

PERCS PERTH



WESTERN AUSTRALIA

.....
On the global gas stage



LNG 18
PERTH
AUSTRALIA
11-15 April 2016



This edition of *Prospect* coincides with the 18th International Conference & Exhibition on Liquefied Natural Gas (LNG 18), which is being hosted in Perth in April.

We welcome conference delegates and international visitors to Western Australia and to Perth – the only city in the world to host this prestigious event twice (following LNG 12 in 1998).

During the past two decades, our State's LNG sector has grown substantially – from a single operational LNG export project to now, where Western Australia is poised to more than double LNG production from 21 million tonnes in 2014, to almost 50 million tonnes by 2018.

Western Australia is home to some of the world's largest LNG projects and the sector has a pivotal role in our community and economy – employing thousands of people in construction, operation and related services, and supplying gas to business, industry and to the Western Australian community.

This edition of *Prospect* shines a spotlight on Western Australia as a leading LNG producer and exporter on the world stage – exploring the history of oil and gas in Western Australia (story page 10) and providing an overview of the State's LNG sector (stories from page 2).

With an abundance of natural resources and a sophisticated resources industry, Western Australia has emerged as the nation's gas leader.

Our highly skilled, experienced workforce and a commitment to innovation in the broader resources sector strengthen Western Australia's position as a global force in LNG.

Colin Barnett
PREMIER OF WESTERN AUSTRALIA & MINISTER FOR STATE DEVELOPMENT

Bill Marmion
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 and Petroleum (DMP) and Department of State Development (DSD).

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

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

DMP Editorial management: Beau Pearson, DMP Communications and Marketing Division.

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

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 and Petroleum (DMP) and Department of State Development (DSD). Opinions expressed in Prospect are those of the authors and do not necessarily represent the views, or have the endorsement of DMP and DSD. DMP and DSD 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. DMP and DSD 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.



Cover photo: Aerial view of a liquefied natural gas (LNG) tanker at the Port of Dampier in Western Australia's Pilbara region – the port is the world's second largest bulk export port.
Photo: Pilbara Ports Authority.

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

DEPARTMENT OF STATE DEVELOPMENT

International Trade and Investment

Level 6, 1 Adelaide Terrace
East Perth, Western Australia 6004 • AUSTRALIA
Tel: +61 8 9222 0555 • Fax: +61 8 9222 0505
Email: invest@dsd.wa.gov.au • www.dsd.wa.gov.au

INTERNATIONAL OFFICES

Europe — London

Government of Western Australian – European Office
5th floor, The Australia Centre
Corner of Strand and Melbourne Place
London WC2B 4LG • UNITED KINGDOM
Tel: +44 20 7240 2881 • Fax: +44 20 7240 6637
Email: agent_general@wago.co.uk • www.wago.co.uk
twitter.com/wagoEU

India — Mumbai

Western Australian Trade Office
93 Jolly Maker Chambers No 2
9th floor, Nariman Point • Mumbai 400 021 • INDIA
Tel: +91 22 6630 3973 • Fax: +91 22 6630 3977
Email: india@dsd.wa.gov.au • www.watoindia.in

Indonesia — Jakarta

Western Australia Trade Office
Level 48, Wisma 46, Jalan Jenderal Sudirman Kavling 1
Jakarta Pusat 10220 • INDONESIA
Tel: +62 21 574 8834 • Fax: +62 21 574 8888
Email: invest@dsd.wa.gov.au

Japan — Tokyo

Western Australian Government Office
14th floor, Imperial Tower
1-1-1 Uchisaiwai-cho Chiyoda-ku
Tokyo 100-0011 • JAPAN
Tel: +81 3 5157 8281 • Fax: +81 3 5157 8286
Email: wa.tokyo@wajapan.net • www.wajapan.net

Japan — Kobe

Western Australian Government Office
6th floor, Golden Sun Building 4-3-6 Nakayamate-dori
Chuo-Ku • Kobe 650-0004 • JAPAN
Tel: +81 78 242 7705 • Fax: +81 78 242 7707
Email: wa.kobe@wajapan.net • www.wajapan.net

