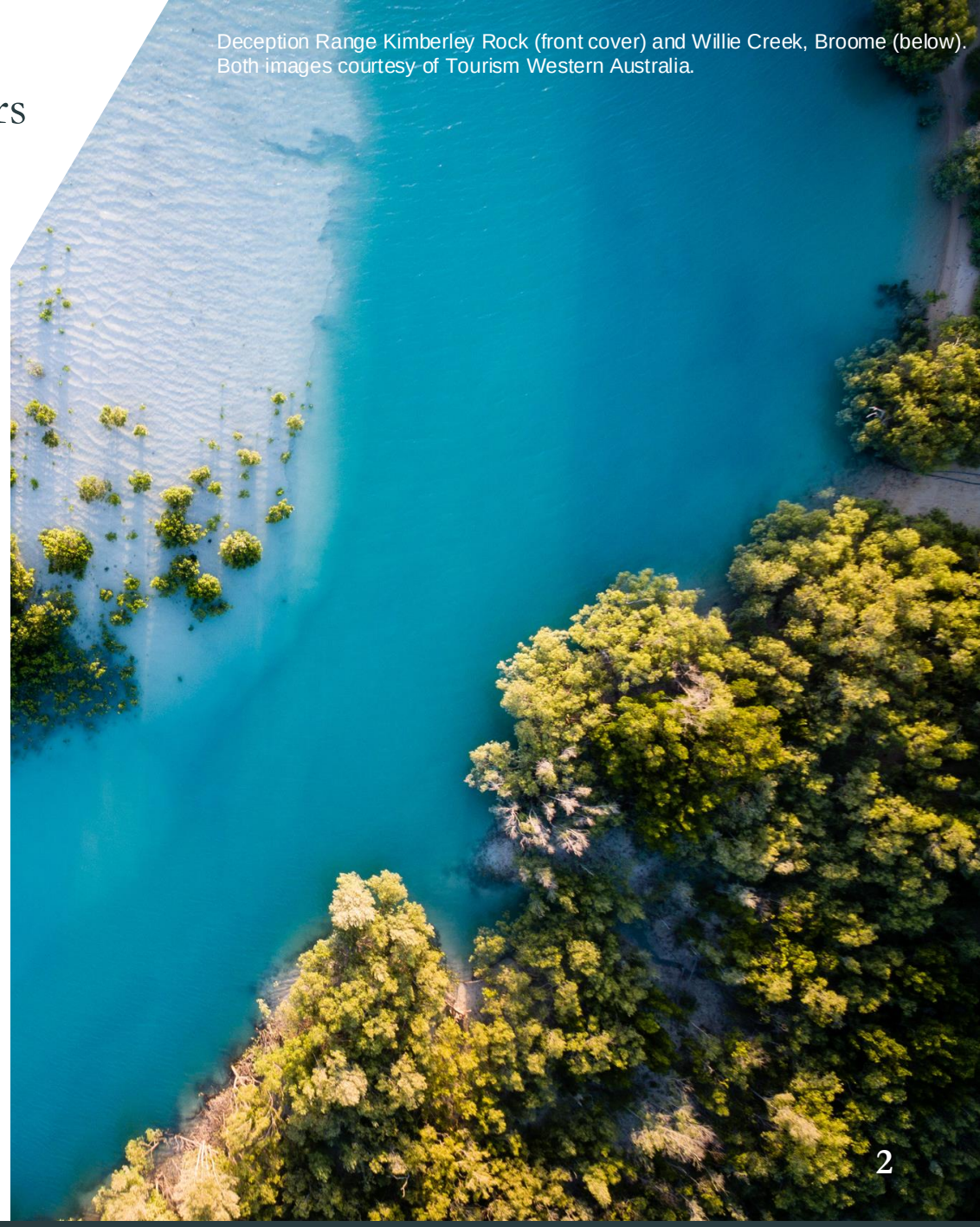
Decarbonising Western Australia and Our Trading Partners

Foreword

This investor focused publication seeks to provide holistic insight on how the Western Australian Government and industry are mobilising to transition the State and our trading partners towards a net-zero future. It seeks to complement the ESG disclosure series Supporting Continuous Improvement in ESG Outcomes for Western Australia and Western Australian Treasury Corporation's Sustainable Finance Program.

For Western Australia, as a large and resource rich jurisdiction, the transition represents a multi-decade investment opportunity to secure a sustainable energy system and foster carbon-competitive industries in a climate-resilient future. Pursuing opportunities that facilitate both global and local emissions reduction, however, means our decarbonisation pathway will be different to that of other jurisdictions.

Data convention: All annual figures for Australian or Western Australian data points relate to the financial year ending 30 June unless otherwise stated.



Deception Range Kimberley Rock (front cover) and Willie Creek, Broome (below). Both images courtesy of Tourism Western Australia.

