

On the rise

Gas projects push WA jobs

FOR
S
T
A
C
T



P R O S P E C T



The first edition of *Prospect* magazine for 2019 coincides with a positive start to the New Year.

Confidence is returning to the Western Australian economy and new jobs are being created.

Western Australia's total employment rose through last year to November 2018, with a rise in full-time employment – up four per cent or 35,520 full time workers.

The largest increases in employment through the year to the December quarter 2018 were in the State's mining (up 24,027) and manufacturing (up 23,786) sectors.

Our State continues to lead the way nationally as the main minerals and petroleum exporting region of Australia and produces a significant proportion of the world's minerals and petroleum commodities.

Western Australia accounted for over half of Australia's mining output (52 per cent gross value added) in 2017–18, during which minerals and petroleum sales rose nine per cent to \$115 billion, mainly due to increased sales of LNG.

This edition of *Prospect* covers recent successes across Western Australia's resources sector, including for Western Australian gas giant Woodside in Karratha (page 2); the 2018 Resources Sector Awards for Excellence (24); and the 130th anniversary of Western Australia's Geological Survey (20).

New industries also feature in this edition, including a lithium projects update (page 8); the launch of Airbus Defence and Space's pseudo-satellite aircraft in Western Australia (page 23); and opportunities in renewable hydrogen for Western Australia (11).

The Western Australian Government is continuing to work with the State's resources industry across the board to ensure local jobs are maximised on new projects, and we are committed to implementing our Plan for Jobs and diversifying the economy.

Mark McGowan

PREMIER; MINISTER FOR STATE DEVELOPMENT, JOBS AND TRADE

Bill Johnston

MINISTER FOR MINES AND PETROLEUM

ISSN 1037-4590

Prospect

Western Australian *Prospect* magazine is published quarterly by the Western Australian Government's Department of Mines, Industry Regulation and Safety (DMIRS) and Department of Jobs, Tourism, Science and Innovation (JTSI).

JTSI Editorial management: Rebecca Atkinson, JTSI Communications and Marketing Division.

Tel: +61 08 9222 0417 • Fax: +61 08 9222 0505

DMIRS Editorial management: Beau Pearson, DMIRS Corporate Communications Division.

Tel: +61 08 9222 3736 • Fax: +61 08 9222 3862

Digital Subscriptions: www.dmp.wa.gov.au/prospect. Tel: +61 08 9222 3333

Disclaimer

Prospect has been compiled in good faith by the Department of Mines, Industry Regulation and Safety (DMIRS) and Department of Jobs, Tourism, Science and Innovation (JTSI). Opinions expressed in *Prospect* are those of the authors and do not necessarily represent the views, or have the endorsement of DMIRS and JTSI. DMIRS and JTSI has used all reasonable endeavours to ensure the material contained in this publication is correct, but it is intended to be general in nature. No representation is made with regard to the completeness or accuracy of the information contained herein. DMIRS and JTSI disclaims any or all liability for loss or damage whatsoever suffered or incurred resulting from the use of or reliance on information contained herein. Readers of this publication should make and rely on their own enquiries, research and judgements in making decisions affecting their own or any other persons' interest.

All currency figures in *Prospect* are in Australian dollars unless otherwise specified.



Cover Photo: Pluto LNG Plant onshore gas plant employees. Copyright Woodside Energy Ltd.
(story page 2)

Scan this QR code to view links to all the department's publications

DEPARTMENT OF JOBS, TOURISM, SCIENCE AND INNOVATION

Level 6, 1 Adelaide Terrace

East Perth, Western Australia 6004 • AUSTRALIA

Tel: +61 8 9222 0555 • Fax: +61 8 9222 0505

www.jtsi.wa.gov.au

DEPARTMENT OF MINES, INDUSTRY REGULATION AND SAFETY

Mineral House, 100 Plain Street

East Perth, Western Australia 6004 • AUSTRALIA

Tel: +61 8 9222 3333 • Fax: +61 8 9222 3862

www.dmirs.wa.gov.au

In this issue



05



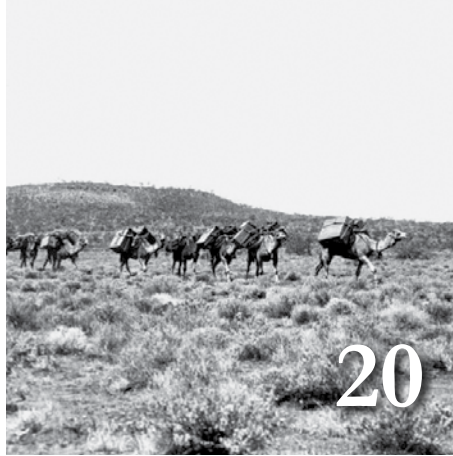
08



12



18



20



23

05 LNG jobs taskforce

Government and industry come together to maximise jobs and economic benefits for WA.

08 New mines

Two new lithium mines in WA's Pilbara region officially open.

12 Asian engagement

The WA Government brings Asian Business Councils together to discuss job creation and future economic prosperity.

18 New MRIWA CEO

The Minerals Research Institute of Western Australia appoints new CEO Nicole Roocke to lead the way with mineral research priorities for the State.

20 GSWA marks 130th anniversary

From plane-tables and glass-plate negatives, to GPS and drones, the Geological Survey of Western Australia celebrates its rich history.

23 From the UK to WA and into space

Airbus Defence and Space chooses Western Australia to launch its High Altitude Pseudo Satellites program.



Department of **Mines, Industry Regulation and Safety**
Department of **Jobs, Tourism, Science and Innovation**

Department of Mines, Industry Regulation and Safety
www.dmirs.wa.gov.au

Department of Jobs, Tourism, Science and Innovation
www.jtsi.wa.gov.au



Pluto LNG onshore gas plant. Photo: Woodside Energy Ltd

GAS SUCCESSES FOR WOODSIDE AND KARRATHA

Australian oil and gas giant Woodside is entering a growth and construction phase and investing significantly into its developments, with thousands of job opportunities to be created, helping secure the long-term future of Karratha.

Growth and expansion projects, including the Pluto LNG expansion, upgrade of the Karratha Gas Plant and future processing of Browse and Scarborough gas in Karratha, are part of Woodside's plans to build on the significant infrastructure it has already developed locally.

December saw the Woodside-operated Pluto LNG Project supply its first gas to the Dampier to Bunbury Natural Gas Pipeline, with successful commissioning of the Pluto pipeline gas facility.

A ceremony was held on site in Karratha on 18 December following the completion of commissioning activities, during which the facility produced at near its capacity of 25 terajoules per day.

The company stated that Pluto pipeline gas will now form part of Woodside's domestic gas supply

portfolio, adding to its foundation domestic gas facility at the North West Shelf.

Additional domestic gas supply from Pluto is scheduled to start up early this year with the commissioning of the Pluto LNG trucking facility.

Woodside stated the domestic gas infrastructure on the Pluto site also will be expanded as part of the proposed Pluto Train 2 Project, for which a final investment decision is targeted in 2020.

Late last year, gas production at the Woodside-operated North West Shelf Greater Western Flank Phase 2 (GWF-2) Project off the northwest coast of Australia commenced ahead of schedule.

The GWF-2 Project was approved in December 2015 to develop gas and condensate from gas fields in the Camarvon Basin.

Between 2015 and 2018, Woodside implemented the two-phase project, connecting additional fields to the Goodwyn A platform using subsea tiebacks.

Woodside CEO Peter Coleman said the project had been delivered below the expected cost of about \$2 billion, and six months ahead of schedule.

"The project team has done an outstanding job executing and delivering GWF-2, which represents the next phase in gas supply to the NWS Goodwyn A platform, extending the life of the Karratha Gas Plant and contributing to Woodside achieving our targeted production of 100 MMboe (million barrels of oil equivalent) in 2020," he said.

"This success has been achieved by combining the two GWF-2 drilling campaigns, accelerating project work packages and collaborating closely with our contractors."

Mr Coleman said that the capabilities demonstrated on the GWF-2 Project would be carried forward in the next phase of growth, including proposed developments of the Scarborough and Browse offshore gas resources.

"The Scarborough and Browse projects are part of our vision for the Burrup Hub, which would unlock the future of the Karratha Gas Plant and Pluto LNG," he said.



Future plans and local jobs

The start of gas production at the Greater Western Flank Phase 2 Project in October followed the announcement in mid-2018 of a new local jobs plan and online jobs portal by Woodside, to ensure Karratha locals are given more opportunities to secure work on Woodside projects.

Premier and Minister for State Development, Jobs and Trade, Mark McGowan welcomed Woodside's commitment to local jobs in Karratha.

"The Local Participation Plan will ensure that the next wave of Woodside projects create direct jobs for people in the Pilbara," Mr McGowan said.

The plan includes a Local Jobs Portal, an online tool where locals can register their skills and availability for jobs, with Woodside using the portal to find suitable workers from the Pilbara region before considering FIFO workers to work on its facilities in the region.

Woodside's contractors will also be required to use the 'Locals First Portal', to ensure more local jobs are created.

"I'm pleased we've been able to work with Woodside to ensure that the development will lead to long-term jobs for people in Karratha," Mr McGowan said.

"I'd like to acknowledge local MP Kevin Michel for his tireless work to ensure that people in the Pilbara are given every opportunity to secure work on big resources projects.

"I have made it clear that creating local jobs is my number one priority, and my Government is keen to ensure that future resources projects create similar outcomes for local communities."

Mr Michel said the announcement of the Local Participation Plan and Local Jobs Portal would be key to the future of Karratha.

"Karratha workers have the skill and the knowledge to do this work and the Local Jobs Portal will ensure they are in the box seat for future job opportunities," he said.

"With the expansion of Pluto and the potential for Browse and Scarborough gas to be processed in Karratha, there is an opportunity to create a pipeline of jobs for locals, supporting the local economy for years to come.

"This announcement will ensure Karratha has a strong future and the local workforce will play a key role."

To view the jobs portal, visit www.karrathalocaljobs.com.au ■

North West Shelf Project: nation's largest oil and gas development in WA

- The Woodside-operated North West Shelf (NWS) Project's facilities constitute Australia's largest oil and gas development and represent an investment of more than \$34 billion.
- Accounting for more than one third of Australia's oil and gas production, the NWS Project is a joint venture between six major international companies.
- It is one of the world's largest liquefied natural gas (LNG) producers, supplying oil and gas to Australian and international markets from huge offshore gas, oil and condensate fields in the Carnarvon Basin.
- The NWS Project participants are Woodside Energy Ltd (Operator 16.67%); BHP Billiton Petroleum (North West Shelf) Pty Ltd (16.67%); BP Developments Australia Pty Ltd (16.67%); Chevron Australia Pty Ltd (16.67%); Japan Australia LNG (MIMI) Pty Ltd (16.67%); and Shell Australia Pty Ltd (16.67%).

AUSTRALASIAN OIL AND GAS CONFERENCE 2019

Featuring a world-class conference program, AOG 2019 is set to soar when the premier oil and gas conference event lands in Perth in March.

Future jobs in oil and gas will be a focus of a Collaboration Forum to be held at the Australasian Oil and Gas (AOG) Conference and Exhibition 2019, with sessions seeking to identify new long-term job opportunities focused on servicing, maintaining and improving existing oil and gas operations.

AOG is working with key partners NERA, Woodside, Deloitte, Shell, Chevron, and the Western Australian Government to reflect the current trends and challenges impacting the wider oil and gas industry.

The Collaboration Forum will include a presentation from the Western Australian Government's LNG Taskforce.

The oil and gas industry is currently going through rapid changes related to new market requirements, the introduction of new technologies, increased digitalisation and the retirement of many experienced workers, and there has been significant government, industry and academic focus on identifying the workforce of the future.

To be held at the Perth Convention & Exhibition Centre from March 13–15, AOG 2019 aims to connect, re-engage and inspire the oil and gas industry to move forward and embrace the shifting market.

With this renewed sense of optimism comes a focus on new jobs and employment.

AOG 2019 is working alongside the Western Australian Government, through the Department of Jobs, Tourism, Science and Innovation (JTSI), to deliver the Collaboration Forum.

The Collaboration Forum is a free-to-attend opportunity for industry professionals, with a focus on enhancing collaboration between operators, contractors and the supply chain to drive a greater understanding of challenges and access to opportunities – including new markets and future jobs.

The Collaboration Forum will have a full day dedicated to new energy, focussing on renewables for power generation for gas processing facilities, remote power generation (LNG and renewables), and alternate uses for LNG and future fuels including hydrogen.

In addition to the Collaboration Forum, the AOG conference program offers attendees the opportunity to discuss the latest techniques

and technology from specialised industry sectors at the Knowledge Forum, with keynote presentations on offshore marine technology, drilling, completions and reservoir management, new energy, micro grids and energy efficiency, non-destructive testing and automation.

Partnering with the Society for Underwater Technology, Subsea Energy Australia and Subsea UK, the AOG Subsea Forum will focus on how the industry can adjust to the evolving market, engage with the latest thinking on subsea engineering solutions, life extension and the application of subsea geoscience.

As the largest gathering of oil and gas professionals in Australia, with major operator and government support, AOG 2019 provides an opportunity to network and create valuable connections.

AOG Event Director Bill Hare said, "Input from industry leaders is key to the event's success - we're delighted to have Woodside, Chevron, Deloitte, NERA and the Department of Jobs, Tourism, Science and Innovation on board again, and we're looking forward to the exhibition being 30 per cent larger this year with renewed optimism generating a high level of interest."

Registrations are open for fast and free entry to the event at www.aogexpo.com.au ■

AOG

AUSTRALASIAN OIL & GAS
EXHIBITION & CONFERENCE

The Australasian oil and gas market is changing, and with change comes new energy and differing perspectives.