Middle East — Dubai

Western Australian Trade Office
106, Emarat Atrium
PO Box 58007 • Dubai • UNITED ARAB EMIRATES
Tel: +971 4 343 3226 • Fax: +971 4 343 3238
Email: info@wato.ae • www.wato.ae

Kenya — Nairobi

Western Australian Trade Office
Kenya Representative Office
PO Box 25567
Nairobi 00603 • KENYA

People's Republic of China — Shanghai

Western Australian Trade and Investment Office
Level 22 • CITIC Square
1168 Nanjing Road West
Shanghai 200041 • PEOPLE'S REPUBLIC OF CHINA
Tel: +86 21 5292 5899 • Fax: +86 21 5292 5889
Email: invest@dsd.wa.gov.au • www.westernaustralia.cn

People's Republic of China — Hangzhou

Western Australian Trade and Investment Promotion
Hangzhou Representative Office
Room 1705 • World Trade Centre Plaza
Zhejiang World Trade Centre
122 Shuguang Road
Hangzhou 310007 • PEOPLE'S REPUBLIC OF CHINA
Tel: +86 571 8795 0296 • Fax: +86 571 8795 0295
Email: invest@dsd.wa.gov.au • www.westernaustralia.cn

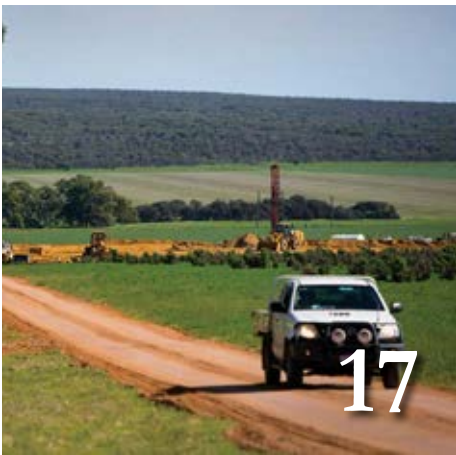
Singapore

Western Australian Trade and Investment Office
6 Temasek Boulevard #20-02
Suntec Tower Four
Singapore 038986 • SINGAPORE
Tel: +65 6836 5626 • Fax: +65 6836 5698
Email: invest@dsd.wa.gov.au

South Korea — Seoul

Western Australian Trade and Investment Office
Unit 702, 7th floor, Kwanghwamoon Building
149 Sejong-daero, Jongno-gu, Seoul, 110-730, KOREA
Tel: +82 2 722 1217 • Fax: +82 2 722 1218
Email: invest@dsd.wa.gov.au • www.westernaustralia.or.kr

In this issue



02 LNG leader

Western Australia is in line to become one of the world's largest exporters of liquefied natural gas (LNG).

06 Unique State

Western Australia is uniquely positioned internationally as a leader in innovation and technology in the resources sector.

08 Petroleum potential

Petroleum and geothermal industries benefit from the Western Australian Government's Exploration Incentive Scheme.

17 Onshore gas go-ahead

The Waitsia onshore gas project in the northern Perth Basin – part of Australia's largest onshore conventional gas discovery in thirty years – announces first stage.

20 In demand

Western Australia is poised to become a dominant force in the global lithium industry.

22 Data, drilling, 3D

The 2016 Geological Survey of Western Australia Open Day covered three key elements of mineral exploration leading to new discoveries.



Department of **Mines and Petroleum**
Department of **State Development**

Department of Mines and Petroleum
www.dmp.wa.gov.au

Department of State Development
www.dsd.wa.gov.au

WESTERN AUSTRALIA: A GLOBAL GAS PLAYER



Woodside's Pluto LNG onshore gas plant in Western Australia's North West. Photo: Woodside Energy Ltd

By the end of 2018, Australia's liquefied natural gas (LNG) production capacity is expected to be 87 million tonnes a year – the largest of any country.

Western Australia is leading the nation in the LNG sector, with Perth hosting the world's largest international gas conference in April this year – the 18th International Conference & Exhibition on Liquefied Natural Gas (LNG 18).