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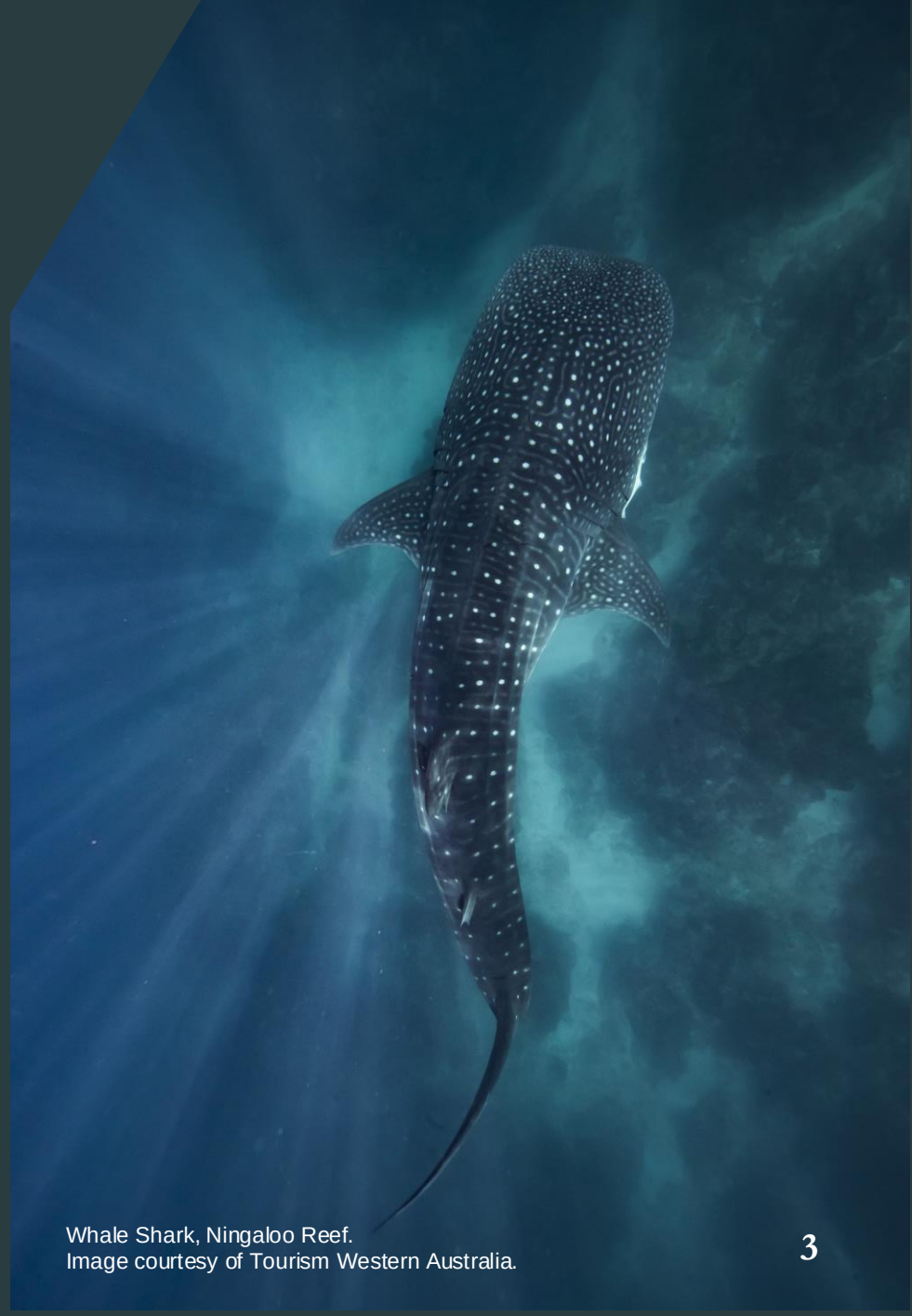
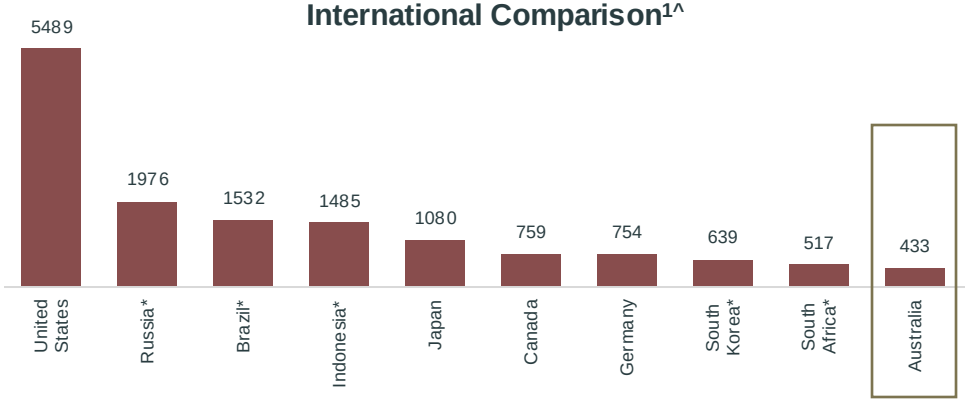


Whale Shark, Ningaloo Reef.
Image courtesy of Tourism Western Australia.

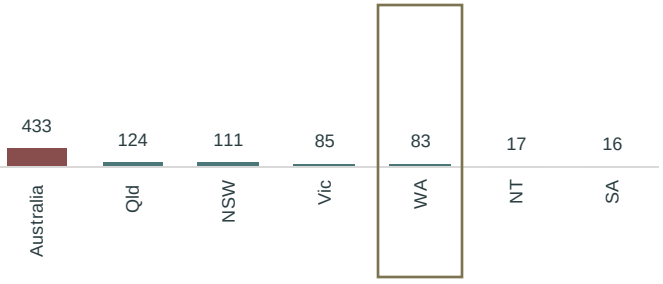
Western Australia's emissions profile compares favourably to other export orientated resource intensive economies

Total Emissions (mt CO_2-e) - 2022

International Comparison[1^]

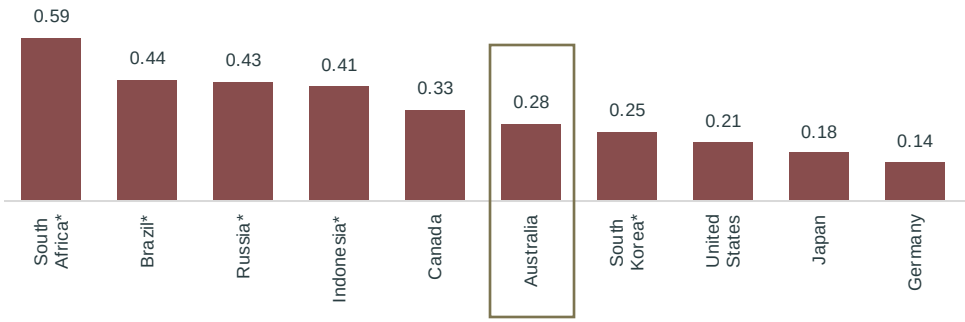


Australia and its States and Territories[2]



Emissions Intensity (kgCO_2-e / US$ GDP or GSP on a Purchasing Power Parity Adjusted Basis) - 2022

International Comparison[3]



Australia and its States and Territories[3,4]

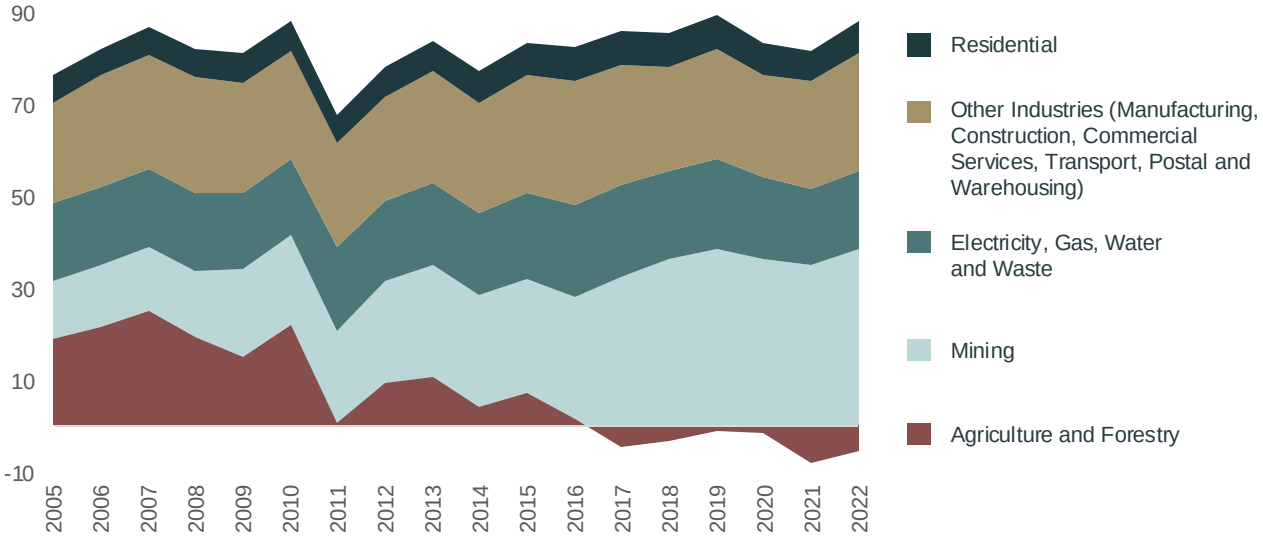
- Western Australia is responsible for 56% of Australia's resources exports but has an emissions intensity close to the Australian average.
- Western Australia has a land mass seven times the size of Germany but a sparsely distributed population of only 3 million. As such, emissions intensity based on economic output should be used as a comparative measure across economies, rather than emissions per capita which has limited relevance.
- Australia has robust reporting and accounting of emissions and is continually improving estimation methods.