AOG 2019 is determined to re-connect, engage and inspire the oil and gas industry to move forward and embrace the shifting market.

#AOG2019 [f](#) [t](#) [in](#)

A ENERGY SHIFT

**13-15
MARCH 2019**

PERTH CONVENTION
AND EXHIBITION CENTRE

REGISTER FREE
AOGEXPO.COM.AU

**FREE 3-DAY
INDUSTRY CONFERENCE**

**PREMIUM
NETWORKING EVENTS**

**A FOCUS ON
NEW ENERGIES**

**LARGEST AUSTRALIAN
OIL & GAS EXPO**

PLATINUM SPONSOR



PRINCIPAL SPONSORS



City of Perth



Government of Western Australia
Department of Jobs, Tourism, Science and Innovation



NATIONAL
ENERGY RESOURCES
AUSTRALIA





A State Government, union and industry collaboration is working to maximise benefits in the LNG sector for Western Australia.

ON TASK: FOCUS ON LNG JOBS

Western Australia's LNG Jobs Taskforce met for the first time in December, bringing government and industry together to focus on maximising local jobs and economic benefits from the liquefied natural gas (LNG) industry and establishing Western Australia as a hub servicing Australia and the broader region.

Premier and Minister for State Development, Jobs and Trade Mark McGowan announced in March 2018 the State Government's intention to form the Taskforce.

In August last year, the Taskforce was formally established and its membership announced by WA Agent General Mike Deeks, representing the Premier, and industry representatives at the ONS 2018 Conference in Stavanger, Norway.

Chaired by the Premier, the Taskforce includes the Chief Executive Officers of major LNG producers in Western Australia as well as the Secretary of Unions WA and the Australian Petroleum Production and Exploration Association (APPEA).

The Taskforce's first meeting leapt straight into action with a structure and governance framework agreed, establishing a steering group to be chaired by the Director General of the Department of Jobs, Tourism, Science and Innovation (JTSI) Rebecca Brown and senior industry and union representatives.

In addition, a number of working groups will add to Taskforce momentum, with each group based around targeted themes, including:

- Education, Training and Innovation – identifying skills for success in the sector, ensuring Western Australian talent is developed, identifying opportunities for innovation and new technologies, and encouraging collaboration.
- Business Development and Diversification – developing complementary industries and maximising local business participation during construction and operations, attracting long term investment to Western Australia.
- Downstream and Future Energies – pursuing emerging opportunities arising from the availability and production of gas in Western Australia, including value adding downstream processing and future energies such as hydrogen production.
- Technology, Ocean Industries and Renewables – encouraging innovative technology and collaboration with other industry sectors including ocean industries and renewables.

Addressing the Taskforce, the Premier targeted growth opportunities for Western Australia's LNG industry.

"Western Australia has experienced a prolonged period of capital investment in new and expanded LNG production capacity. WA is home to a significant proportion of the world's LNG production, and when Prelude and Gorgon Phase 2 are completed we will be the second largest producer in our own right," he said.

"This period of investment created over 30,000 direct jobs during the construction phase, and has helped to drive strong growth in the Western Australian economy.

"However, the operations phase of these projects has the potential to create many thousands of highly skilled, well paid jobs for decades to come.

"The operational phase of LNG projects has positive employment flow-on effects on the rest of the economy through direct maintenance, servicing and supply contracts and through increased consumption."

The Premier cited recent figures estimating the costs to sustain operations on LNG plants over their lifetimes, to be equivalent to 125 per cent of the original capital investments.

Recent figures also estimate servicing and maintenance work in the Western Australian LNG industry to be worth about \$9 billion per year, and research indicates that each job in the LNG industry supports up to 10 jobs in the rest of the economy through procurement and induced consumption.

"By working collaboratively, government, unions and industry have an opportunity to maximise the benefits for WA arising from this new phase and establish Perth and Western Australia as a major hub servicing the LNG industry in the southern hemisphere," Mr McGowan said. ■



LNG sales increased from \$12.7 billion to \$19.1 billion in 2017–18. Photo: Chevron

WA'S MINERAL AND PETROLEUM SALES REFLECT GLOBAL GROWTH

In 2017–18 Western Australia's mineral and petroleum industry reported sales of \$114.9 billion, up \$10 billion from 2016–17.

It was the second highest financial year sales value on record, behind only the \$123 billion achieved in 2013–14.

Department of Mines, Industry Regulation and Safety Director General David Smith said the figures reflected the improvement across global commodity markets in 2017–18.

"About half of the world's countries experienced an increase in economic growth, creating a period of synchronised global upturn with most Western Australian producers benefitting from the recovery in prices seen throughout 2017 and into the start of 2018," Mr Smith said.

"However, in the latter half of the period, growing tensions between the US and China and talk of a potential trade war became a major headline, creating some investor uncertainty."

Other factors to influence global commodity markets during this period included the moderation of China's economic growth,

fluctuations in crude oil prices and a lack of project investment which saw minimal mine supply growth in some commodities.

"While these factors created uncertainty in financial markets, WA's commodity driven export market remained steady with the exception of the LNG sector which grew substantially over the period," Mr Smith said.

"We also saw the emergence of WA as a potential supplier of the battery related materials needed to support substantial green energy initiatives around the world.

"Stemming from this, it is pleasing to see a new wave of investment in lithium and related sectors which will help sustain our minerals and petroleum sector into the future."

A number of commodities reached record production levels including gold, iron ore, LNG and lithium.

LNG saw the largest increase in value, climbing from \$12.7 billion to \$19.1 billion, coming off the back of a 32 per cent increase in production.

Lithium continued to see significant increases in both production and value, with sales of spodumene concentrate rising 167 per cent to reach \$1.6 billion and 2.1 million tonnes.

The number of individuals employed by the State's mining industry also increased to 112,008 people, up from 106,490 the previous financial year. However, consistent with the trend towards more contract employment over the past few years, the number of full time equivalents was 89,819.

Mines and Petroleum Minister Bill Johnston said overall the figures demonstrate the strength of Western Australia's resources sector.

"Creating job opportunities is the State Government's number one priority and it's pleasing to see strong job numbers, as well as record production and sales in our resources industry," Mr Johnston said.

"The State Government is committed to supporting industry investment in Western Australia's diverse and record-setting sector and the opportunities it brings to our economy."

Mineral sector highlights

Mineral commodities still dominate the State's resources sector, accounting for 77 per cent, or \$88 billion, of total sales value. Iron ore was by far the most valuable commodity, accounting for 70 per cent of mineral sales and 54 per cent of overall sales.

Iron ore recorded sales valued at \$61.7 billion in 2017–18, down slightly (three per cent) on last year. Record sales volumes of almost 826 million tonnes was not enough to offset the lower prices received by Western Australian producers.

Gold sales volumes increased for the third year in a row to reach a record 212 tonnes (7.5 million ounces) in 2017–18. Increased volumes combined with strong gold prices to deliver a five per cent increase in the value of the sector, from \$10.9 billion in 2016–17 to \$11.4 billion in 2017–18.

Alumina and bauxite sales accounted for 7.5 per cent of mineral sales and six per cent of total sales. Sales volumes increased more than four per cent year-on-year, attributable to a substantial increase in bauxite sales, which offset a decrease in alumina sales. This meant that the value of the sector increased 30 per cent to \$6.6 billion in 2017–18.

Western Australia's nickel sector has struggled in recent years, with the value of the sector declining year-on-year since 2010–11. However, in 2017–18, fortunes turned with the value of the sector increasing 26 per cent from \$2.1 billion in 2016–17 to \$2.6 billion in 2017–18.

Mineral exploration

Australia's mineral exploration expenditure was \$2 billion in 2017–18, up from \$1.6 billion in 2016–17. WA contributed \$1.2 billion (61 per cent) of this spend with the gold and iron ore sectors attracting the largest shares. Gold exploration expenditure in WA continued to increase from \$509.5 million in 2016–17 to \$591.5 million in 2017–18. Iron ore exploration decreased, but only marginally from \$281.6 million in 2016–17 to \$274.1 million in 2017–18.

Globally, exploration budgets have declined since 2012 with the mix between greenfield and brownfield exploration shifting towards the latter. In terms of expenditure, the mix of Australian exploration has remained static over the past five years, roughly weighted 70:30 towards brownfield exploration.

Petroleum sector highlights

The petroleum sector, which comprises crude oil, condensate, LNG, natural gas and LPG, accounted for 23 per cent of the total value of Western Australia's mineral and petroleum sales in 2017–18. This made it the second most valuable sector after iron ore.

The sector was valued at \$26.6 billion in 2017–18, an increase of 39 per cent from \$19.2 billion in 2016–17.

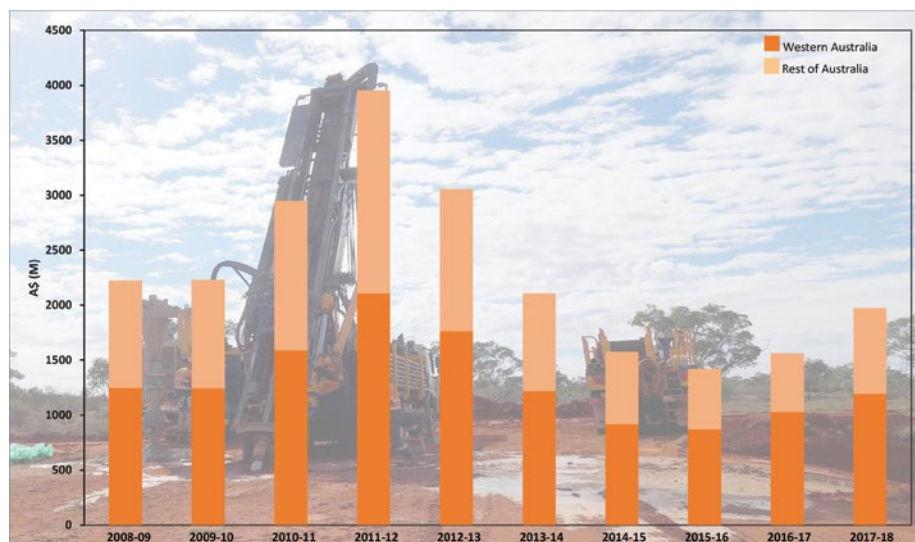


Figure 1: Western Australia's share of Australian mineral exploration expenditure (2008–09 to 2017–18). Data source: ABS

LNG remains Western Australia's most valuable petroleum product, accounting for close to 17 per cent of all mineral and petroleum sales in 2017–18. The value of LNG sales value rose just over \$6 billion from \$12.7 billion in 2016–17 to \$19.1 billion in 2017–18.

The volume of LNG produced in Western Australia increased 45 per cent during the five years to 2016–17 and a further 32 per cent in 2017–18. This follows the start-up of several new LNG projects over the period marking the last of the "mega" LNG investment projects to reach production.

In 2017–18, crude oil volumes were down 11 per cent to 4.8 giga litres, while condensate production increased 18 per cent to 7.1 giga litres. Improvements in the prices received by Western Australian producers contributed to the increase in the value of crude oil and condensate sales which rose for the first time in seven years from \$4.3 billion in 2016–17 to \$5.6 billion in 2017–18.

Petroleum exploration

National petroleum exploration expenditure continued to decline, falling from \$1.4 billion in 2016–17 to \$1 billion in 2017–18. National petroleum exploration expenditure continues to decline rapidly, having fallen 79 per cent (\$3.8 billion) since 2013–14.

WA's share of the petroleum exploration spend increased to 55 per cent in 2017–18, up from 47 per cent on 2016–17. This was still well below the 70 per cent share the State averaged in the 10 years prior to 2016–17. ■

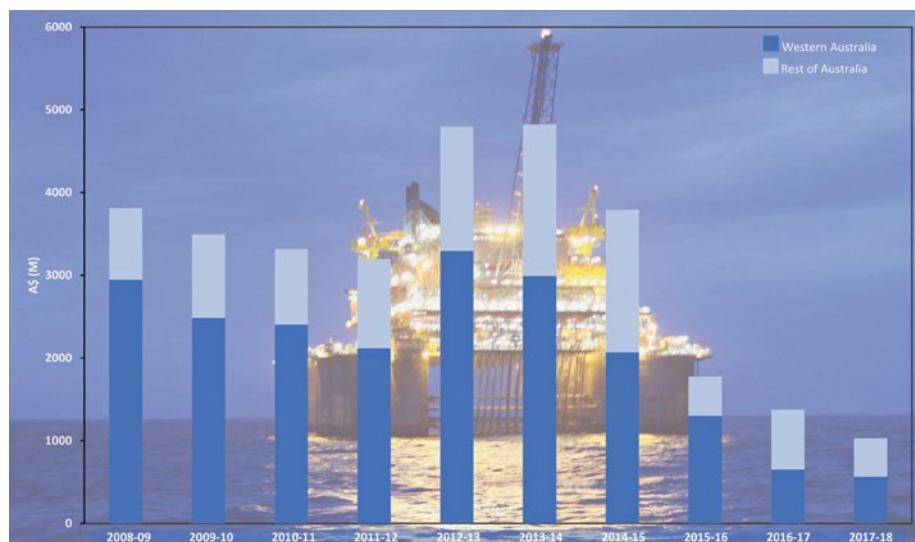


Figure 2: Western Australia's share of Australian petroleum exploration expenditure (2008–09 to 2017–18). Data source: ABS



An aerial view of Altura Mining's Pilgangoora operation. Photo: Altura Mining

NEW LITHIUM MINES POWER UP IN THE PILBARA

Western Australia's two newest lithium mines are hard at work in the State's far-north Pilbara region.

Pilbara Minerals' lithium-tantalum project at Pilgangoora, 120km south of Port Hedland, was officially opened in November by Mines and Petroleum Minister Bill Johnston, bringing the number of operating lithium mines in WA to seven.