With this edition of *Prospect* coinciding with the conference, we take a look at Western Australia as a global LNG leader.

The majority of Australia's known conventional natural gas resources are held in basins located along the Western Australian coastline.

The State's known conventional gas resources are estimated to be more than 130 trillion cubic feet (tcf), while oil and natural gas liquids reserves are estimated to be 1,700 million barrels.

Shale gas resources in the Perth, Carnarvon and Canning Basins are estimated to contain between 91 and 193tcf, while an estimated 86tcf of tight gas resources are contained in the Perth and Canning Basins.

The State accounts for the largest share of Australia's petroleum exploration expenditure in onshore, offshore and adjacent Commonwealth offshore areas (55 per cent of the national total in 2014-15).

There are around 50 operating oil and gas fields in Western Australia and the State is the largest producer of natural gas, crude oil and natural gas liquids in Australia.

As of September 2015, Western Australia has A\$171 billion in resource projects under construction or in the committed stage of development with LNG projects making up 89 per cent (A\$153 billion) of the total, and another A\$74.5 billion in LNG projects also under consideration.

To market, to market

As the first Australian state to commence exports of LNG (from the North West Shelf project in 1989), Western Australia's LNG industry has undergone rapid growth during the past three decades.

The State has emerged as a leader in the field with an established and experienced industry, skilled and innovative workforce and a strong reputation internationally as a reliable supplier of LNG.

There are more than 800 global and local energy companies and petroleum equipment, technology and services companies based in Perth.

Western Australia's capital city has the largest concentration of international oil and gas companies in Australia. These companies operate projects across the country, and service and supply oil and gas exploration and production across the Indian Ocean and Pacific regions.

Perth is well located for doing business worldwide, sharing a business time zone (within two hours) with 60 per cent of the world's population, including the populous and dynamic Asian economies.

Western Australia's abundant natural resources, coupled with the State's strategic location and proximity to the Asian region, have seen the State secure long-term LNG sales contracts.

Japan was a foundation customer for Western Australian LNG and remains the State's largest consumer.

In 2006, Western Australia became the first jurisdiction to sell LNG to China. The State also exports LNG to South Korea and Taiwan and new contracts with customers in China and India are expected to diversify the State's future exports of LNG.

Western Australia has a large and committed program of LNG investments. The State's annual production capacity of LNG is forecast to more than double, from 20.6 million tonnes in 2015 to 48.7 million tonnes by 2018.

Leading projects

Western Australia's operational LNG projects are the North West Shelf (with a current capacity of 16.3 million tonnes per annum of LNG) and Pluto (4.3mtpa capacity).

Three major LNG projects are under construction in Western Australia: Gorgon (15.6mtpa capacity), Wheatstone (8.9mtpa capacity) and the Prelude floating LNG (FLNG) project (3.6mtpa capacity).

The Inpex-operated Ichthys Project (8.94mtpa capacity), which will source gas from the Browse Basin off Western Australia's coast and process it onshore near Darwin and offshore near the field, is also currently under construction. The Ichthys gas field is the largest discovery of hydrocarbon liquids in Australia in over 40 years.

The Chevron-operated Gorgon Project, located on the northwest coast of Western Australia, is one of the world's largest natural gas projects and the largest single resource development in Australia's history.

The Chevron-led Wheatstone Project is located in Western Australia's Pilbara region and includes an onshore processing facility located at the Ashburton North Strategic Industrial Area. The initial project comprises two LNG trains with a combined capacity of 8.9mtpa with approval to expand to 25mtpa of LNG over time, as well as a domestic gas plant with a capacity of 200 terajoules per day.

Based in the Browse Basin off the Western Australian coast, Shell's Prelude FLNG project was the first floating LNG project globally to make a final investment decision, and the first to commence construction. When it begins production, Prelude will likely be the largest floating LNG project in the world.

Supporting infrastructure

One of Western Australia's most prominent features – the sheer size of the State at about 2.5 million square kilometres – together with the location of the State's gas reserves (predominantly in the State's northern half), has seen the development of sophisticated gas infrastructure supporting the industry across the State.