Sources: [1] OECD Greenhouse gas emissions inventories | Total emissions except Russia, Brazil, Indonesia and South Africa from Climate Watch World | Total including LUCF | Greenhouse Gas (GHG) Emissions | Climate Watch (climatewatchdata.org). [2] Australia's National Greenhouse Accounts | Emissions by state and territory. [3] Emissions intensity calculated using IMF estimates of PPP adjusted GDP Report for Selected Countries and Subjects (imf.org). [4] Australia's National Greenhouse Accounts | Emissions per dollar of PPP adjusted GDP/GSP calculated using ABS state accounts.
Notes: * 2021 – latest available from source. ^ comparison country selection guided by RBA research (2013) on comparable resource-exporting countries, OECD countries with significant trade in energy and key Western Australian trade partners.

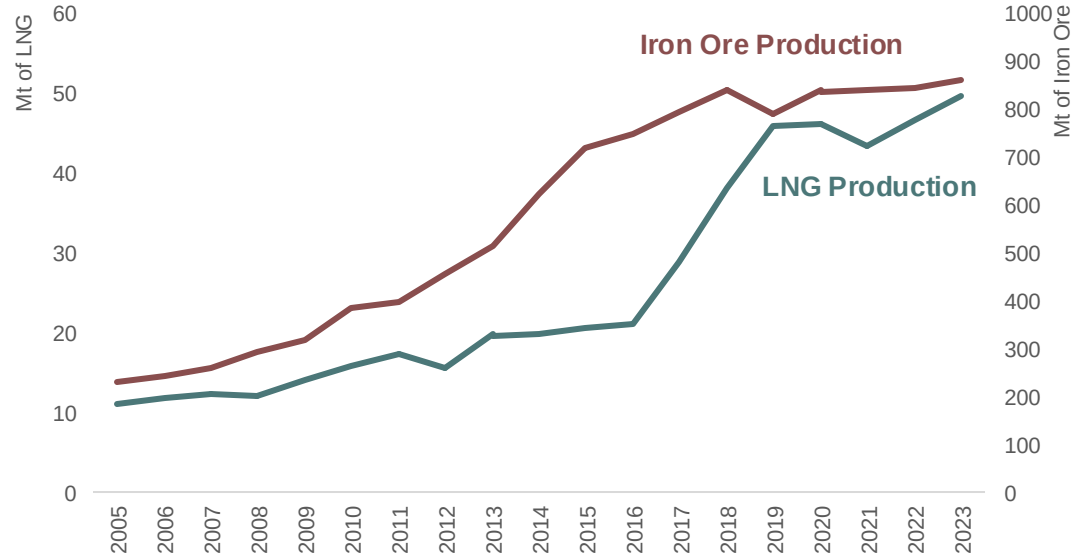
Western Australia's key mining industries have expanded rapidly since 2005 to support our trading partners, this has significantly impacted the level of mining emissions relative to other sectors

Western Australian Emissions by Industry 2005 – 2022 (mt CO_2-e)[1]

Note: Industry categories are individual or grouped by Australia and New Zealand Standard Industry Classification.



Western Australian LNG and Iron Ore Production Volume 2005 – 2023[2]



- Western Australia's volume of production for iron ore and LNG has quadrupled since 2005 to become the world's largest supplier of iron ore and in the top three of global LNG exporters, critical in supporting infrastructure development and energy security of our trading partners. The mining industry now accounts for 45% of Gross State Product.[1]
- The share of Western Australia's total emissions attributable to mining industry production has grown from a sixth in 2005 to just under half in 2022. This will significantly impact making meaningful comparison of Western Australian future emission reduction targets relative to other economies where the 2005 baseline is used.[1]
- Since 2016, carbon sequestration associated with land use, land use change and forestry has more than offset emissions produced by the agriculture sector.[1]

Sources: [1] Australia's National Greenhouse Accounts: Emissions inventories by economic sector. [2] Major Commodities Resource Data.

Western Australia is implementing strategic governance structures and policies to drive decarbonisation of its economy and provide certainty to key stakeholders

The State Government introduced the Climate Change Bill 2023 to Parliament in November 2023 to contribute to national and global goals for decarbonisation, provide certainty for businesses, and attract the investment required to transition to a net-zero economy.

Western Australian Climate Change Bill – Decarbonisation Specifics

Western Australian Economy

- **Expectation to set a 2035 emissions reduction target during 2025–26**
- **Net zero 2050**

State Government Direct Emissions

- **80% emissions reduction target between 2020–2030**
- **Net zero 2050**

Overview

- Climate Change Bill expected to be passed through Parliament and legislated as the Climate Change Act by end of 2024.
- Requires interim emission reduction targets to be set for the Western Australian economy as a whole and State Government direct emissions.
- The State Government target will apply to government operations, including government trading enterprises that own and operate energy intensive infrastructure such as electricity generation, public transport and water utilities.
- Requires setting of five-yearly emissions budgets as well as point targets.

Targets

- A net-zero emissions target by 2050 for WA total emissions and State Government direct emissions.
- An interim 2030 target for the State Government.
- Interim targets for 2035, 2040, 2045 and 2050 for WA and the State Government, which will be published as soon as practicable after the Federal Government sets Australia's Nationally Determined Contribution under the Paris Agreement for the target year.
- An emissions budget for WA for each target year and the four preceding years.

Accountabilities

- The Minister for Climate Action to report annually to parliament on WA's net emissions and progress against the emissions reduction targets.
- The legislation will require the State Government to develop an emissions reduction strategy covering all sectors of the economy to support achieving the targets. The inaugural strategy, to support achieving 2030 (State Government only) and 2035 targets, will be required within three years of the legislation passing.
- Ministerial Taskforce on Climate Action has responsibility for overseeing implementation and monitoring progress on the effective delivery of State policies on decarbonisation.

Shark Bay World Heritage Area.
Image courtesy of Tourism Australia.