Only two months earlier, the Minister also opened Altura Mining's Pilgangoora lithium project 90km south-east of Port Hedland.

Pilbara Minerals' first shipment on 2 October 2018 marked the successful conclusion of stage one of the mining and processing operation which is expected to process 2 million tonnes per annum (Mtpa) of spodumene to produce 330,000 tonnes of spodumene concentrate.

The Perth-based company has since made a final investment decision to expand the project to stage two, with an annual capacity of 5 Mtpa, subject to regulatory approvals.

The Pilbara Minerals mine is Western Australia's second-largest operating lithium project and includes one of the world's largest pegmatite-hosted tantalum deposits.

Tantalum is primarily used to manufacture capacitors in electronic applications such as mobile phones, pagers, medical appliances and computers.

General Lithium, Ganfeng Lithium, Great Wall Motors, and Posco have all signed up as global offtake partners.

The company has also completed a stage-two definitive feasibility study for a \$118-million expansion that would increase production to 450,000 tonnes per annum.

Altura has offtake agreements with Chinese companies OptimunNano and Lionenergy for 100 per cent of Pilgangoora's production.

Western Australia stands alone as the world's biggest lithium producer.


In 2017–18, Western Australia produced nearly 2.1 million tonnes of spodumene concentrate worth \$1.6 billion.

More than \$4 billion has been invested in lithium mining and downstream processing operations since 2017 and the industry now directly employs more than 2000 people.

Sales reached a record \$678 million last year and the industry employed more than 1200 people. ■



Standing next to the plaque commemorating the mine's opening are Pilbara Minerals' first employee, Water Resources Manager George Karageorge, Mines and Petroleum Minister Bill Johnston, and the company's non-executive chairman, Tony Kiernan.



.....

BRIGHT FUTURE: WA LEADING THE WAY IN FUTURE BATTERY INDUSTRY

.....

Western Australia is on target to become a leading exporter of future battery minerals, materials, technologies and expertise.

Increased demand for electric vehicles and energy storage systems has created a unique opportunity for the State to become a central player in the global battery value chain.

The Western Australian Government engaged closely with government, industry, research organisations and the community to deliver a strategy that aims to unlock the State's potential in this growing sector.

On January 31, Premier and Minister for State Development, Jobs and Trade, Mark McGowan, and Minister for Mines and Petroleum; and Energy, Bill Johnston, launched the *Western Australian Future Battery Industry Strategy*.

One of the first initiatives of the strategy is the development and implementation of an investment attraction strategy – to further develop and strengthen relationships with investors and manufacturers in global battery and electric vehicle supply chains.

The State Government will continue to facilitate the establishment of new future battery projects in Western Australia – assisting and supporting projects through the approvals process.

The next steps for the State Government include filling current and future skill gaps, and facilitating access to infrastructure and funding for technology SMEs.

Other measures include exploring initiatives to increase the uptake of batteries across the State and globally. These include opportunities through

assembly, installation and management of energy storage systems.

Additionally, the State Government will commit \$6 million if it is successful in its bid to host the Future Battery Industries Cooperative Research Centre in Perth.

"The unprecedented growth of the future battery industry represents a once-in-a-lifetime opportunity for Western Australia," Mr McGowan said.

"Our Future Battery Industry Strategy will drive the development of the Western Australian battery materials industry that will create local jobs, contribute to skills development and economic diversification, and maximise benefits to regional communities.

"This is an exciting opportunity for Western Australia to be recognised as a world-leading producer and exporter of future battery materials, technologies and expertise, with huge potential for industry growth and job creation across the battery value chain."

Mr Johnston said the strategy's release signified the State Government's commitment to establishing a world leading, sustainable, value-adding battery industry in Western Australia.

"The growing global demand for battery technologies presents an opportunity for Western Australia to build on its expertise in the resources industry and move further along the value chain into downstream processing activities," he said.

"Western Australia has all the battery minerals you need to make batteries and energy technologies, we also have a stable and robust

economy with low sovereign-risk, and we're world-leaders in research and development."

The State Government will drive the implementation of the strategy and continue to work closely with industry, research organisations and the community.

More information and a copy of the *Western Australian Future Battery Industry Strategy* can be found at: www.jtsi.wa.gov.au/fbis ■

- Western Australia has a significant proportion of global battery minerals, including lithium (9%), cobalt (17%), nickel (25%), alumina (20%), manganese (14%), vanadium (9.5%), and non-battery minerals used in the manufacturing of electric vehicles and energy storage systems, such as rare earths.
- Western Australia is the largest single producer of lithium worldwide, accounting for 42% of lithium production in 2017.
- Three of the world's four largest producers of lithium are developing downstream processing projects to produce lithium hydroxide, lithium carbonate, and nickel sulphate in Western Australia: Tianqi (China), Albermarle (US) and SQM (Chile).
- The State Government manages 12 Strategic Industrial Areas (SIAs) and leases land and utilities for strategic industry proponents.



The Albemarle lithium hydroxide manufacturing plant is located at the Kemerton Strategic Industrial Area (pictured), north of Bunbury in WA's South West.
Photo: LandCorp

WORK BEGINS ON ALBEMARLE LITHIUM HYDROXIDE PROCESSING PLANT AT KEMERTON

Site works began in January on Albemarle Corporation's lithium hydroxide manufacturing plant, located in the Kemerton Strategic Industrial Area in Western Australia's South West.

Kemerton is the South West's largest strategic industrial area and is designed for major downstream processing industries that add value to the region's primary resources.

The plant, to be constructed on an 89 hectare site, has approval to process spodumene ore concentrate from the Talison Lithium Greenbushes mine, through five process trains. It is expected to produce up to 100,000 tonnes per annum of lithium hydroxide.

The Albemarle Kemerton Plant will create more than 500 construction jobs and an initial 100 operational jobs, increasing to 500 at full operational capacity. Commissioning of the Kemerton Plant is expected to begin in 2021.

The Western Australian Government welcomed the start of site works, and will work with Albemarle to maximise the benefit of the project for the South West region.

"I am pleased that the State Government could facilitate the necessary approvals to allow Albemarle to begin bulk earthworks at the Kemerton site," Acting Premier Roger Cook said.

"The commencement of construction by Albemarle demonstrates the benefits presented

to the South West and the State by the Government's investment in Kemerton.

"This initiative paves the way for additional downstream processing industries to be established in Kemerton in the future, which will mean more jobs for regional Western Australia."

Mr Cook said the announcement of the Albemarle Kemerton Plant underscored the importance of Strategic Industrial Areas.

"The Kemerton SIA is the largest in the South West region, and is already home to Kemerton Power Station and major established industries including Simcoa Operations and Cristal," he said.

"Albemarle would see the Kemerton SIA play a crucial role in growing and supporting a major growth industry for Western Australia."



Photo: South West Development Commission.

Kemerton Strategic Industrial Area

- Located in the South West of Western Australia, the Kemerton Strategic Industrial Area (SIA) is designed for strategic and downstream processing industries in the region.
- The SIA is connected to major road, power and gas networks and is just 17 kilometres northeast of the Bunbury Port.
- For more information on Strategic Industrial Areas in Western Australia, visit the Department of Jobs, Tourism, Science and Innovation website at www.jtsi.wa.gov.au/what-we-do/offer-project-support/industrial-land



Australia's Chief Scientist Dr Alan Finkel and Regional Development Minister Alannah MacTiernan with the hydrogen fuel cell vehicles on display, Hyundai's NEXO and Toyota's Mirai, at the Renewable Hydrogen Conference.

BOLD IDEAS TO MAP FUTURE FOR RENEWABLE HYDROGEN IN WA

More than 300 national and international delegates came together in Perth recently at the State's Renewable Hydrogen Conference, at the invitation of the Western Australian Government.

Hydrogen is a clean-burning fuel and, when made using renewable energy, it is a carbon-free fuel from production to utilisation.

Hydrogen can be used in a range of industries – including transport and electricity generation – and can also be stored and exported.

Western Australia has the potential for the development of a renewable hydrogen industry with its vast available land and renewable energy resources.

With key international markets such as Japan and Korea choosing a substantial role for hydrogen in their future energy mix, the opportunities for Western Australia to export its renewable energy via hydrogen are potentially significant.

"This Government is pushing for innovation, diversification and bold new ways to develop clean energies, grow exports and drive new job opportunities across regional WA," Premier and Minister for State Development, Jobs and Trade, Mark McGowan said.

"As the world continues to transition to a low-emissions future, it is increasingly apparent that

hydrogen can play an important role - and WA can be central to that future."

Exploration of the opportunities for hydrogen will be driven by a Renewable Hydrogen Council, which will provide guidance on ways to progress the industry and maximise benefits to the State and jobs for Western Australians.

Meeting in October for the first time, the Renewable Hydrogen Council is a collective of government (State and Federal), industry, and other representatives with significant renewable hydrogen industry expertise.

The council is led by Regional Development Minister Alannah MacTiernan and members have been drawn from the Office of the Minister for Energy; the Department of Primary Industries and Regional Development; the Department of Jobs, Tourism, Science and Innovation, the Australian Gas Infrastructure Group; ATCO Gas; Woodside; ENGIE; Hydrogen Mobility Australia; CSIRO; ARENA; Yara; and Jackson McDonald.

A Working Group comprised of a cross section of industry and government representatives active in the hydrogen space has also been created to support the work of the Council.

"To create renewable hydrogen you need vast stretches of land and high-quality renewable energy resources – two things Western Australia has in abundance," Ms MacTiernan said.

"This State has a long history of delivering energy and resources to the world, with established infrastructure and supply chains.

"Now is the time to embrace this opportunity and drive forward the hydrogen industry and its place in WA - to realise the thousands of jobs this industry could create.

"The Renewable Hydrogen Council will report back to Government on the best ways to grow the industry and maximise benefits for the State." ■

- Western Australia is in a prime position to become home to a job-creating renewable hydrogen sector, meeting strong demand from Asian neighbours.
- The Renewable Hydrogen Council is working with industry to shape the future for a new sector for Western Australia.
- Hydrogen is a clean-burning fuel and, when made using renewable energy, it is a carbon free fuel from production to utilisation.
- Hydrogen can be used in a range of industries – including transport and electricity generation – but can also be stored and exported.



Asian Engagement Minister Peter Tinley with JTSI Director General Rebecca Brown (centre) and Chinese Provincial Business Council members at Chung Wah.

ENGAGING ASIA

Western Australia has longstanding relationships with many countries in Asia, and many of these relationships were largely founded on the State's resources export industry and Asia's demand for those resources.

In December, Premier Mark McGowan announced changes to the Western Australian Cabinet, with Minister Peter Tinley now responsible for the Asian Engagement portfolio taking over from Bill Johnston.

Asian markets are set to dominate the world economy and the Western Australian Government is committed to deepening the State's ties with Asia.

The Association of Southeast Asian Nations (ASEAN) was established on 8 August 1967 in Bangkok, Thailand, with the signing of the ASEAN Declaration (Bangkok Declaration).

Today, ASEAN has 10 member states, including Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam.

As a single market, ASEAN is Western Australia's third largest trade partner and is projected to become the world's fourth largest economy by 2030.

An inaugural Western Australia–ASEAN Trade and Investment Dialogue was held in November 2018, bringing together business leaders to renew their focus on the way Western Australia sees South East Asia.

During the event, then Minister for Asian Engagement Bill Johnston attended a full day roundtable meeting where he met with 40 invited participants, from both government and business across ASEAN and throughout Australia. They discussed opportunities to engage with South East Asia across the agriculture, energy, mining, and science, technology, research and development industry sectors.

A free public seminar followed featuring keynote presentations and a panel discussion, and was attended by around 220 people.

"With ASEAN's growing middle-class, and increasingly urbanised populations, there is a

need for Western Australia to increase its focus on ASEAN and develop a clear understanding of the economic and job-creating opportunities," Mr Johnston said.

Mr Johnston launched the State Government's Asian Engagement Strategy consultation paper at the event. The consultation paper is the first formal step in the State's Asian Engagement Strategy, which the Western Australian Government is developing to outline how the State will develop its long-term relationships with Asia.