The Western Australian Government has established a number of Strategic Industrial Areas (SIAs) across the State for downstream processing of gas and other heavy industrial and strategic industrial activities (see story page 4).

Key SIAs are located close to the State's gas resources and are connected to key infrastructure including roads, rail and ports.

Natural gas supplies about 50 per cent of total primary energy consumption in Western Australia.

As the State's gas fields are such a great distance from major domestic gas customers in the State's southwest, pipeline operators have invested extensively in natural gas transmission pipelines.

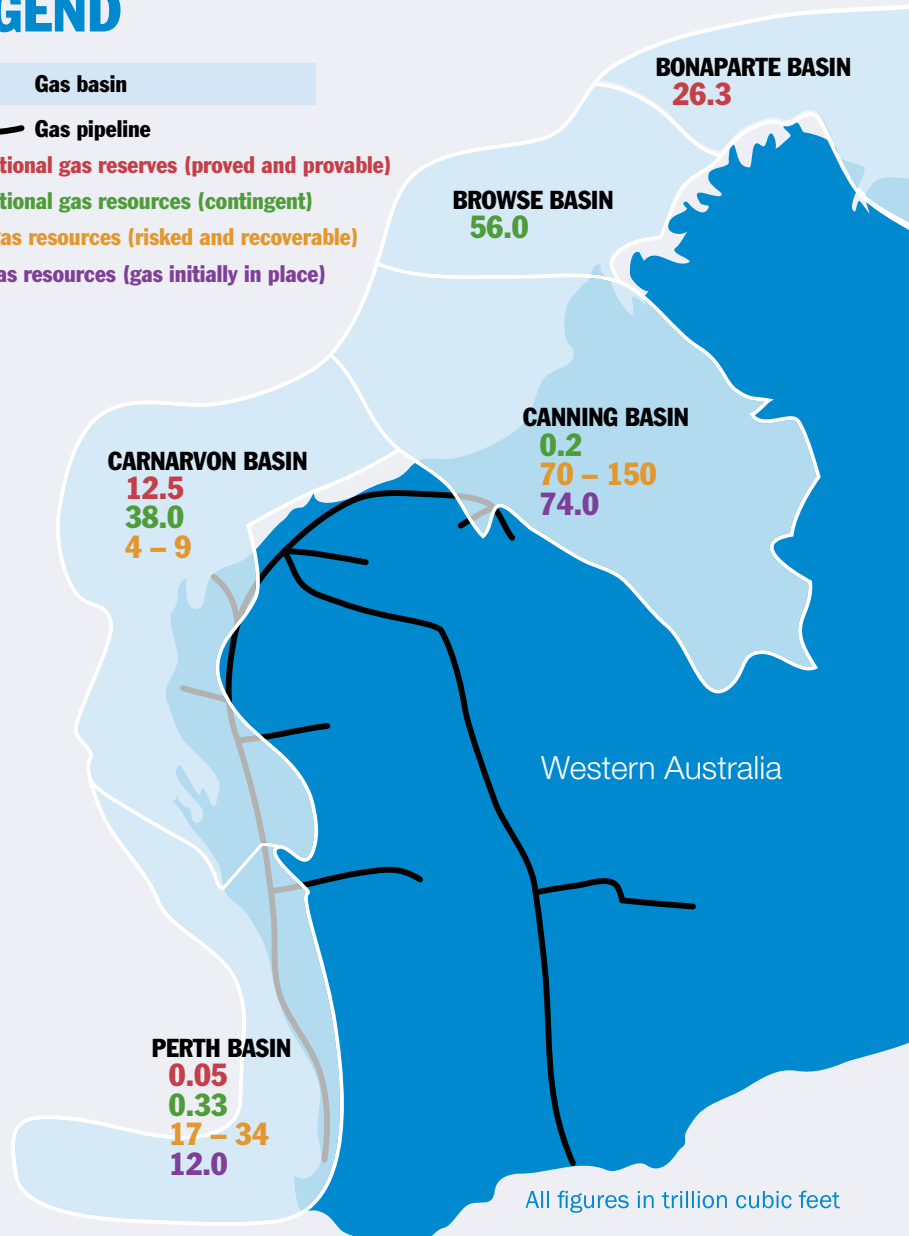
There are four major natural gas transmission pipeline networks that supply the Western Australian gas market: the Dampier Bunbury Natural Gas Pipeline network (which transports gas from the Carnarvon Basin to the Mid West, Perth