2

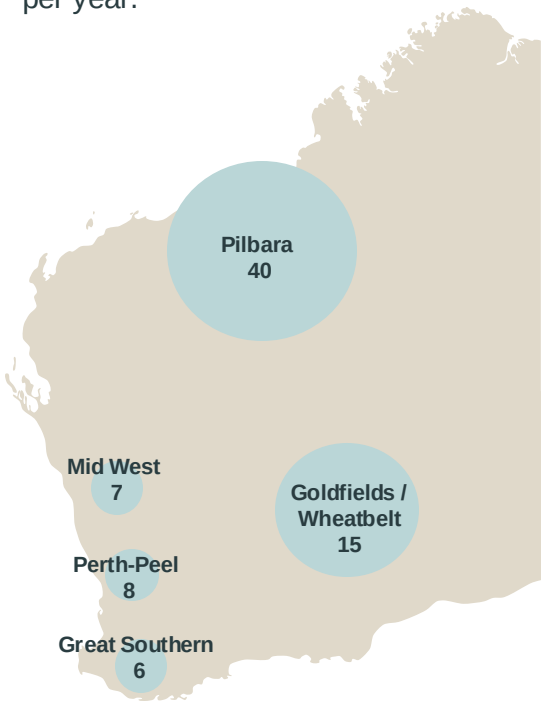
Decarbonisation drivers and engagement with trading partners

Western Australia’s economic activity is already playing a key role in supporting our trading partners' decarbonisation and large investments in renewables will progressively decarbonise domestic production.

The Safeguard Mechanism requires that from 2023 Western Australia's largest emitters, concentrated in mining, reduce their baseline emissions by at least 4.9% p.a.

Safeguard Mechanism[1]

Commencing from 1 July 2023, the Federal Government *Safeguard Mechanism* legislates that Australia's highest greenhouse gas emitting facilities (> 100,000 tCO_2-e per year) must reduce their net emissions baseline by a minimum of 4.9% per year.*



~35% Over one third (76) of Australia's largest emitters are located in WA^

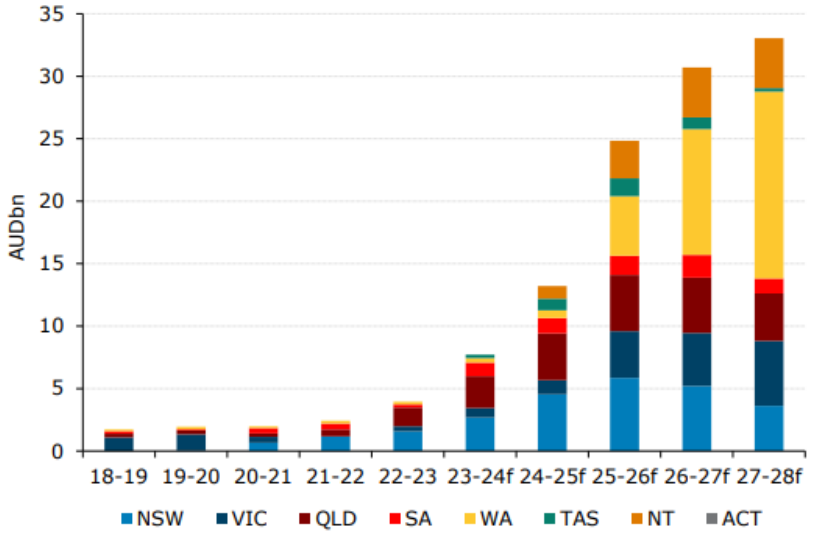
49% of WA's total emissions are from Safeguard Mechanism facilities

85% of WA's emissions from Safeguard facilities are in the Mining sector

Industry Response

- Western Australia's mining industry is well positioned to decarbonise its operations, given its endowment of natural resources, balance sheet strength of its key entities and experience in delivering large scale transition across supply chains and investments.
- Western Australia's top 10 emitters (82% of WA's Safeguard emissions) each have net zero by 2050 commitments, with many including detailed interim targets and extension to scope 3 commitments.[2]
- These commitments are being supported by forecast capital expenditure on decarbonisation initiatives, including direct investment in renewable energy to support mining operations.

Renewables Major Project (>AU$500m) Pipeline by State – WA by far the Largest[3]



Sources: [1] Safeguard Emissions Data 2022–23 – Clean Energy DCCEEW. [2] Safeguard entities websites. [3] ANZ, Australian Major Projects: pipeline to peak in 2025–26, 31 October 2023.
Notes: * 'Baseline' is assuming constant production based on previous year's output, can be complied with by applying eligible carbon offsets.
^Approximate grouped location of Safeguard facilities, noting several are located offshore.

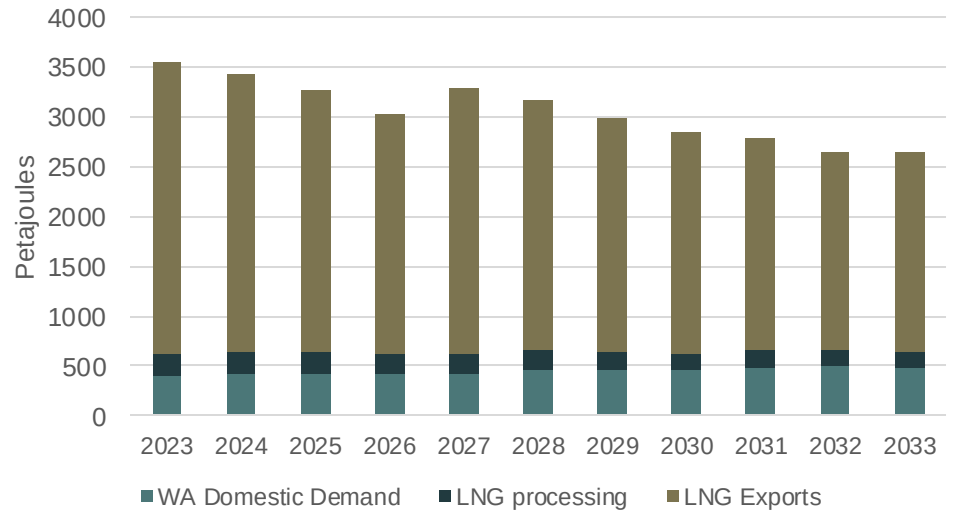
Western Australia produces more than half of Australia's gas – thereby having the primary role in delivering Australia's Future Gas Strategy

The Role of Western Australia's Gas and Impact on Emissions Profile

The Australian Future Gas Strategy outlines the important ongoing dual-role gas will play in providing energy security for Australia and its trading partners, as well as supporting the transition to net zero.

- 60% of Australia's LNG is exported from WA, where production has quadrupled since 2005. Together with the impact of fugitive emissions and domestic consumption, gas contributes around half of Western Australian emissions.
- These dynamics will materially impact WA's ability, in the medium term, to set emissions reductions targets from the 2005 baseline at the same rate as Australia's commitments under its Nationally Determined Contribution.
- Decarbonising gas production, storage and usage is a key focus of collaboration between the WA Government and industry and will require application and advances in CCUS and electrification, underpinned by the requirements of the Safeguard Mechanism.