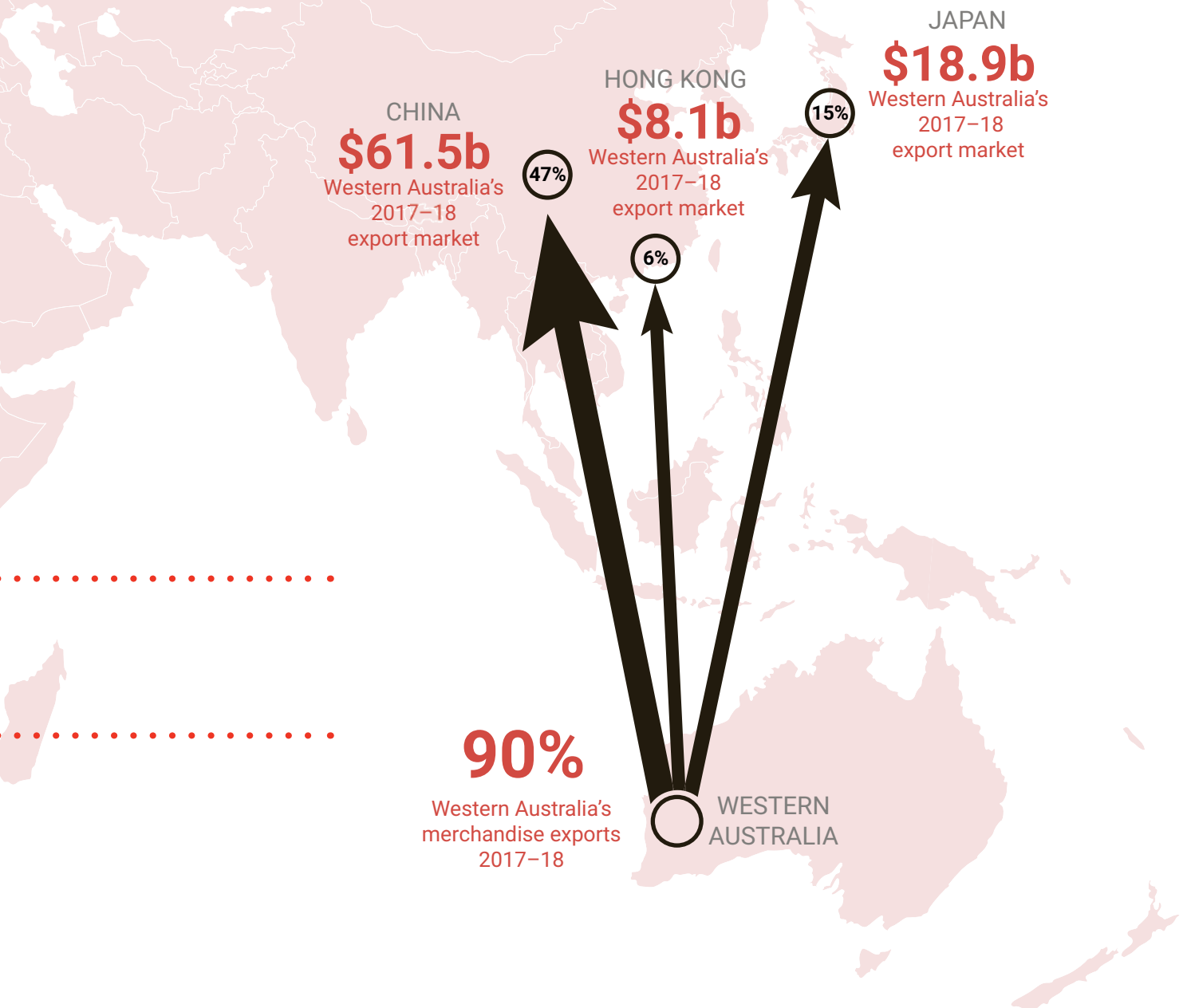
The next Western Australia–ASEAN Trade and Investment Dialogue will be held in 2019.

Working together

The Western Australian Government recently brought together the State's Asian Business Councils for the first time, to discuss job creation and securing Western Australia's future economic prosperity.

The inaugural Asian Business Councils Workshop, held in October, was facilitated by Deloitte and coordinated by JTSI, with Minister Johnston and JTSI Director General Rebecca Brown formally addressing participants.

WESTERN AUSTRALIA'S MERCHANDISE EXPORTS 2017–18 TO ASIA



Attendees participated in facilitated discussions that focused on the priorities and strengths of the councils and how these can align with the State's economic priorities.

"I am aware that Asian Business Councils have a vast range of assets, including market intelligence, business networks and cultural knowledge," Minister Johnston said.

"I would like to lift the profile of the Councils, strengthen their capacity, and include the Councils in the important task ahead of us – securing the economic prosperity of the State."

Mr Johnston identified the first workshop as an opportunity to, "start shaping a strategy about how Councils can be supported to work across business and government, and how together, we can generate more jobs for Western Australians".

"Ultimately, the State Government's focus is on boosting growth in three key areas: exports from WA, investment into WA, and diversification of the State's economy," he said.

"Within our generation, Asian markets will dominate the global economy and Western Australia needs to prepare for this significant change.

"In order to succeed, we will need to do business in the world's fastest growing and therefore most competitive, economic region."

Following the success of the inaugural workshop, a series of Asian Business Roundtables for specific markets is underway – an Indonesia Business Roundtable was held in December, and a Vietnam Business Roundtable will be held in March 2019.

Each event features a range of guest speakers from government, State and Federal, as well as key business and business council leaders.

Minsiter Tinley will speak at the Vietnam Business Round Table. ■

Asian Engagement Strategy

The consultation paper, and additional information is available on the Department of Jobs, Tourism, Science and Innovation (JTSI) website at:
www.jtsi.wa.gov.au/about-the-state/asian-engagement

RENEWED INDUSTRY-WIDE FOCUS AFTER COMMITTEE OVERHAUL



The new Resource Industry Consultative Committee is chaired by DMIRS Deputy Director General Phil Gorey.

The Western Australian Government has transformed one of its key mining industry advisory groups, expanding its focus to include petroleum issues and legislation.

The new Resource Industry Consultative Committee (RICC) replaces the Mining Industry Liaison Committee (MILC), which drove countless amendments to the *Mining Act 1978* and regulations during the past 30 years.

The RICC now includes petroleum sector representation in addition to the existing mining industry members and is chaired by Department of Mines, Industry Regulation and Safety (DMIRS) Deputy Director General Phil Gorey.

The committee's membership includes two members each from the Australian Petroleum Production and Exploration Association, Australian Mining and Petroleum Law Association, Amalgamated Prospectors and Leaseholders Association of WA, Association of Mining and Exploration Companies and the Chamber of Minerals and Energy of Western Australia.

The inaugural RICC meeting was held in October 2018, setting a 2019 focus to streamline and improve land access approvals and timelines, and consider the recommendations from the Federal Government's 'Resources 2030 Taskforce Report' from a State perspective.

"Our new committee will be no different in the sense it will continue to provide advice and make recommendations relating to the industry and legislation – but the focus is now broadened to include the petroleum sector," Dr Gorey said.

"We will be looking at the Resources 2030 Taskforce Report to consider strategic issues facing the resources sector during the next decade and identify potential opportunities and risks that need to be addressed.

"We will also be making recommendations to improve and streamline legislation and processes."

Other key considerations of the RICC will include offering recommendations to enhance resource industry compliance with legislative requirements, conditions on titles and government policies.

The committee will meet three times a year in March, July and November. ■



WA TO HOST LEADING TOURISM EVENT

The Australian Tourism Exchange (ATE), Tourism Australia's premier tourism trade event, is returning to Western Australia in 2019.

ATE19, managed by Tourism Australia and proudly co-hosted by Tourism WA, will take place from April 8–12, 2019 at the Perth Convention and Exhibition Centre.

ATE is the largest tourism trade show of its kind in the southern hemisphere, attracting around 650 international and domestic buyers and 70 media, from more than 30 countries. The event will also bring approximately 1500 sellers from more than 550 companies to Perth.

For 40 years, ATE has provided a forum for Australian tourism businesses to showcase their products, meet overseas contacts and negotiate business deals.

ATE19 will also give the international travel trade the chance to experience our extraordinary State first hand through the extensive familiarisation (famils) program run by Tourism WA. The program will see more than 500 delegates travel across Western Australia, taking in some of our extraordinary experiences. Tourism WA will also be running a famils program in conjunction with Tourism Australia for international media.

This is the fourth time ATE will be hosted in Western Australia. The event is expected to deliver around \$9 million to the State's economy and, in the long-term, help to grow Australia's \$100 billion tourism industry through relationships and future business established at ATE.

More information is available at www.tourism.wa.gov.au/ate19 ■



Asian Engagement Minister Bill Johnston and delegates at the Western Australian-ASEAN Trade and Investment Dialogue held in Perth.

NEW PROGRAM TO SUPPORT GROWTH INTO THE ASIAN REGION

Funding for Western Australian organisations to increase engagement, trade and investment between Western Australia and Asia has been announced.

The Western Australian Government opened applications in October for the new Priority Sector Funding Program, with up to \$30,000 available for outbound projects, such as delegations participating at key international forums or business programs; and \$20,000 for inbound projects showcasing specific Western Australian industries to international delegations.

The program is open to applications from industry associations and bilateral businesses to run projects on behalf of Western Australia's priority trade and investment sectors and markets.

Suitable sectors include mining and energy, education and training, marine and defence, aerospace and aviation, information and communications technology, health care, building and construction, creative industries, and consumer goods.

Asian Engagement Minister Bill Johnston said the program fulfils one of the State Government's election commitments to create opportunities for job growth into the Asian region.

"As our closest neighbours, it's important we continue to strengthen our business ties with Asia – which could create jobs for Western Australians," Mr Johnston said.

"As our closest neighbours, it's important we continue to strengthen our business ties with Asia – which could create jobs for Western Australians," Mr Johnston said.

"I encourage all organisations who meet the criteria, and are keen to expand internationally, to apply."

Projects that could run under the program may include:

- Conducting outbound/inbound delegations as customised stand-alone programs.
- Conducting outbound/inbound delegation programs including participation at a key international forum/event.

- Commissioning of in-market research on trade and investment opportunities.
- Running in-market business events that promote trade and investment linkages.

Guidelines for applicants are available on the Department of Jobs, Tourism, Science and Innovation website: www.jtsi.wa.gov.au/PSFP

A minor Cabinet reshuffle in December saw Minister Johnston take on the Energy portfolio, and Asian Engagement handed to Minister Peter Tinley. ■



Western Australian overseas offices Commissioners and delegates at the ASEAN Dialogue.



Sheffield Resources' Thunderbird project is located between Broome and Derby. Photo: Sheffield Resources

MILESTONES FOR MAJOR PROJECT AFTER 'ONE STOP SHOP' APPROACH

After benefiting from a coordinated State Government approach, one of the world's largest mineral sands deposits in WA's Kimberley reached major milestones in 2018.

Construction will begin later this year on Sheffield Resources' Thunderbird project, which has a 42-year mine life and is located between Broome and Derby.

Perth-based company GR Engineering will build the majority of the first stage of the mine, which aims to begin high-grade zircon and titanium production by 2020.

The two-year construction will include a mineral processing plant, power station, an accommodation village and associated infrastructure.

The project received Federal and State Government environmental approval last year, with Sheffield Resources' Managing Director Bruce McFadzean saying he was pleased all key permits had been secured.

"We're looking forward to developing Thunderbird, a project that will make a significant contribution to the economy and to communities throughout the Kimberley," he said.

Late 2018 also saw the company reach a Native Title Agreement with Traditional Owners Mount Jowlaenga Polygon 2.

The Agreement contains payments to the Traditional Owners, with local and Aboriginal employment and business commitments, including other controls for Aboriginal heritage and the environment.

"We can now all work together and provide long term employment and business opportunities for everyone," Mr McFadzean said.

The Thunderbird project will provide 280 drive-in drive-out (DIDO) full time jobs and aims to have 40 per cent Aboriginal employment by its eighth year.

Department of Mines, Industry Regulation and Safety (DMIRS) Senior Advisor Graham Cobby said the Thunderbird project was considered an important project for the Kimberley in 2014 and, under the State Government Lead Agency Framework, DMIRS was able to provide approval advice and coordination services from feasibility stage through to project commencement.

"As a designated lead agency project, Sheffield was provided with a single point of entry and assigned one department – in this case DMIRS – to assist and coordinate advice on approvals across government," Mr Cobby said.

"This is a relatively small WA company that found something big, and we're pleased to be able to assist them through the approvals process to get to where they are now and provide value to the local community and WA.

"We were able to help the company with coordinating approvals advice across departments, as well as provide regulatory advice regarding tenure, environmental, safety and land access matters.

"DMIRS also provided regulatory information for the Broome and Derby Shires, Port Authorities, industry associations, pastoralists and regional community groups, facilitated multi-agency briefing sessions, which helped smooth the approvals pathway by ensuring the stakeholders were well informed of the process.

"I'd like to acknowledge our department's Liaison Officer for the Kimberley Brian Lloyd – whose experience and local knowledge of the region helped deliver the 'one stop shop' service to Sheffield Resources. ■



The International Mining and Resources Conference was held in Melbourne.

FLYING THE WA FLAG IN MELBOURNE

Mines and Petroleum Minister Bill Johnston took the opportunity at the International Mining and Resources Conference (IMARC) in Melbourne in October to emphasise Western Australia's predominant role in the nation's resources sector.

Now in its fifth year, the conference attracted more than 6000 mining and resource professionals from about 60 countries, including around 35 international mining ministers.

The Minister congratulated the Victorian Government on its recently-released Mineral Resources Strategy before making some striking statistical comparisons between Western Australia and Victoria.

Mr Johnston said that Victoria produced minerals valued at \$1.6 billion in 2016–17, but he reminded the audience that the WA figure for the same period was \$86 billion.

He said that Victoria did have the largest increase in mineral exploration expenditure of any Australian jurisdiction for the year to March 2018, but the State's total spend was \$74 million, compared to WA's \$1.2 billion.

"Victoria is a significant global gold province, with 13 goldfields that have each produced more than one million ounces of gold, but that's not even close to WA's total of 255 million ounces," the Minister said.

Mr Johnston also said that the total number of resource sector jobs in Victoria was 11,000 in February 2018, compared to 112,000 in for WA.

The Minister made the point that although Western Australia had enormous wealth under the ground, the State was not just a big quarry.

"Western Australia is already what Victoria aspires to be – a global mining and petroleum hub," he said.

"We do tech very well indeed, and are a go-to jurisdiction for solutions to challenges, for technical innovation, and the world-class services our METS sector provides."

Mr Johnston said that Western Australia was at the forefront of the national METS sector with more than 350 companies and had become a magnet for oil and gas companies seeking to capitalise on that State's role as a global hub for scientific and technological innovation.

More than 900 companies – 400 of them international – were currently servicing the oil and gas sector from Perth, he said.

The Minister said that Western Australia had also developed powerful capabilities in big data and data analytics.

"Perth is home to the Australian Resources Research Centre, a petroleum and minerals centre of expertise with more than 300 scientists, the National Resource Sciences Precinct and the Pawsey Supercomputing Centre," he said.

Mr Johnston said it was significant many big businesses had established research and development and technology units in Perth, including BP, Santos, Shell, Conoco Phillips, INPEX and Woodside.