metropolitan and South West region); the Goldfields Gas Transmission network (which transports gas from the Carnarvon Basin to the Pilbara, Eastern Goldfields and Esperance regions); the Parmelia Pipeline (which transports gas from various fields in the Perth Basin to customers in Perth and the South West); and the Pilbara Energy Pipeline (which transports gas from the Carnarvon Basin to Port Hedland and northern Pilbara region in the State's north).

The Dampier Bunbury Pipeline is Western Australia's principal gas transmission pipeline. It conveys some 300 terajoules per day of Western Australian standard gas quality natural gas over 1800 kilometres from the offshore natural gas reservoirs of the Carnarvon Basin to industrial, commercial and residential customers in Perth and surrounding regions. ■

LEGEND

- Gas basin
- Gas pipeline
- Conventional gas reserves (proved and provable)
- Conventional gas resources (contingent)
- Shale gas resources (risked and recoverable)
- Tight gas resources (gas initially in place)





INDUSTRIAL ESTATES LNG GROWTH

Western Australia is known as Australia's resources state – the nation's leading exporter of resources including liquefied natural gas (LNG), iron ore and petroleum.

WA is ideally positioned to supply the growing Asian region and other key global markets.

In WA's resources sector, LNG accounts for A\$152.9 billion of the A\$171 billion currently committed in major resource projects, and A\$74.5 billion of the A\$110.4 billion of projects under consideration.

The State is home to over 90 per cent of Australia's known conventional natural gas resources, and some of its biggest projects – the North West Shelf Project, Woodside's Pluto LNG Project, and Chevron's Wheatstone and Gorgon Projects.

The scale of these projects and their potential returns are enormous, but their remote locations can bring with them significant challenges.

The Western Australian Government plays a key role in ensuring these vital projects, and the significant economic benefits they bring, are supported and able to realise their potential.

Located throughout the State in close proximity to WA's major resource projects, Strategic Industrial Areas (SIAs) are modern industrial estates designed to capitalise on the downstream processing potential of a region's resources.

Led by the Department of State Development and delivered by the Western Australian Government's land development and infrastructure agency, LandCorp, the SIAs are strategically positioned with access to key infrastructure such as roads, rail and ports.

LandCorp Chief Executive Frank Marra said the State's network of SIAs provided invaluable support to WA's resource industry and its key projects.

"SIAs are carefully planned and protected industry hubs, located alongside established skilled and productive workforces," Mr Marra said.

"Most importantly, they offer large connected land areas with access to infrastructure and provide the platform for investment in downstream processing and other strategic activities tying in with those big projects."

A total of 12 SIAs are currently being developed across WA, from the southern tip of the State near Albany to the far North West coast.

Two of these – the Burrup SIA and the Ashburton North SIA – already play a crucial role in supporting Australia's biggest LNG projects.

Covering a total of 370 hectares on the Burrup Peninsula, approximately 1500 kilometres north west of Perth, the Burrup SIA is a well-established industrial estate which is home to Western Australia's current operating LNG projects – the North West Shelf Joint Venture and Woodside's Pluto LNG Project.

The North West Shelf Joint Venture's six equal participants are BHP Billiton Petroleum (North West Shelf) Pty Ltd, BP Developments Australia Pty Ltd, Chevron Australia Pty Ltd, Japan Australia LNG (MIMI) Pty Ltd, Shell Development (Australia) Pty Ltd and Woodside Energy Pty Ltd.

The Burrup SIA includes the Yara Pilbara Fertilisers ammonia plant and a range of support industry tenants including port services, marine and sub-sea support industries, heavy lifting, specialty welding and construction and engineering and mining operators.