Western Australia Total Gas Demand Forecast[1]



Impact on Trading Partners

Export demand projections demonstrate WA LNG will play a vital role in providing a reliable supply of electricity and grid stability as renewable power sources become a larger part of the energy mix amongst our trading partners, particularly in Asia.

A reliable supply of LNG can reduce the carbon intensity of our region's energy mix, including by replacing more emissions intensive fuels like coal.

- For example, South Korea, accounting for 13% of WA's LNG exports, will reduce reliance on coal through investment in renewables and nuclear, but also through the switching of 28 coal-fired power plants to LNG by 2036 as part of their *10th Basic Plan for Power Supply.*[2]

Sources: [1] Adapted from AEMO 2023 WA GSOO Data Register - Figures (Expected Case). [2] S&P Global, 12 January 2023.

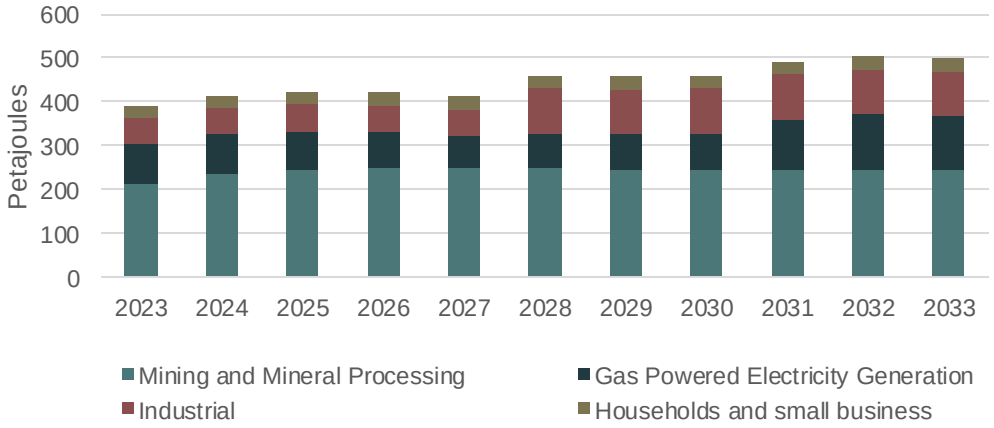
Domestically, gas plays a critical role in supporting mining, minerals processing, industrial use and electricity grid stability for renewables expansion, with each of these key drivers of the WA economy

Key Drivers of Domestic Gas Demand

WA is the largest consumer of gas in Australia (~43%[1]), primarily in support of mining operations, including for critical decarbonisation minerals such as lithium, and industrial processes. Electrification will support decarbonisation, however limited other commercially viable substitute technologies are anticipated to emerge in the short-term, requiring ongoing use of gas in these sectors.

Gas will play an important role as a firm and flexible energy source as WA's electricity systems transition to high levels of renewables to support decarbonisation of industry. Gas firming will facilitate the phased closure of state-owned coal-fired power stations by 2030.

Western Australia Domestic Gas Demand Forecast[2]



Carbon Capture, Utilisation and Storage (CCUS)

CCUS will have an important role to play in supporting the transition to net zero across three key areas:

1. **Decarbonising the gas industry**
2. **Decarbonising hard to abate industrial sectors**
3. **Supporting trading partners through carbon importing**

- WA is already home to the world's largest CCS initiative as part of Chevron's Gorgon LNG Project, which has captured and stored over 9.5 million tonnes of CO_2 to date.
- WA is well positioned to further develop this industry, given its existing technological expertise, geology and infrastructure. A CSIRO and GCCSI study into WA's CCUS potential identified that CCUS hubs have the potential to reduce emissions from gas by up to 27 mt p.a. and support development of hydrogen and ammonia industries.
- The WA Government has passed legislation to support the CCUS industry by enabling the transport and storage of greenhouse gases, as well as enabling exploration for naturally-occurring hydrogen. It has also committed to developing a CCUS Action Plan with associated industry development funding, which aims to:

Accelerate deployment of proven CCUS technology

Support research into new CCUS technology

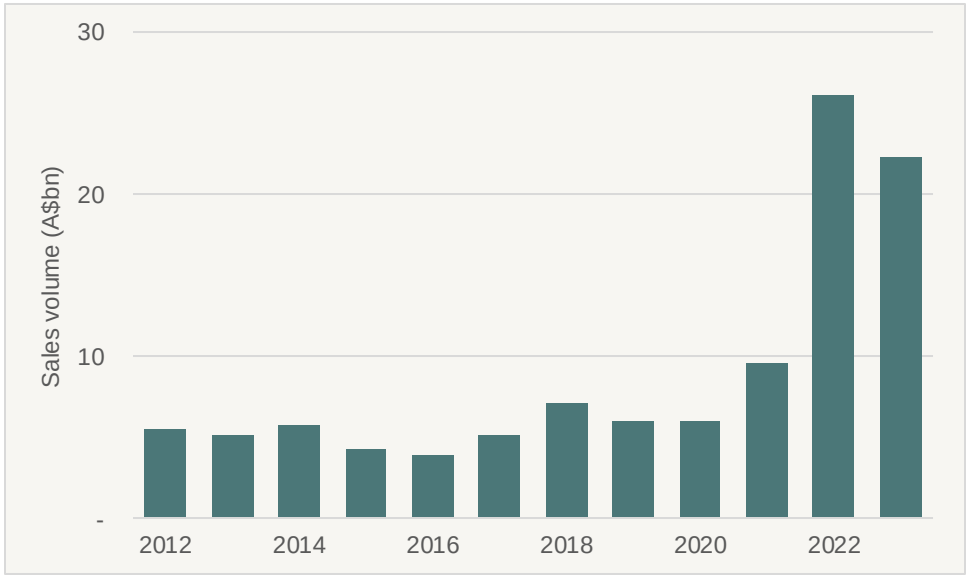
Attract investment in CCUS

Sources: [1] Australian Government, Future Gas Strategy Analytical Report. [2] Adapted from AEMO 2023 WA GSOO Data Register - Figures (Expected Case).

Western Australian critical mineral production is already a major enabler to trading partners' decarbonisation

Critical minerals are fundamental to the energy transition both nationally and globally. WA is uniquely placed to maximise this opportunity as the world's largest lithium supplier and as a leading producer of other critical minerals including cobalt, nickel, manganese and rare earth elements.

Western Australian Battery and Critical Mineral Production[1,2]



Includes sales of lithium, nickel, cobalt, manganese, copper metal and rare earth elements. Note sales data for manganese and rare earth elements was classified as not for publication in some years.