The Minister said that renewed confidence in Western Australia's resources sector was driving a sharp rise in exploration.

The Department of Mines, Industry Regulation and Safety received almost 2600 mineral exploration applications in 2017 – a jump of 43 per cent on 2016. ■



Minerals Research Institute of Western Australia's (MRIWA) new chief executive officer Nicole Roocke.

NEW CEO TO HELP SHAPE MINERALS RESEARCH IN WA

Nicole Roocke has been announced as the Minerals Research Institute of Western Australia's (MRIWA) new chief executive officer after the retirement of former CEO Mark Woffenden late last year.

Mines and Petroleum Minister Bill Johnston announced the appointment and said Ms Roocke was an outstanding candidate for the job.

"Ms Roocke is highly regarded in the resources industry, and has a strong understanding of MRIWA, the challenges the industry faces and minerals research in our State," Mr Johnston said.

Ms Roocke comes to the position after a distinguished career with the Chamber of Minerals and Energy of Western Australia, most recently as its deputy chief executive officer.

"I have spent 15 years at the Chamber coordinating industry input on a variety of government regulatory and policy issues and facilitating communication within the resources sector," Ms Roocke said.

"Having had responsibility for a broad range of policy portfolios has enabled me to develop a comprehensive understanding of the challenges being faced by the mining sector."

This isn't the first time Ms Roocke has been involved in shaping the future of MRIWA. Between 2010 and 2013 she chaired the working group, which developed the proposal to transform the organisation.

"To be part of the team and again lead the discussion on what the mineral research priorities are for the State is exciting," she said.

"MRIWA fills an important gap in the market between science and application, and between industry and academia.

"Key to the organisation's success is being able to foster collaboration and helping create linkages between government, industry and the research community – working with all these stakeholders creates great opportunities."

One such opportunity is in an emerging sector that has become critical to the world's energy future.

"MRIWA is working with the State Government on developing strategies to create a world-leading lithium and energy material industry in Western Australia," Ms Roocke said.

"This includes supporting the bid to host the national Future Battery Industries Cooperative Research Centre (FBI CRC) headquarters here in this State."

The centre aims to connect world class research with industry to build knowledge and develop processes and battery applications using Australia's new energy materials.

Mr Johnston said the State Government will invest \$5.5 million, through MRIWA, and \$500,000 from the Department of Jobs, Tourism, Science and Innovation towards the CRC.

"MRIWA is a key member of the Future Battery Industries CRC bid and I know it will be well-led by Ms Roocke during this exciting time," he said.

"Our State is the ideal place to host the CRC. We have the resources, highly skilled workers and technical expertise, and we're also the largest producer of lithium in the world."

These are qualities Ms Rooke also believes can provide long-term benefits to the State.

"The FBI CRC proposal is one which has the potential to position Western Australia globally in the future battery industry value chain," she said.

It is also an opportunity to further strengthen Western Australia's global reputation – an opportunity in which MRIWA can also play an important role.

"While WA's mining industry is globally competitive, by no means is its competitive advantage assured," Ms Rooke said.

"There is a need for the mining sector to continually look to technology solutions to become more productive and efficient in the face of the growing challenges.

"The capability in the State to undertake minerals research is very high and the quality of the research is globally recognised."

Ms Rooke said investment in mining research was not just important for the industry but for all of Western Australia.

"Given the significance of the mining sector to Western Australia in terms of economic activity, jobs and royalty contributions, the ability of the industry to continue to make this significant

economic contribution into the future is dependent upon creating new knowledge and technology," she said.

That is why collaboration will continue to be a key focus for MRIWA under Ms Rooke's leadership.

"Government investment in minerals research fills an important void for those projects where there is a need for funding over an extended period to undertake fundamental research and transition it into application or demonstrate proof of concept," she said.

"In effect it reduces the costs of research and stimulates corporate research and development spending.

"For example, the MRIWA portfolio of research projects was valued at \$37.3 million, as at the end of 2017–18 and \$22 million of that was co-invested by other parties."

Ms Rooke said that through its research programs MRIWA has been a catalyst for change since it was first formed in 1981.

"As the resources sector has grown over that time and new challenges come to the fore, MRIWA has responded by facilitating government, industry, and research community collaboration to respond to the emerging knowledge and technology issues of the day," she said.

"For a small team, MRIWA has an impressive impact. We currently manage a portfolio of over 50 projects across five research themes.

"These projects are delivering direct benefits to Western Australia."

The organisation also plays an important role in nurturing future leaders through its scholarship program.

"Sixteen scholarships have been awarded over the past five years, which attracts international students, helping further build Western Australia's research capability," Ms Rooke said.

Another important focus for the future is on promoting not just the mining story of Western Australia but also the technology and knowledge story that exists because of mining in WA.

"We have an incredible research capability in this State. Not just in the universities, but also the METS (Mining Equipment, Technology and Services) companies and mining companies themselves," Ms Rooke said.

"It is important we share that story." ■

State Government releases economic review of MRIWA

In February, the State Government released a report into the economic impact of the Minerals Research Institute of Western Australia (MRIWA) that demonstrates the significant value of government investment into Western Australian minerals research.

ACIL Allen's economic impact assessment found for each \$1 invested by government there is at least \$3.12 in direct benefits to the State.

The report found that funding for MRIWA, and its corresponding impact on the mining industry, provides a significant boost to the WA economy and enhances our reputation globally in the technology and innovation value chain.

MRIWA's research program is forecast to deliver \$121.5 million in real income benefits to Western Australian businesses, people and government agencies in the next 10 years.

The State Government funded initiative had a portfolio of research projects valued at \$37.3 million, in 2017–18, with \$22 million co-invested by other parties.

Mines and Petroleum Minister Bill Johnston said the State Government is committed to supporting minerals research in Western Australia.

"It's pleasing that funding for MRIWA provides a significant boost to the economy and creates jobs for Western Australians," he said.

"MRIWA's research program will create 913 jobs and will deliver an additional \$6.6 million in State Government taxes over the next 10 years.

"With MRIWA playing an important role in the McGowan Government's Future Battery Industry Strategy, our State will continue to be a world-leader in technological innovation in the minerals sector." ■





CELEBRATING 130 YEARS



*The "father" of GSWA,
Andrew Gibb Maitland.*

A rich vein of history runs through the Geological Survey of Western Australia.

The earliest Survey geologists quite literally had it tough. They had no GPS, air-conditioned four-wheel drives and satellite phones.

Pioneer Government Geologists like Edward Hardman, Harry Woodward, Andrew Gibb Maitland and Torrington Blatchford risked death when they explored Western Australia's outback on horses and camels.

Not only did they have to be good geologists and map-makers, they also had to be good bushmen.

Today, Survey men and women in the field have the advantage of amazing technology, including drones that can map inaccessible outcrops.

Starting in the 1990s, digital technology has transformed the way GSWA produces maps and delivers data and information.

It's all a far cry from theodolites, plane-tables and glass-plate negatives, but the hunger for discovery and the passion for the work is unchanged today.

2018 marked the 130th anniversary of the establishment of the Survey.

However, the beginning of this revered institution was resolutely opposed by a vocal faction in the State's Legislative Council.

MP Septimus Burt, who would go on to be Attorney General, was scathing about geologists, saying that people did not want to know if something was "Eocene, Miocene or Pliocene or any technical rubbish like that".

He denied scientists had contributed in any way to the important mineral discoveries which had made the fortunes of the other colonies, and he wondered "what good had any geologist ever done to Western Australia?"

But the geological observations and maps of temporary Government Geologist Edward Hardman that led to the Kimberley gold rush, swung a vote by the Council in 1886 to establish a permanent Geological Department.

Harry Woodward became the first permanent Government Geologist in 1888 when the State Government formed the Geological Survey within the Department of Lands and Surveys.

In 1894, GSWA moved to the newly formed Department of Mines and in 1896, with the appointment of Andrew Gibb Maitland, the Survey embarked on three memorable decades of growth and development.

Gibb Maitland is recognised as the "father" of the modern Survey and is the inspiration for the coveted Gibb Maitland medal awarded by the WA Division of the Geological Society of Australia for outstanding contributions to geoscience in Western Australia.

It has been awarded to eight GSWA geoscientists since its inception in 1986.

That's rather impressive when you consider that there have been five years when no award was made, and that the Survey can claim to have earned nearly a third of all Gibb Maitland medals.

Thirteen Government Geologists and Directors have been at the helm of GSWA since its establishment, each providing vital guidance and responses to the challenges of the day.

Over its 130 years, the Survey has become an internationally respected organisation and has contributed to the understanding of the geology of the State for the benefit of all Western Australians.

The mining industry holds GSWA in high regard, particularly because the geoscience data it provides lowers exploration risks.

Since its establishment, the Survey has remained faithful to the dual objectives of practical, field-based research and the provision of solid, unbiased geoscientific advice to government, industry and the public.

Mapping of the State started in the 19th century and continues to this day.

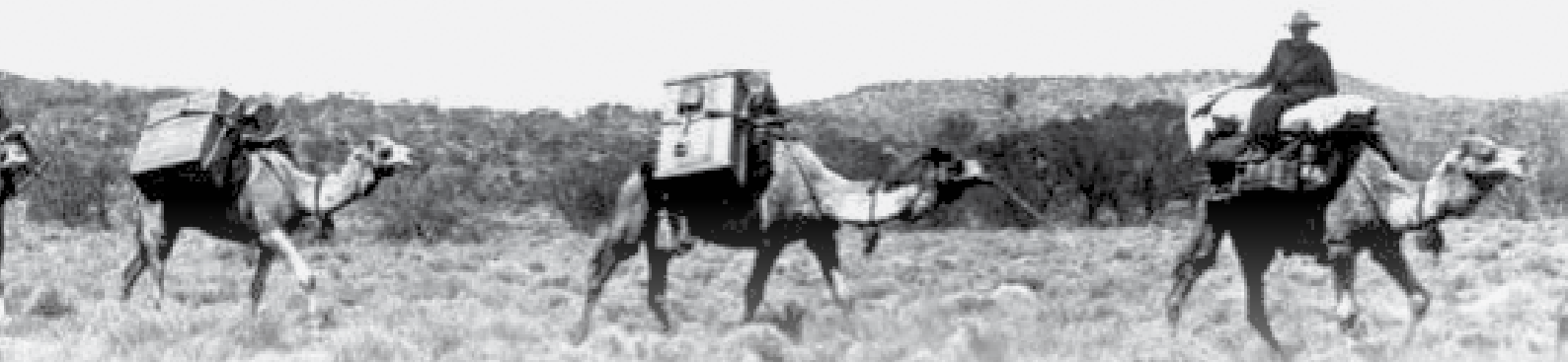
Tools of the trade have evolved from pencil, compass and theodolites to sophisticated GPS-tracking and capturing information digitally while in the field.

Other pivotal technological advances over the years include aerial photography in the 1960s, remote sensing techniques such as aeromagnetic, gravity, and satellite imagery that began in the 1980s, and the seismic profiles that today allow imaging of deep crust.

GSWA has produced more than 12,000 publications ranging from classical geological maps at various scales, to records, reports and bulletins.

Digital delivery is at the core of the Survey's data and information products today, and includes leading products such as drill hole core atlases, 3D models, and digital geological packages.

GeoVIEW.WA, GSWA's in-house system for online data delivery, has won many awards and provides up-to-date delivery of data to the minerals and petroleum industry.



A camel train geological expedition.

OF GEOLOGICAL EXCELLENCE

As the custodian of geological knowledge for the State, the Survey also manages the Perth and Kalgoorlie core libraries, where drill cores are preserved as an invaluable resource held in perpetuity for the exploration industry.

The Exploration Incentive Scheme created and managed by GSWA to promote exploration in WA is highly popular with industry.

The State Government has approved the continuation of the scheme with \$10 million a year sourced from Mining Tenement Rents, to continue supporting the long-term sustainability of the State's resources.

Survey staff have shown their loyalty to this proud institution by successfully arguing, with the support of industry, to keep its historic name from being lost during the merger between the former departments of Mines and Petroleum and Commerce.

This devotion is testament to the spirit of the dedicated men and women who make up the Geological Survey. ■



Geologist, historian, explorer and former head of the geological survey Phillip Playford.

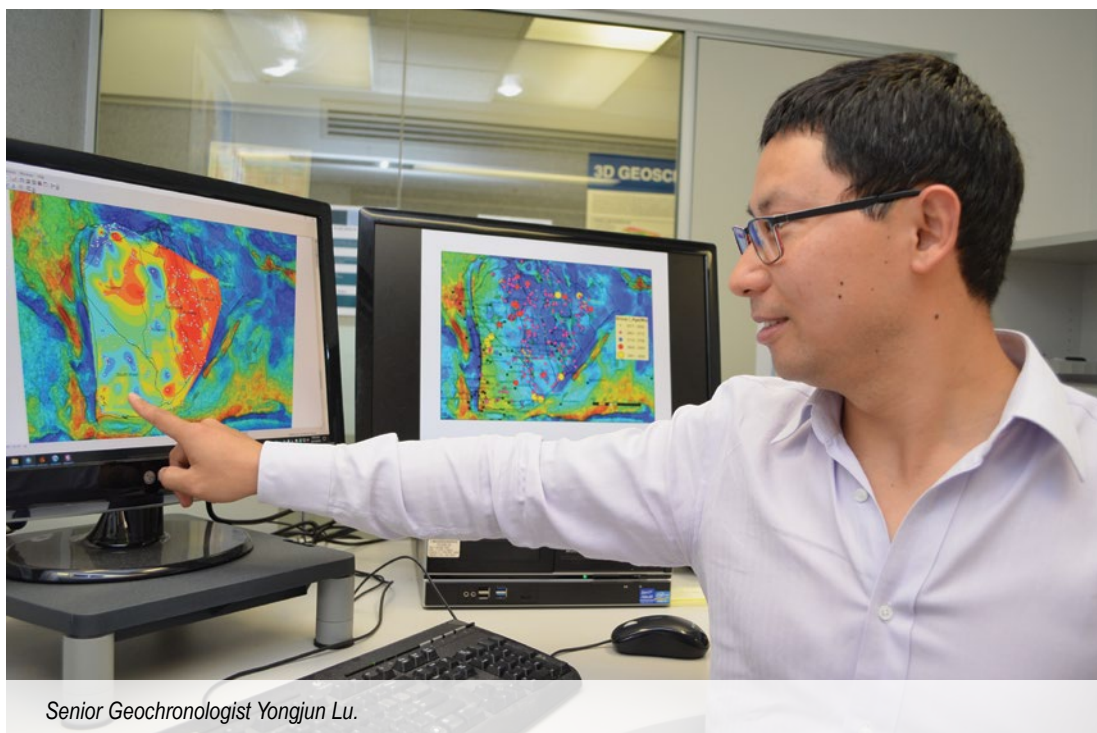


GSWA tie pin recipients pose for a group photo with Mines and Petroleum Minister Bill Johnston.