An A\$600 million technical ammonium nitrate plant is also being constructed in the estate by Yara Pilbara Nitrates.

"Work began on the Burrup SIA in 2002, and today more than 70 per cent of the estate has been developed," Mr Marra said.

"All sites located within the estate are connected to the nearby Dampier Port and multi-user bulk liquids jetty by a service corridor, and have good access to key transport links including the Dampier and Karratha road networks."

Some 215km south west of the Burrup Peninsula is the Ashburton North SIA (ANSIA), the site of Chevron's Wheatstone Project.

The ANSIA is an 8000ha specialist precinct with the potential to accommodate up to two LNG processing sites and associated domestic gas facilities, and multiple downstream processing industries.

The ANSIA includes a deep water port, multi-user infrastructure corridors, general industrial sites, workforce accommodation areas, and direct access to natural gas pipelines. New planning is underway to formalise a surrounding buffer area to ensure the future operation of key strategic industries is protected.

The ANSIA is also home to BHP Billiton's US\$1.5 billion Macedon Domestic Gas Project, which began supplying gas to the WA market in late 2013.

Wheatstone's onshore component at the ANSIA will include two LNG trains with a combined 8.9 million tonnes per annum (mtpa) capacity, domestic gas plant, and port facilities.

In addition to the SIAs in the State's north, the Australian Marine Complex (AMC) located at Henderson, 23km south of Perth, provides another key link in the Western Australian Government's support of the resources industry.

POWER

The 407ha industrial estate comprises four precincts under a mix of government and private ownership, and is managed jointly by LandCorp and the Department of Commerce.

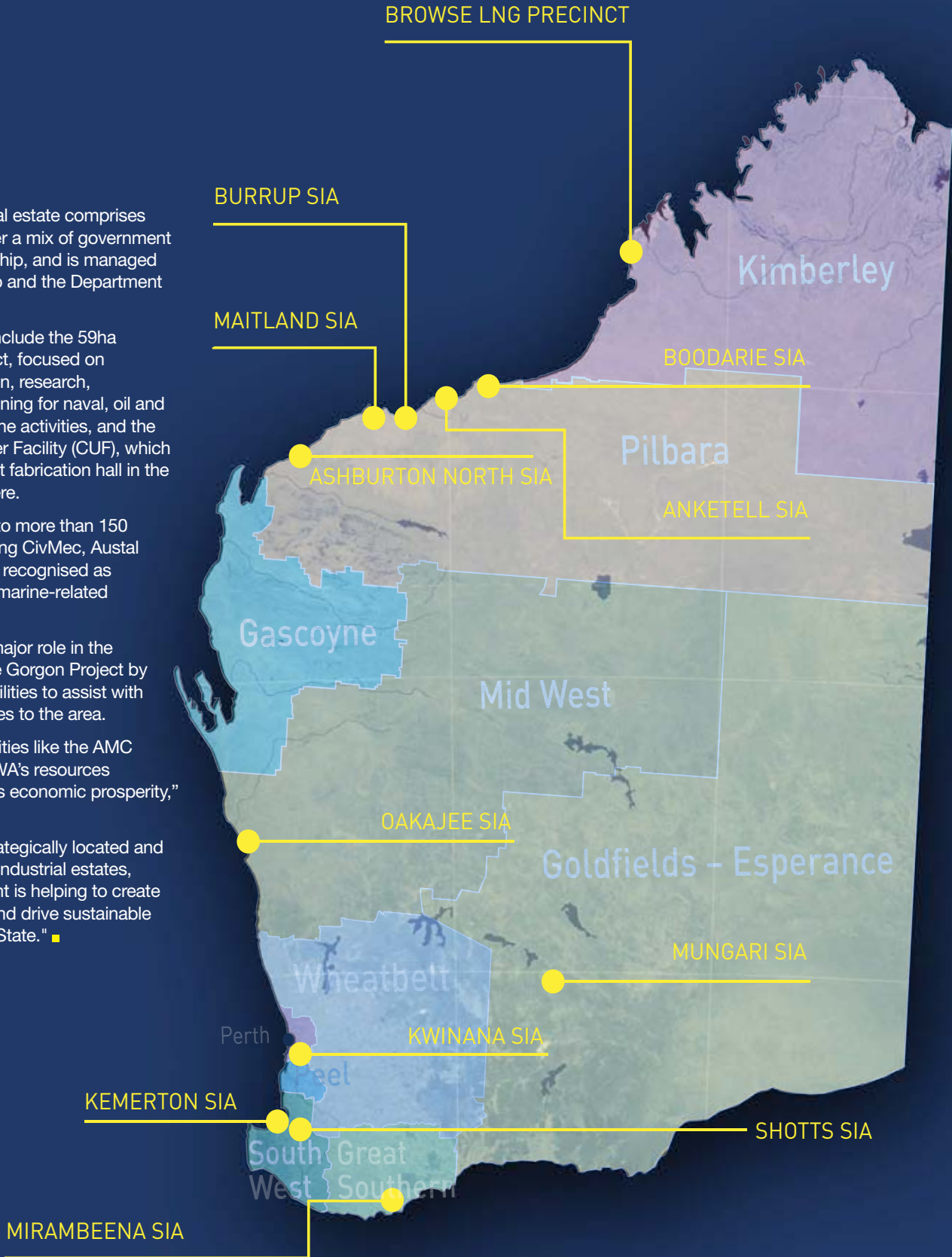
Key components include the 59ha Technology Precinct, focused on leading-edge design, research, technology and training for naval, oil and gas and other marine activities, and the 40ha Common User Facility (CUF), which features the biggest fabrication hall in the southern hemisphere.