WA Global Ranking	Critical Mineral	WA Market Share (global)
#1	Lithium	52.9%
#2	Alumina	9.9%
#3	Rare earth oxides	9.6%
#3	Zircon	16.0%
#4	Cobalt	3.1%
#5	Nickel	4.7%
#6	Manganese	2.5%

Figures are for 2023. Market share data from WA Mineral and Petroleum Statistics Digest 2022–23.

Renewable Energy and Clean Technology Uses

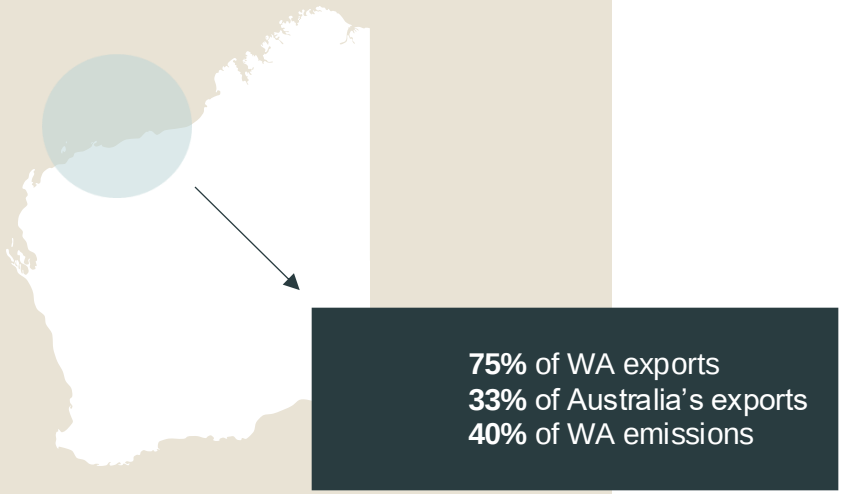
- Electric vehicles
- Batteries
- Wind turbines
- Solar photovoltaics (PV)
- Hydrogen electrolysers

Recognising the importance of international partnerships in global decarbonisation efforts, the Western Australian Government is working with the Australian Government and its trade and investment offices to foster international partnerships, attract investment, and promote diversified and ethical supply chains.[3]

Sources: [1] WA 2023 Major Commodities Resource Data File. [2] WA Mineral and Petroleum Statistics Digest 2022–23. [3] WA Battery and Critical Mineral Strategy 2024–2030.

Decarbonising the Pilbara region through transition to renewables and its expansion to support electrification of mining processes is an enormous task but work has commenced supported by robust long-term plans and government partnership with industry

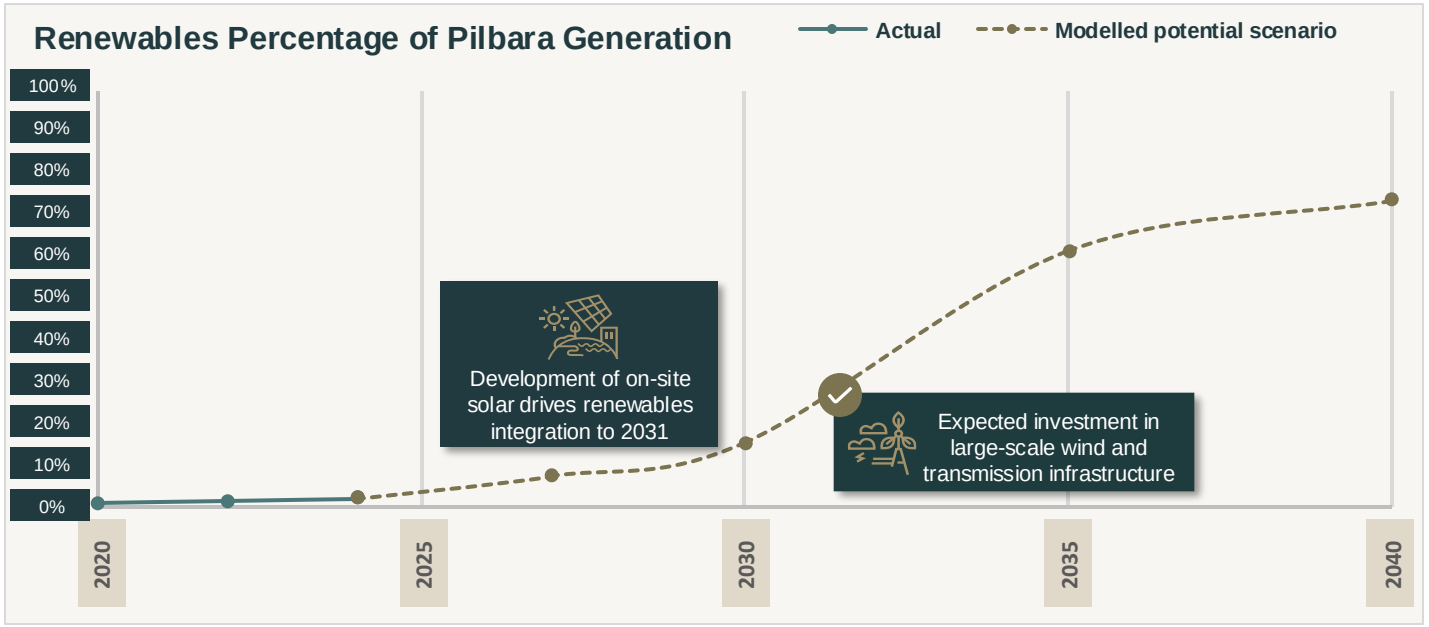
Pilbara Region



75% of WA exports
33% of Australia's exports
40% of WA emissions

Sources: Pilbara Development Commission, Sectoral Emissions Reduction Strategy (WA Government, December 2023).

Renewables Percentage of Pilbara Generation



Notes: * Independent modelling commissioned by the Western Australian Government, informed by views of industry representatives and publicly stated company targets.

At present:

- Highly decentralised (over two thirds of companies self-supplied).
- More than 95% generation from gas.

The future:

- Significant expansion of common user infrastructure from landmark agreement between industry and WA Government leading to the Pilbara Energy Transition Plan.
- Generation capacity to at least double by 2040 from renewables investment.
- Government funding support: up to $3 billion Federal and initial $148 million State.

Industry led renewable electricity generation projects: Pilbara region case studies

There are numerous renewable projects in the pipeline in the Pilbara region which will drive decarbonisation of the energy sources used in the mining industry – the majority of which will connect to an expanded common user network infrastructure.