The commemorative tie pin presented to past and present members of GSWA.

GSWA SCIENTIST WINS PRESTIGIOUS INTERNATIONAL AWARD



Senior Geochronologist Yongjun Lu.

A Department of Mines, Industry Regulation and Safety (DMIRS) scientist has won one of the world's most prestigious geology awards for young scientists.

Senior Geochronologist Dr Yongjun Lu has won the Society of Economic Geologists' (SEG) 2018 Waldemar Lindgren Award.

Congratulating Lu on becoming the 52nd recipient of the society's award for young scientists, SEG President Bruce Gemmell said it recognised Dr Lu's "significant contribution to the science of economic geology at this early stage in your career".

Dr Lu said he was deeply honoured to have been chosen for the award by the society.

"It is such a privilege to win this very prestigious award," he said. "It's also recognition of the excellent work being done by the Geological Survey of Western Australia (GSWA)."

Dr Lu said that the award was for a body of work including isotopic mapping and zircon fertility, an area of geoscience that he is passionate about and has figured prominently in his career for a number of years, going back to his work on the Tibetan plateau as part of his post-graduate research at The University of Western Australia.

Dr Lu's supervisor, GSWA Geochronology and Geochemistry Manager Dr Michael Wingate said that Dr Lu thoroughly deserved to win the medal and praised his work at GSWA.

"Yongjun's work has been highly impressive, particularly his work in using geochemistry and the trace element compositions of zircons to identify granitic rocks that might be prospective for copper – molybdenum – gold deposits, an area that no doubt contributed to his win," Dr Wingate said.

Dr Lu is currently working on the isotopic mapping and fertility of Archean granitic rocks in the South West Terrane of the Yilgarn Craton.

"Western Australia's south-west region is not well understood," he said. "There has been very little research in the past 20 years despite the fact that the region has what is currently Australia's largest gold mine at Boddington and the world's largest lithium mine at Greenbushes.

"In the past two years I have been working with GSWA's Dr Hugh Smithies in the field collecting more than 250 granite samples across the South West Terrane to try to understand the ages of the rocks, their chemical compositions, and the crustal structure.

"I have also been working with Dr Michael Wingate on the geochronology of these rocks, and combining this with isotope studies and zircon chemistry, all sorts of different analyses, to understand the terrane's crustal evolution in space and time."

Dr Lu said that he believed it was essential to gain a better understanding of the regional geology before considering prospectivity.

"We have to understand the regional geological context before we start looking for mineralisation," he said. "Understanding the geological evolution of this terrane will help industry to explore in this area."

Dr Lu, who has been with GSWA since 2015, has a wide network of research affiliations that includes Curtin University's John de Laeter Centre, The University of Western Australia's Centre for Exploration Targeting, Macquarie University's Australian Research Council Centre of Excellence for Core to Crust Fluid Systems, the Chinese Academy of Geological Sciences' Institute of Geology, and the China University of Geosciences' School of Earth Science and Mineral Resources. ■

WA FLYING HIGH



Premier Mark McGowan (centre) joined senior ministers and Airbus representatives at the launch of the Zephyr aircraft.

International aerospace company Airbus took the next step in the development of their new Zephyr aircraft program in November, after choosing Western Australia as the world's first operational site for the launch of its solar-powered pseudo satellites.

The company has established an operating base at Wyndham Airport from where several of the Zephyr aircraft – part of Airbus Defence and Space's innovative High Altitude Pseudo Satellites (HAPS) program – will undertake test flights.

The Zephyr HAPS project is a solar-powered aerial platform that flies at more than 65,000 feet to provide a range of earth observation services and communications connectivity for people in remote areas, including for civil, military or humanitarian purposes. These purposes could include environmental management, mineral exploration, or bushfire management.

Wyndham was chosen due to the largely unrestricted airspace and reliable weather, together with strong support by the Western Australian Government, with the project set to create new jobs in its future operations.

The State Government began working with Airbus in early 2018. During their United Kingdom visit in March 2018, Premier and Minister for State Development, Jobs and Trade, Mark McGowan, and Defence Issues Minister Paul Papalia visited Airbus in Farnborough where they were briefed on the proposal.

"This is a major coup for Western Australia; I'm thrilled that Airbus has chosen Wyndham Airport as the operational and launch site for the Zephyr project," Mr McGowan said.

"Our local economy will benefit from this decision, with up to 20 Airbus staff also earmarked to be based in the local area during operational phases. I am optimistic that early success of the project will lead to expanded job opportunities in the east Kimberley and elsewhere in Western Australia.

"From my meeting with the company in March, I was very impressed with the proposal and Airbus' international reputation. The technically advanced nature of the project will also help build Western Australia's profile in the aerospace, defence and innovation spaces.

"The Government looks forward to the operational success of Zephyr and to exploration by both local and other Australian government agencies and companies of opportunities to utilise such HAPS technology to improve economic, social and environmental outcomes in our region."

The State Government coordinated support for the Zephyr project with the Shire of Wyndham East Kimberley and the Kimberley Development Commission, to ensure that all arrangements were in place to support the operational start of the project at Wyndham. ■



The solar-powered pseudo satellite, 'Zephyr' aircraft.

A photograph of a person in a cave, wearing a yellow high-visibility vest and a hard hat, standing next to a white tent. The cave walls are rocky and illuminated by warm, orange light. The person is looking towards the tent. The tent is set up on a rocky floor. The overall scene is dimly lit, with the primary light source being the warm, orange light illuminating the cave walls and the person.

WESTERN AUSTRALIA LEADING THE WAY IN THE RESOURCES SECTOR

BHP monitoring Ghost Bats in the Pilbara. Photo: BHP

Bats, biosecurity, lightning protection, emergency response procedures, health, infrastructure and education were all in the spotlight at the Department of Mines, Industry Regulation and Safety's (DMIRS) Resources Sector Awards for Excellence ceremony.

Attended by more than 200 people from the resources industry, community groups and government representatives, the evening celebrated projects that demonstrate excellence in innovation, environmental outcomes, worker health and safety, and meaningful community partnerships.

Five projects from across Western Australia were recognised for their commitment to continuous innovation and excellence in the State's resources sector.

DMIRS Director General David Smith said the winners were a credit to WA's nationally significant industry.

"Our State continues to be at the forefront of social, safety and environmental outcomes in the resources sector and sharing these great projects is an important part of continuing that trend," Mr Smith said.

"Western Australians want resources companies to be responsible. That means being aware of their duties in environmental stewardship, their need to work hand in hand with the communities in which they operate, and the importance of protecting employees from harm.

"The winners of these awards have gone above and beyond their regulatory commitments to demonstrate that dedication."

The men and women behind these innovations and improvements have worked hard to improve the lives of Western Australians, coming up with ideas that will benefit our environment, our communities, and the safety and health of our workers.

The calibre of entries received were of such a high quality, two projects were awarded the prestigious Golden Gecko award for environmental excellence. This edition takes a closer look at these two projects. The next edition of *Prospect* magazine will feature the winners of the Safety and Health, and Community Partnership Resources Sector Awards.

Nominations for the 2019 Resources Sector Awards for Excellence will open on 25 February 2019. For more information visit www.dmirs.wa.gov.au/excellenceawards.



The WA Port Authorities and the Department of Primary Industries and Regional Development won a Golden Gecko for their State Wide Array Surveillance Program.

GOLDEN GECKO WINNERS

State Wide Array Surveillance Program

WA Port Authorities and Department of Primary Industries and Regional Development

Western Australia's ports, spanning more than 11,000km of coastline, form critically important sea gateways for the State's resources sector enabling access to international markets through seaborne trade.

While there are stringent State and Commonwealth environmental regulations in place, international trading vessels visiting WA's Ports have the potential to carry unwanted marine pests in their ballast or as part of hull biofouling. The potential impacts would affect delicate marine environments, human health, aquaculture and disruptions to trade.

The effective management of marine pests across WA's vast coastline requires a collaborative approach between port authorities and the Department of Primary Industries and Regional Development (DPIRD) as the State regulator for aquatic biosecurity, and industry.

The State Wide Array Surveillance Program (SWASP) was developed to keep Western Australia's marine environment free of marine pests by providing DPIRD, WA Port Authorities, and industry tenants and customers (including the resource sector) with an early warning of a possible incursion of marine pests, before they can establish and cause significant impacts.

By helping to keep ports free of marine pests, the SWASP ensures ongoing access to international markets for our resource and other commercial trade sectors.

Pilbara Ports Authority Environment and Heritage Manager, Dan Pedersen said all of the WA port authorities and DPIRD had celebrated the Golden Gecko Award.

"The win highlights that a cost effective, consistent and practical solution to marine biosecurity surveillance is possible when there is a strong foundation of collaboration and trust between the regulator, ports and industry," Mr Pedersen said.

"We hope this recognition encourages other ports and industry across Australia to adopt our marine biosecurity surveillance approach, which would help us to further improve and advance the program."

Following engagement with Ports Australia, the SWASP will be implemented at five Queensland ports (Brisbane, Cairns, Gladstone, Mackay and Townsville) as part of a collaborative pilot study between Ports Queensland and the Queensland Department of Agriculture and Fisheries.

A successful pilot program in Queensland could be the next step to achieving a National Array Surveillance Program across other Australian ports. This would allow port authorities and regulators to collaboratively and more rapidly respond to a potential incursion of an introduced marine pest, thereby decreasing the impact of invasive pests on the environment.



Golden Gecko winners BHP for their project *Chasing Ghosts: Understanding Ghost Bat Ecology in the Pilbara*.

Chasing Ghosts: Understanding Ghost Bat Ecology in the Pilbara

BHP

In 2011, BHP commenced a regional study to understand the ecology of the ghost bat in the Pilbara. During the eight-year research program, BHP collaborated with two environmental consultancies, three universities, two government departments and 14 mining companies.

BHP Principal Ecologist and technical manager for the project, Belinda Barnett said they knew ghost bats were in the area.

"The evidence of their distinctive scats and feeding remains in caves confirmed their existence, however not being able to see or catch the bats made it very difficult to study them, which is where innovation and collaboration was essential to the success of the project," Ms Barnett said.

An adaptive study approach tested new technology in the study of the species. DNA and faecal steroid analysis, 3D roost mapping and radio-telemetry tracking were some of the new and innovative techniques utilised to calculate how many individual bats used a cave, how many caves they used, how far they moved and

over what duration. The results have improved the knowledge of roosting and foraging habitats, diet, breeding and population dynamics of ghost bats in the Pilbara.

The morphology of caves used by ghost bats has been used to design artificial roosts across the Pilbara, with pockets and ledges for the bats to habitat.

BHP has also initiated the establishment of a Motus Wildlife Tracking System, which will enable increased research capabilities for any species across the Pilbara.

Ms Barnett explained that this project has provided significant detail about how the ghost bats use habitats in the Pilbara and how to most effectively study them and manage the impacts to the species.

"This study shows the benefit of 'thinking outside of the box' and obtaining specialist input where required to solve complex challenges," Ms Barnett said.

"The Golden Gecko award is amazing recognition of the collaborative efforts not only within BHP, but by the industry as a whole to continue to research, learn and ultimately reduce the footprint of mining operations."

"Chasing Ghosts" has seen widespread industry collaboration between other mining companies, education institutions and government bodies. ■



The WA Port Authorities State Wide Array Surveillance Program in operation.



2018 Resources Sector Awards for Excellence Winners

Golden Gecko Award

Winners:

*Chasing Ghosts: Understanding Ghost Bat Ecology in the Pilbara, BHP Iron Ore

*The State Wide Array Surveillance Program – WA Port Authorities and Department of Primary Industries and Regional Development

Certificate of Merit:

Alcoa and Murdoch University Partnership
Eradicates Biological Bulldozer Phytophthora Dieback, Alcoa of Australia



Safety and Health Resources Sector Award

Engineering Winner:

Lightning Protection System, Roy Hill Holdings

Certificate of Merit:

Spring Leaf Pack Hoist – Mineral Resources Limited

Systems and People Winner:

Emergency Response Exposure Reduction Initiative – BARRIO, Rio Tinto Iron Ore

Certificate of Merit:

Newmont Boddington Gold Health and Safety Representative Mentoring Program, Newmont Mining



Community Partnership Resources Sector

Award Winner:

Healthy Food for All – Pilbara Regional Strategy, Foodbank WA and BHP



Mining operations at IGO's Nova mine. Photo: IGO

EIS OPENS DOOR TO NEW MINING PROSPECTS IN FRASER RANGE

A significant copper-zinc discovery has encouraged a wave of exploration drilling in Western Australia's Fraser Range north-east of Esperance.