Almost 50% ($83 billion) of an Estimated $177 billion Potential Future Capital Expenditure Across 70 Projects in the Pilbara is for Clean Energy.[1]

Yindjibarndi Renewable Project[2]

Production	First generation expected end 2027
Status	In development
Companies involved	Yindjibarndi Energy Corporation (YEC), a partnership between Yindjibarndi and ACEN Corporation
Renewable Type	Solar, Wind, Battery, related infrastructure (including transmission)
Total Investment	A$1.4 billion (Stage 1)
Renewable Capacity	Stage 1: 375 - 450 MW solar, 250 MW wind Stage 2: 2 - 3 GW (various projects)
Key Features	• YEC represents one of the largest Indigenous-led renewable energy initiatives in Australia. YEC is working to develop, own and operate renewable energy projects on Traditional Owner country located within Yindjibarndi Native Title Determination Areas

Port Hedland Solar and Battery Project[3]

Production	Late 2024
Status	Under construction
Companies involved	APA Group
Renewable Type	Solar Batteries
Total Investment	A$200 million ($1.5 million of Government funding as part of Clean Energy Future Fund)
Renewable Capacity	Solar: 45 MW Battery storage capacity: 36.7 MWh
Key Features	• Being connected to the existing Port Hedland power station • Will supply renewable energy for large mining customers in the Pilbara region

Woodside Solar Facility[4]

Production	50MW (target during 2026)
Status	Subject to Final Investment Decision (FID)
Companies involved	Woodside Energy
Renewable Type	Solar Battery storage (future consideration)
Total Investment	To be determined
Renewable Capacity	Initial phase 50 MW Planning approval for up to 500 MW
Key Features	• 50 MW solar farm to supply renewable energy to Woodside's Pluto LNG facility • Proposed to be connected to the North-West Interconnected System via new common use transmission infrastructure

Sources: [1] Pilbara Development Commission. [2] Yindjibarndi Energy. [3] Port Headland solar and battery project. [4] Woodside: Thriving through the energy transition.
Images of Yindjibarndi Renewable Project, Port Hedland Solar and Battery Project and Woodside Solar Facility courtesy of corresponding companies.

Expansion of midstream critical mineral processing will further support trading partner decarbonisation

Building upon WA's competitive advantage in critical minerals, WA will look to expand its midstream processing industries to provide low-carbon battery materials and further enhance global decarbonisation efforts.

WA's Midstream Processing - Future Opportunities Aiding Global Decarbonisation

Expansion of the midstream battery and critical minerals processing industry is a key pillar of WA Government's Battery and Critical Minerals Strategy 2024–2030, with key opportunities for decarbonisation including:

- Co-locating mining and minerals processing operations, reducing carbon emissions associated with transporting raw materials.
- Use of renewable energy in processing to potentially displace processing in other jurisdictions reliant on high-emitting electricity generation.

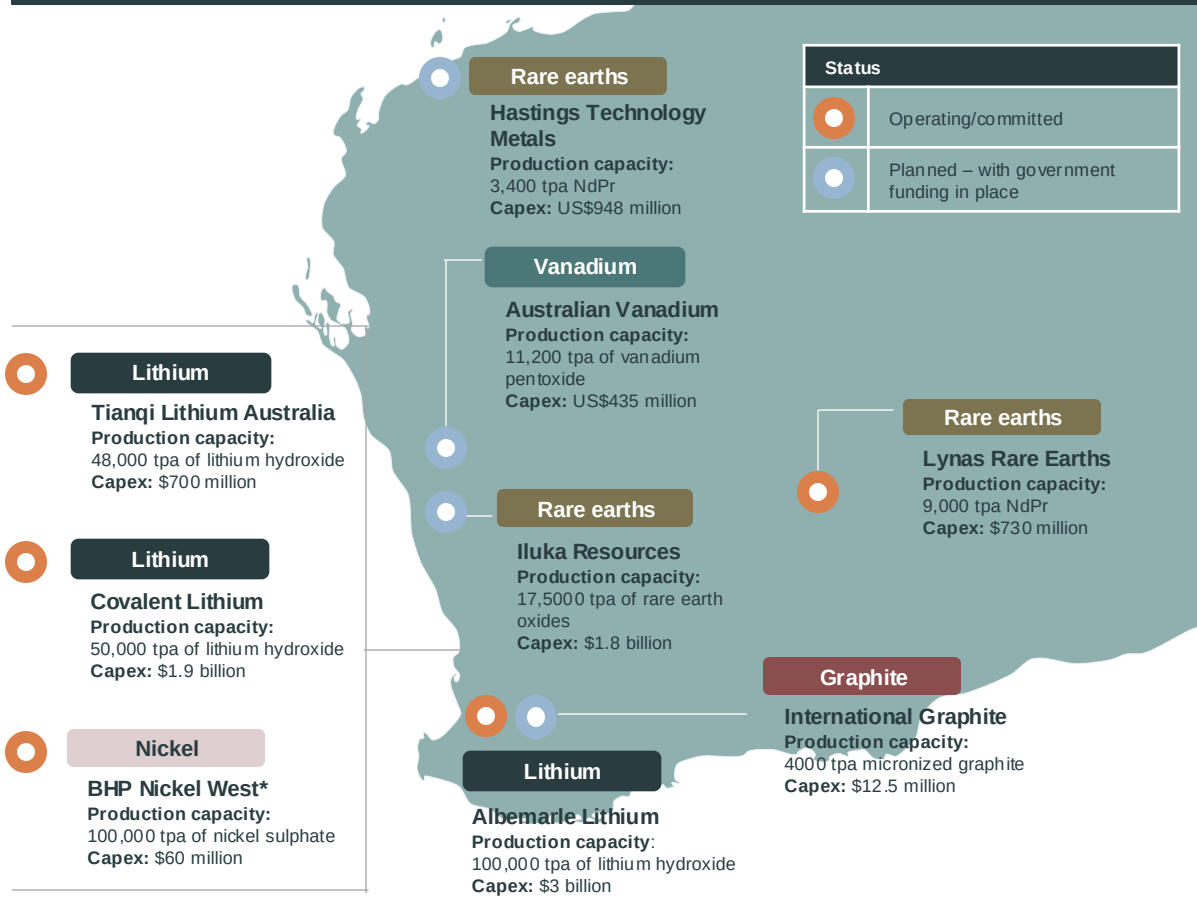
Case Study: Austvolt – Precursor Cathode Active Material (PCAM)[1]

The Austvolt Facility aims to be Australia's first commercial scale PCAM and / or CAM plant, helping to drive Western Australia's advanced manufacturing ambitions.

With an externally estimated investment range of $251–500 million[1] (including $3 million from the WA Government), the facility is currently planning its pilot programme for battery cathodes, with capacity for more than 500,000 EVs per year expected from 2027.

Sources: [1] WA Investments.
Notes: * Operations temporarily suspended.

Western Australia's Key Midstream Investments - Approx. $9 billion Since 2015



Western Australia has the potential to become a major world producer and exporter of renewable hydrogen

WA Comparative Advantage[1]

- 2.5 million km^2 land
- 13,000 km coastline
- Intense wind and solar conditions at prospective locations:
  - e.g. Oakajee (average wind speed ~8m/s and annual Global Horizontal Irradiation of 2,100 kWh/m^2
- Existing export facilities plus committed WA Government support for land and supporting infrastructure
- Extensive resources industry experience that 'make projects happen'

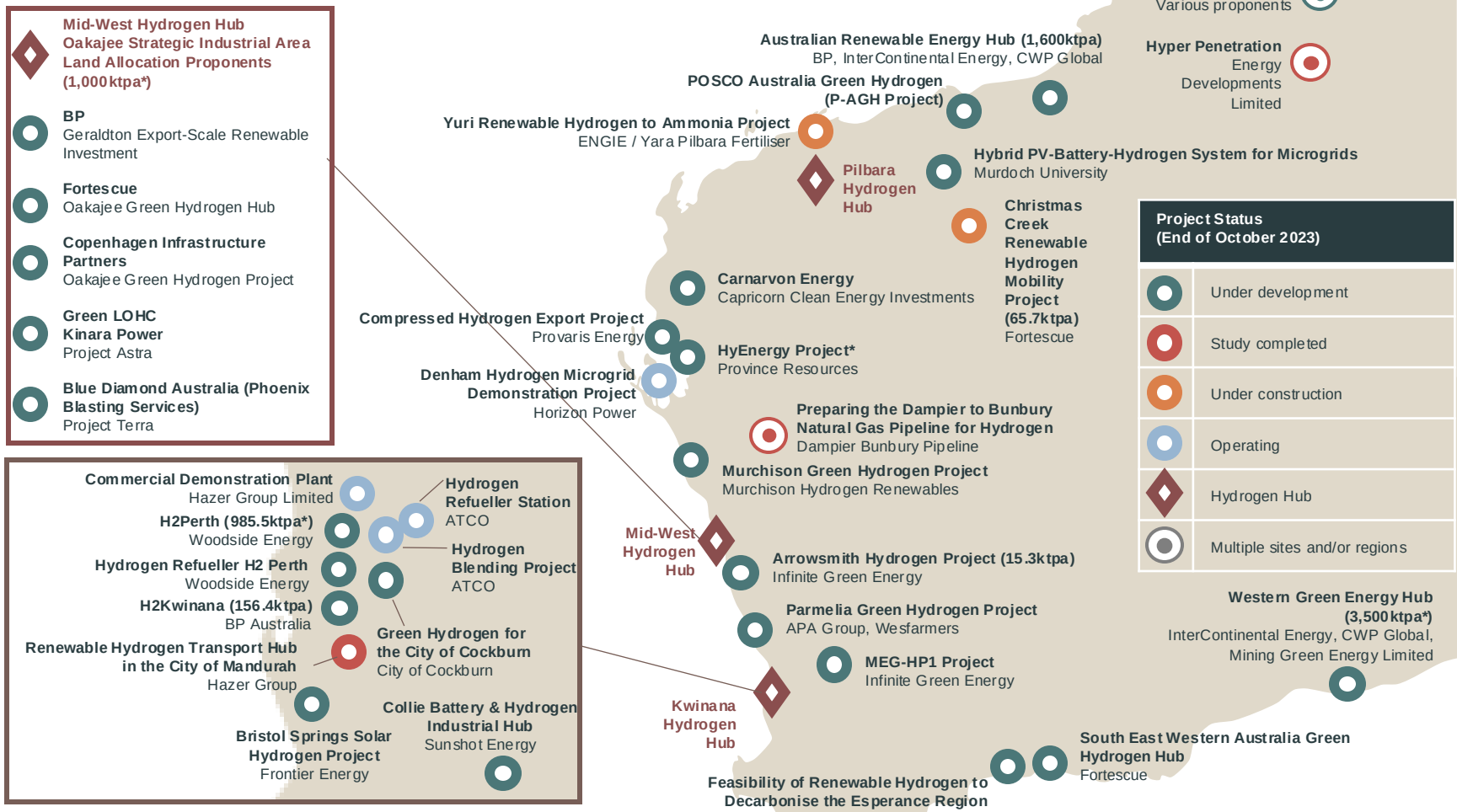
Project Summary[2]

23 Renewable hydrogen production projects (as tracked by CSIRO)

>6,000 ktpa Potential future renewable hydrogen production capacity

14 Projects have received government funding including 8 through WA Government's Renewable Hydrogen Fund

WA Renewable Hydrogen Projects[3]



Sources: [1] Western Australia: An outstanding place for renewable hydrogen investment. [2] CSIRO, HyResource. [3] WA: An outstanding place for renewable hydrogen investment.
Notes: *On hold.

Greening the steelmaking value chain – Western Australia has the potential to realise a unique competitive advantage and materially support global decarbonisation

As the world's leading iron ore producer accounting for around one third of global supply, WA's Green Steel Opportunity positions the State to facilitate decarbonisation of the global steelmaking industry, which is currently estimated to generate more than 7% of global carbon emissions.[1]

WA's green steel value chain opportunities offer the possibility of lowering global emissions, but with at least a medium-term trade-off in increasing WA's domestic emissions.

Opportunities for WA to Decarbonise the Steel Value Chain

Greening iron ore supply
Deploy renewables to replace fossil fuel generated power at mines and use alternative fuels to transport ore.

Decarbonised iron-making
Replace coal blast furnace processing of iron ore feedstock with natural gas or renewable hydrogen shaft furnaces to produce iron in the form of hot-briquetted iron (HBI).

Green steel production
Convert green iron into green steel domestically, leveraging a full suite of renewable energy solutions across the full value chain.

Lower-carbon Iron Production Using Natural Gas

Estimated impact on value chain emissions of replacing iron ore exports with production of HBI using natural gas shaft furnaces in WA:*

Onshore emissions impact (WA)
+0.51 tCO_2-e
per tonne HBI produced

Value chain emissions – net global impact
-1.17 tCO_2-e
per tonne HBI produced

This opportunity will become even greater should it become feasible and economic to replace natural gas with renewable hydrogen, allowing WA to produce **Green HBI**.

Case Study: Christmas Creek Green Metal Project[2]

The Christmas Creek Green Metal Project will use green hydrogen produced at Fortescue's gaseous and liquid facility, together with an electric smelting furnace, to produce high-purity iron metal through a 'green pit to product' supply chain. This will be suitable for use in almost any steel plant globally.

US$50 million
capital expenditure

1,500 tpa
production volume

2025
anticipated first production

Green Steel Opportunity

MIRWA modelling suggests a longer-term opportunity for WA green steel to contribute to global decarbonisation. Replacing just 50MT (~5%) of WA **iron ore exports** with 30MT **green steel exports** could achieve:

-0.14%
reduction in global emissions

Notably, this reduction is approximately equal to WA's overall contribution to global emissions at present.

Sources: [1] MRIWA Green Steel Resources. [2] Fortescue, Christmas Creek Green Iron Pilot.
Notes: *Assumes use of green iron ore feedstock (Green Pellets), meaning ore has been pelletised using a hydrogen indium furnace.

Oxer Lookout, Karijini National Park. Image courtesy of Tourism Western Australia.

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