"Once considered unprospective, the Albany-Fraser Orogen can now claim a new mineralisation style following the discovery by Independence Group (IGO) at its Andromeda prospect," Geological Survey of Western Australia's (GSWA) Exploration Incentive Scheme (EIS) Coordinator Dr Charlotte Hall said.

"The discovery was supported by the EIS co-funded drilling program and GSWA geophysical pre-competitive data.

"The diamond drilling intersected zinc-bearing sulphides in metasedimentary rocks and that has opened a new search space for base metals."

Dr Hall said that recent exploration in the area had focused on mafic rocks which hosted the Ni-Cu-Co Nova-Bollinger deposit now being mined by IGO.

"The importance of understanding the tectonic setting for mineralisation and furthering effective exploration targeting in this belt has resulted in ongoing collaboration between the GSWA and exploration companies such as IGO, the Creasy Group and the Minerals Research Institute of WA (MRIWA)," Dr Hall said.

She said that GSWA had been mapping the unexposed areas of the Fraser Range with support from the Creasy Group for several years.

"GSWA has made extensive geochemical data available through its online geochemistry database and currently is a major sponsor with the Creasy Group on a MRIWA project investigating mineral systems at the margin of cratons that includes the Albany-Fraser Orogen," Dr Hall said.

"Only 10 years ago the Fraser Range was mainly known as pastoral-lease sheep country, and now it is a hive of exploration activity with one operating Ni-Cu-Co mine, and more than likely, other mines to follow."

Mines and Petroleum Minister Bill Johnston applauded the collaboration leading to the Andromeda discovery.

"This is the sort of breakthrough that could lead to a new mine similar to the nearby Nova-Bollinger project," he said.

"IGO's Fraser Range success is testament to the importance of the EIS and demonstrates why the State Government is investing \$10 million a year towards the scheme.

"The EIS plays a crucial role in encouraging exploration in underexplored and greenfields areas of the State, and creating jobs in regional communities." ■

IRON ORE PROCESSING**Pilbara – Cape Preston – Sino Iron
CITIC PACIFIC**

The Sino Iron project is located at Cape Preston, 100km southwest of Karratha. The project is the largest magnetite mining and processing development in Australia, with a mine life of more than 25 years. Six processing lines are now operational. The first shipment of magnetite concentrate to China occurred in late 2013. The project comprises in-pit crushers, a 29km slurry pipeline, with an approved annual capacity to produce up to 27.6 million tonnes of magnetite concentrate. The downstream processing facility has required significant investment in dedicated supporting infrastructure including a new port facility, a 51GL desalination plant and a 450MW combined cycle gas fired power station.

Expenditure: \$12b.

Employment: Construction: 4000

Operation: 1500

OIL & GAS DEVELOPMENTS**Carnarvon Offshore Basin – Barrow Island
– Gorgon Project****GORGON JOINT VENTURE**

The Gorgon Foundation Project on Barrow Island, is a three train LNG development with a nameplate capacity of 15.6Mtpa and includes a domestic gas plant capable of delivering 300TJ/d of gas to the mainland. Cost estimates for the project construction are expected to total more than \$55 billion. The project involves the processing of gas from both the Gorgon and Jansz/lo gas fields and includes potentially the largest commercial CO₂ geosequestration project in the world. Train one start up and first shipment of LNG commenced in March 2016. Train 2 produced first LNG in October 2016 and train three was commissioned in March 2017. Commissioning of the CO₂ injection project is expected in Q1 2019.

Expenditure: \$55b.

Employment: Construction: 8000

Operation: 300

ELECTRICITY GENERATION**Kwinana Waste to Energy Project
PHEONIX ENERGY AUSTRALIA PTY LTD**

On 18 October 2018, it was announced that the Project had achieved Financial Close. The facility will be Australia's first thermal waste-to-energy facility. Construction of the facility, which has been co-developed by Macquarie Capital and Phoenix Energy has commenced and is scheduled to open by the end of 2021. The facility will divert 400,000 tonnes of household, commercial, and industrial waste from landfill each year and recover that waste as energy. The Project currently has 20-year waste supply agreements with the Rivers Regional Council, which represents seven Local Government Authorities, and the City of Kwinana. During the construction phase more than 800 jobs, including apprenticeships, will be created and approximately 60 full-time positions once the facility is operational.

Expenditure: \$668m

Employment: Construction: 800

Operation: 60

IRON ORE**Pilbara – South Flank Project
BHP BILLITON IRON ORE PTY LTD**

The \$4.7 billion South Flank project is set to become the single largest annual production iron ore mine that BHP has ever developed. Leveraging off much of the existing Mining Area C infrastructure, South Flank will replace production from the 80Mtpa (100% basis) Yandi mine as its ore source depletes in the early to mid-2020s. Given the proximity of the South Flank deposit to the Mining Area C hub, the project will create a mining infrastructure hub within reach of several billion tonnes of high grade iron ore. Construction commenced in July 2018. First ore from South Flank is targeted in the 2021 calendar year, with the project expected to produce ore for more than 25 years. The South Flank project will create about 2500 jobs during peak construction and more than 600 ongoing operational roles over its expected 25 year life span.

Expenditure: Approximately \$4.7b

Employment: Construction 2500

Operation: 600

**Pilbara – Eliwana Mine and Rail Project
FORTESCUE METALS GROUP PTY LTD**

Fortescue Metals Group announced a financial investment decision on 28 May 2018 for the development of its Eliwana mine and 143 kilometre railway project. The \$1.7 billion project has an expected mine life of over 20 years and an average production rate of 30 million tonnes per annum. The company is targeting construction to begin in mid-2019, creating up to 1900 jobs during construction with 500 full-time site positions once operational.

Expenditure: \$1.7b.

Employment: Construction: 1900

Operation: 500

**Shire of East Pilbara – Koodaideri Iron Ore
Mine and Infrastructure Project****MOUNT BRUCE MINING PTY LTD
(RIO TINTO)**

Rio Tinto has made an investment decision for the development of the Koodaideri iron ore deposit located about 110km north-west of Newman. The Koodaideri Project will have a capacity of about 43 million tonnes of iron ore per annum requiring the development of a new mining area at Koodaideri, crushing, screening, stockpiling and rail load out infrastructure plus a 170 km railway.

Expenditure: \$3.5b.

Employment: Construction: 2000

Operation: 600

LITHIUM**Greenbushes Lithium Mine Expansion
TALISON LITHIUM AUSTRALIA PTY LTD**

Talison Lithium Australia Pty Ltd operates the Greenbushes lithium mine in Western Australia. 51 per cent of Talison shares are held by Tianqi Lithium and 49 per cent by Albemarle Corporation. The Greenbushes mine contains the highest grade of hard rock lithium in the world and supplies a third of the global lithium supply. Talison has announced a two-stage expansion project at Greenbushes which will increase the annual production capacity from the current 650 tonnes per annum to 1.35Mtpa by Q2 2019 and then to 1.95Mtpa by Q4 2020. The increased production will meet the feedstock requirements of the Tianqi Lithium (Kwinana) and the Albemarle Corporation (Kemerton) lithium hydroxide processing plants. Global lithium hydroxide demand has increased principally as a result of its critical use in lithium batteries for hybrid vehicles and energy storage.

Expenditure: \$1.2b

Employment: Construction: 500

Operation: 180

**Lithium Hydroxide Processing Plant
TIANQI LITHIUM AUSTRALIA PTY LTD**

Tianqi Lithium Australia Pty Ltd holds a 51 per cent interest in Talison Lithium, the operator of the Greenbushes mine in the South West of Western Australia. The company has committed to a major expansion of the mine and the construction of a lithium hydroxide processing plant at the Kwinana Strategic Industrial Area, south of Perth. The processing plant will be constructed in two stages. The first stage will accommodate the production of 24ktpa of lithium hydroxide. The second stage will expand the plant to produce up to 48ktpa of lithium hydroxide. Lithium hydroxide is a highly-valued resource for industries involved in electric vehicles, energy storage, aviation and other technological industries.

Expenditure: \$700m.

Employment: Construction: 500

Operation: 175

Wodgina Lithium Project MINERAL RESOURCES LTD

The Wodgina lithium mine, located approximately 120km south of Port Hedland, contains the world's largest known reserve of hard rock lithium with an estimated total mineral resource of 259 Mt and a mine life beyond 30 years. Mineral Resources Limited (MRL) is progressing the Wodgina Lithium Project in three stages as follows: (1) the export of direct shipping ore; (2) the construction of a spodumene concentrate plant, which is well advanced and scheduled for completion in 2019; and (3) subject to a final decision to proceed, the construction of a lithium hydroxide processing plant in conjunction with Albemarle.

Expenditure: \$610m

Employment: Construction: Approximately 450

Operation: Approximately 200

NICKEL

Kwinana Refinery Debottlenecking Program and Nickel Sulphate Project BHP BILLITON NICKEL WEST PTY LTD

BHP Nickel West is constructing Stage 1 of its nickel sulphate production facility at the Kwinana Nickel Refinery, south of Perth. Nickel West is currently seeking approvals for Stage 2 for the facility. Once constructed, the Stage 1 facility will be one of the world's largest nickel sulphate plants, producing approximately 100ktpa of nickel sulphate which is an important component for the manufacturing of lithium-ion batteries. Nickel West is also undertaking a debottlenecking program to potentially increase production from currently approximately 70ktpa to an aspiration of approximately 90ktpa of nickel for sale into the emerging battery market.

Expenditure: \$60m

Employment: Construction: 200

Operation: 20

OIL & GAS DEVELOPMENTS

Carnarvon Offshore Basin – Gorgon Stage 2 GORGON JOINT VENTURE

Gorgon Stage 2 is an expansion of the existing subsea gas gathering network for the Gorgon and Jansz-lo gas fields, which is required to ensure future supply to the three existing LNG Trains on Barrow Island. Seven new wells are to be drilled in the Gorgon field and four in Jansz-lo field for connection to the existing subsea facilities, in water depths of between 220 and 1320 metres. The decision to proceed with the four year project, with an estimated capital expenditure of \$5.1b, was announced in April 2018.

Expenditure: \$5.1b.

Carnarvon Basin – Greater Western Flank Phase 2

WOODSIDE ENERGY

The Greater Western Flank 2 Project was approved in December 2015 to develop gas and condensate from the Keast, Dockrell, Sculptor, Rankin, Lady Nora and Pemberton fields via a subsea tieback to the existing Goodwyn A platform. Production commenced in Q4 2018, six months ahead of schedule.

Expenditure: \$2.8b.

AGRICULTURE

East Kimberley – Project Sea Dragon SEAFARMS GROUP LIMITED

Seafarms Group is a Queensland based producer of farmed prawns. Seafarms proposes to invest up to US\$1.45b over the next eight years in Project Sea Dragon, a large scale, integrated, land based aquaculture project to produce black tiger prawns for export markets in Asia. The aquaculture component of the project will be located in the Northern Territory and is planned as a staged development commencing with Stage 1, with 1,000 hectares of ponds and supporting infrastructure. In Western Australia a founder stock and quarantine centre is operational in Exmouth, a processing plant is proposed for Kununurra, and subject to competitive tender Wyndham port will be utilised for export and import. The project will create approximately 300 jobs in the Kimberley during construction, 150 direct jobs in the region at Stage 1 building to 700 direct jobs when fully operational. Seafarms Group expect to make a Financial Investment Decision in Q4 2018 or Q1 2019.

CHEMICAL PROCESSING

Perdaman Urea Project PERDAMAN CHEMICALS AND FERTILISERS PTY LTD

Perdaman Chemicals and Fertilisers Pty Ltd, plans to construct and operate a urea plant with production capacity of approximately 2.0Mtpa on Sites C and F within the Burrup Strategic Industrial Area on Murujuga (the Burrup Peninsula). Perdaman announced it has signed a Gas Sale and Purchase Agreement for the supply by Woodside Petroleum Ltd of domestic gas to the proposed urea plant for a period of 20 years with option to extend to 25 years. The Environmental Protection Authority announced it would assess the Perdaman project as a Public Environmental Review.

Expenditure: \$4.5b

Employment: Construction: 2000+

Operation: 200

Downstream Processing Chemical Production Facility WESFARMERS CHEMICALS, ENERGY AND FERTILISERS (WESCEF) AND JOINT VENTURE PARTNERS

WesCEF, along with Joint Venture partners are considering a 1.8Mtpa methanol plant on Site E of the Burrup Strategic Industrial Area (SIA) on Murujuga (the Burrup Peninsula). The EPA has announced it will assess the project as a Public Environmental Review.

Expenditure: \$2.0b.

Employment: Construction: 1000+

Operation: 100

ELECTRICAL GENERATION

East Rockingham Waste to Energy Facility NEW ENERGY CORPORATION PTY LTD

The East Rockingham Waste to Energy Facility is a resource recovery facility that will process up to 300,000 tonnes per annum of waste and produce 28MW of baseload renewable electricity to the South West Interconnecting System (SWIS). The project is being led by a consortium formed between New Energy, Hitachi Zosen Inova and Tribe Infrastructure Group. The consortium has entered into a 20 year waste supply agreement with the Eastern Metropolitan Regional Council and with the City of Cockburn. The project was recently recommended for approval by the Environmental Protection Authority and is on target to reach financial close by the end of March 2019.

Expenditure: \$400m

Employment: Construction: 300

Operation: 50

HEAVY MINERAL SANDS

Shark Bay – Coburn Mineral Sands Project STRANDLINE RESOURCES LIMITED

The Coburn mineral sands project, located south of Shark Bay and approximately 250km north of Geraldton, contains total ore reserves of 308Mt at an average grade of 1.2 per cent heavy minerals. At a mining rate of 23.4Mtpa, the project is expected to produce 49,500tpa of zircon, 109,000tpa of chloride ilmenite and 23,500tpa of a mixed rutile-leucoxene over its 19 year mine life. A Definitive Feasibility Study was commenced in June 2018 and is expected to be completed in Q1 2019.

Expenditure: \$173m.

Employment: Construction: 170

Operation: 110

IRON ORE

Pilbara – Balla Balla Infrastructure Project BALLA BALLA JOINT VENTURE

BBJ Group (BBIG) is proposing the Balla Balla Infrastructure project (BBIP), a rail and port development, which when constructed will comprise an integrated port and rail infrastructure system that will provide a new gateway to the iron ore rich Pilbara region in Western Australia. Initial planned annual capacity of the rail and port is 50 million tonnes per annum. The Balla Balla port is located halfway between Dampier and Port Hedland. The proposed infrastructure for the BBIP includes a train loading facility at the central Pilbara iron ore source, a 165km single-track standard gauge railway and a multi-user port facility. The Railway (BBJ Rail Aus Pty Ltd) Agreement 2017 was executed between the State, the Company and the Guarantors in January 2017 with the Railway (BBJ Rail Aus Pty Ltd) Agreement 2017 being ratified by the Western Australian Parliament in December 2017.

Expenditure: \$5.6b.

Employment: Construction: 3300

Operation: 900

Pilbara – West Pilbara Iron Ore Project – API Port/Rail

API MANAGEMENT PTY LTD

The Australian Premium Iron Joint Venture is proposing to develop the West Pilbara Iron Ore Project. Stage 1 of the project is based on the production of 40Mtpa of direct shipping iron ore from deposits, including Red Hill and Mt Stuart deposits, located 35-80km south west of Pannawonica. The ore is proposed to be transported by a 240km heavy haul railway for export via the proposed multi-user port at Anketell. State and Federal environmental approvals for the mine, rail and port elements of the project are in place. Subject to the successful completion of feasibility studies, and receipt of final regulatory approvals, the company anticipates construction to commence following a decision to proceed by the joint venturers and completion of funding arrangements.

Expenditure: \$6.8b.

Employment: Construction: 1500

Operation: 900

LITHIUM

Albemarle Kemerton Plant

ALBEMARLE CORPORATION PTY LTD

Albemarle Corporation Pty Ltd holds a 49 per cent interest in Talison Lithium, the operator of the Greenbushes mine in the South West of Western Australia. The company has committed to a major expansion of the mine and is in the final stages of obtaining project approvals for a lithium hydroxide manufacturing plant within the Kemerton Strategic Industrial Area, 17km north-east of Bunbury. The Albemarle Kemerton Plant would process spodumene ore concentrate, through five process trains, to produce up to 100,000 tonnes of lithium hydroxide product per year. Once construction commences, the Albemarle Kemerton plant would be the second and largest lithium hydroxide manufacturing plant to invest in Western Australia in two years.

Employment: Construction: 500

Operation: 100-500

Mt Holland Lithium Project COVALENT LITHIUM PTY LTD

Covalent Lithium, 50:50 JV between Kidman Resources Ltd and Sociedad Quimica y Minera de Chile S.A. (SQM), is progressing the Mt Holland Lithium Project. The Project comprises a mine and concentrator at Mt Holland, and a refinery at Kwinana. The Earl Grey Lithium Deposit at Mt Holland is estimated to contain 189 million tonnes of 1.50% lithium oxide representing a significant hard rock lithium deposit. The Mt Holland Lithium Project will produce a spodumene concentrate from the mine and concentrator, which will be transported to the refinery and processed to produce an average of approximately 45,254 tonnes per annum of battery-grade lithium hydroxide.

Expenditure: \$1.05b.

Employment: Construction: 700

Operation: 300.

OIL & GAS DEVELOPMENTS

Browse to North West Shelf WOODSIDE ENERGY

In September 2018, the Browse Joint Venture (BJV) selected the Browse to North West Shelf concept to develop its gas resources at the Brecknock, Calliance and Torosa fields. These fields are estimated to contain a contingent resource of 13.9 trillion cubic feet of gas. The concept involves two floating production, storage and offtake vessels at the fields delivering gas to the North West Shelf Joint Venture's (NWSJV) gas facilities via a 900km pipeline. Through a tolling agreement with the NWSJV the project will produce 10Mtpa of LNG and the equivalent of 1.5Mtpa of domestic gas. The BJV is aiming for commencement in mid-2020s and is expected to be operational for up to 50 years.

Expenditure: \$30b.

Scarborough LNG Project WOODSIDE ENERGY

Woodside Energy and BHP are working together to identify an economically viable development option for the Scarborough gas field located offshore, 280km northwest of Onslow, in about 950m of water. The project is at an early stage of consideration with FID targeted for 2020 and ready for start up in 2023.

Expenditure: \$14b.



Prospect ONLINE

Did you know you can register for the digital edition of *Prospect* for free by signing up to the RSS feed on the *Prospect* page of DMIRS's website? Once registered, you will receive notification as soon as a new edition of *Prospect* is available to view online.

Just go to:

www.dmp.wa.gov.au/prospect
to sign up.

Prospect goes digital for subscribers

For the past 12 months, *Prospect* has suspended hard copy subscription renewals.

The Department will no longer provide hard copy editions directly to subscribers and is encouraging readers to sign up for the free digital version of the magazine.

Hard copies of the magazine will still be available for collection from front reception areas at DMIRS' Mineral House building in East Perth and JTSI's office at 1 Adelaide Terrace in East Perth.

In order to download your digital version free of charge visit www.dmp.wa.gov.au/prospect and sign up to the *Prospect* magazine mailing list.

Thank you for your continued support of *Prospect* Magazine.

Sign up to receive your FREE digital copy of *Prospect* magazine at www.dmp.wa.gov.au/prospect

Significant resource projects in Western Australia

Western Australia continues to lead the way as Australia's premier resources investment destination. There are more than A\$81 billion worth of projects either committed or under consideration for the State during the next few years. These would create 15,600 construction jobs and over 3600 permanent jobs.

This section is intended as an overview and does not constitute an exhaustive list of projects within the Western Australia resources industry. Based on company announcements.

Significant Projects as at December 2018

	Project Value (estimated A\$m)	Employment Construction Permanent
Chemical Processing		
Perdaman Chemicals and Fertilisers Pty Ltd – Perdaman Urea Project	4500	2000 200
WesCEF & JV Partners – Downstream Processing Chemical Production Facility	2000	1000 100
Sub Total	6500	3000 300
Iron and Steel		
API Management Pty Ltd – West Pilbara Iron Ore Project	6800	1500 900
Balla Balla Joint Venture – Balla Balla Infrastructure Project	5600	3300 900
BHP Billiton Iron Ore Pty Ltd – South Flank	4700	2500 n/a
FMG – Eliwana Mine and Rail Project	1700	1900 500
Mount Bruce Mining Pty Ltd – Koodaideri Iron Ore Mine and Infrastructure Project	3500	2000 600
Sub Total	22300	11200 2900
Lithium		
Talison Lithium Australia Pty Ltd – Greenbushes Lithium Mine Expansion	1200	500 180
Covalent Lithium Pty Ltd – Mt Holland Lithium Project	1052	700 300
Sub Total	2252	1200 480
Oil, Gas and Condensate		
Gorgon Joint Venture – Gorgon Stage 2	5100	200 n/a
Woodside Energy – Greater Western Flank Phase 2	1370	n/a n/a
Woodside Energy – Browse to North West Shelf	30000	n/a n/a
Woodside Energy – Scarborough LNG Project	14000	n/a n/a
Sub Total	50470	200 n/a
TOTAL	81522	15600 3680

All currency figures are in Australian dollars unless otherwise specified.

Abbreviations Key

b	billion
EPC	Engineering, Procurement and Construction
GL	gigalitres
ha	hectares
JV	joint venture
km	kilometres
ktpa	kilo tonnes per annum
LNG	liquefied natural gas

LOA	length overall
m	million
Mt	million tonnes
Mtpa	million tonnes per annum
MW	megawatts
t	tonnes
THM	total heavy mineral
TJ	terajoules
tpa	tonnes per annum



Major Resource Projects

January 2019



Mineral symbols	Commodities
◆ Precious metal Au (or as shown)	Ag..... Silver
◆ Steel alloy metal Ni (or as shown)	Au..... Gold
◆ Speciality metal Ti-Zr (or as shown)	Cu..... Copper
▲ Base metal	Fe..... Iron
■ Iron	K..... Potassium
■ Alumina	Kn..... Kaolin
All sites are bauxite	Li..... Lithium
● Coal and lignite	LNG..... Liquefied natural gas
● Industrial mineral	LPG..... Liquefied petroleum gas
☒ Processing plant	Mag..... Magnetite
	Mn..... Manganese
	Mo..... Molybdenum
	Ni..... Nickel
	Pb..... Lead
	Phos..... Phosphate
	REE..... Rare earth elements
	Sid..... Silica sand
	Sn..... Tin
	Ta..... Tantalum
	Ti..... Titanium
	TiC..... Taic
	V..... Vanadium
	W..... Tungsten
	Zn..... Zinc
	Zr..... Zirconium

Petroleum symbols
● Gas field
● Oil field
● Oil and gas field
● Significant oil discovery
☒ Processing plant
— Oil / gas pipeline, operating
- - - Oil / gas pipeline, proposed

Infrastructure
■ Power plant
■ Irrigation / water / desalination
■ Port

Enquiries for latest information for Commonwealth controlled waters is available from the National Offshore Petroleum Titles Administrator (NOPITA) at <info@nopita.gov.au>



Project labels:

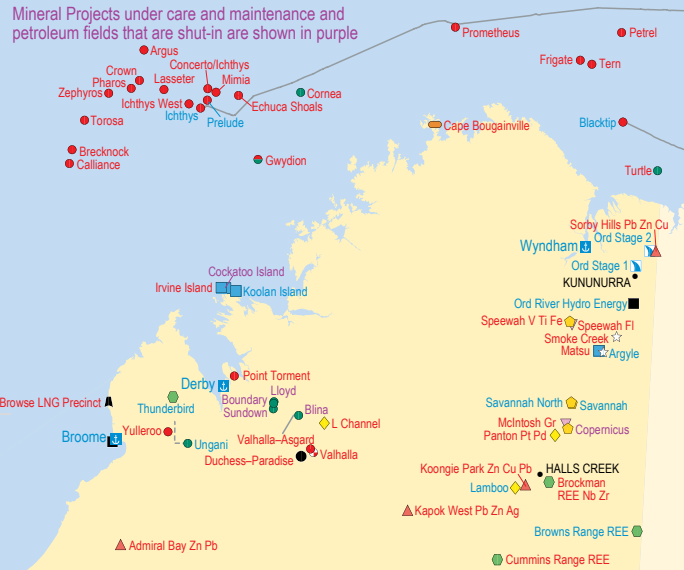
Projects operating or currently under development with an actual or anticipated value of production greater than A\$10 Million are shown in blue

Proposed or potential projects with a capital expenditure greater than A\$20 Million are shown in red

Mineral Projects under care and maintenance and petroleum fields that are shut-in are shown in purple



Mineral Projects under care and maintenance and petroleum fields that are shut-in are shown in purple



This map of Western Australia illustrates the distribution of mineral resources and renewable energy potential. Key features include:

- Mineral Deposits:** Numerous locations are marked with colored symbols representing different minerals:
 - Red symbols:** Various copper (Cu), zinc (Zn), and lead (Pb) deposits, including Citadel Au Cu, Minyari-WACA Au Cu Co, Teller Au Cu, O'Callaghans W Cu Zn Pb, Yeneena Cu, Maroochydore Cu Co, Kintyre, Nicholas Downs Mn, and Succoth Cu PGE.
 - Yellow symbols:** Gold (Au) and silver (Ag) deposits, such as Butcherbird Mn, Plutonic Dome, Fortnum, Telecom Hill, DeGrussa Cu Au, Monty Cu Au, Wiluna West, Wiluna Toro, Lake Way K, Honeymoon Well, Mt Keith, Kathleen Valley Li Ta, Bronzewing, Dalgarranga, Mt Magnet, Windimurra V Fe, Youanmi V Ti, Kerkalocka, Edna May, Colgar wind, Tampia, Katanning, Mt Cattlin Li Ta, Ravensthorpe, and Great Southern Au Cu.
 - Blue symbols:** Nickel (Ni) and cobalt (Co) deposits, including Woodie Woodie Mn, Nifty Cu, and Jack Hills.
 - Green symbols:** Rare earth elements (REE), specifically Yangibana REE, Cummins Range REE, and Cyclone.
 - Purple symbols:** Potash deposits, including Lake Wells / Salt Lake Potash and Lake Wells / Australian Potash.
- Renewable Energy:**
 - Asian Renewable Energy Hub wind & solar:** Indicated by a black square symbol.
 - Wind:** Colgar wind and Wingalling.
 - Solar:** Various locations marked with red triangles, including Yalbra Gr, Yogi Mag, and Scaddan.
- Geographical Features and Infrastructure:**
 - Coastal Features:** Cape Cuvier, Lake MacLeod Gp, Lake MacLeod Salt, Shark Bay Salt, Port Gregory Grt, Balline Grt, Fremantle, Bunbury, and Esperance.
 - Major Cities and Towns:** Carnarvon, Geraldton, Perth, and Eucla.
 - Water Bodies:** Lake Mackay K, Lake Disappointment K, and Lake Wells.
 - Other Features:** Mulga Rock, Silver Knight, Nova-Bollinger, and Cosmic Boy Concentrator.
- Scale and Orientation:** A scale bar at the bottom right indicates distances from 0 to 400 Kilometres. The map includes several inset boxes for enlarged views of specific regions: North West Shelf, Port Hedland, Pilbara (inside cover), and Goldfields (inside cover).