The AMC is home to more than 150 businesses, including CivMec, Austal and Ausdrill, and is recognised as Australia's leading marine-related industrial facility.

The AMC plays a major role in the development of the Gorgon Project by providing wharf facilities to assist with transporting supplies to the area.

"The SIAs and facilities like the AMC underpin not only WA's resources industry, but also its economic prosperity," Mr Marra said.

"Through these strategically located and carefully designed industrial estates, the WA Government is helping to create job opportunities and drive sustainable growth across the State." ■



Western Australia's Strategic Industrial Areas (SIAs) are located across the State in close proximity to major resource projects.

WA: A GLOBALLY UNIQUE INNOVATION HUB



The Dampier to Bunbury Pipeline. Photo: DUET

Western Australia is home to more than 1000 operating mine sites and around 50 operating oil and gas fields that together produce over 50 different commodities.

Significant minerals and energy resources have seen Western Australia's resources industry grow to become the largest contributor to the State's economy.

In 2014-15, the value of Western Australia's mineral and petroleum exports was A\$93.5 billion (representing around 38 per cent of Gross State Product).

Iron ore is Western Australia's largest export item - accounting for 95 per cent of Australia's total production and 37 per cent of global iron ore production in 2014. However, iron ore is just one of more than ten commodities where Western Australia has a global market share.

The State is also home to some of the world's largest liquefied natural gas (LNG) developments. By 2018, Western Australia will have the world's second largest LNG production capacity, behind Qatar.

Perth is home to the Australasian head or major operational offices of some of the world's largest resource companies, including BP, Chevron, ConocoPhillips, Eni, GDF Suez, Halliburton, Hess, Inpex, KUFPEC, Shell and Total and the global headquarters for Australia's largest energy producer, Woodside.

Western Australia is also home to global technology and innovation divisions of Chevron, Shell, Woodside, GE Oil & Gas, Cisco and IBM.

The growth of the State's LNG industry is benefiting from the development of Perth as a centre for scientific and technological innovation, driven by the needs of the mining industry and the expertise of the mining, equipment, technology and services (METS) industry.

Department of State Development International Trade and Investment General Manager David McCulloch said that this development had placed the State in a unique position globally.

"What makes Perth unique, and Western Australia as a whole, is our mining and METS technology offering a platform for further development of our LNG industry," Mr McCulloch said.

"Nowhere else in the world is this the case – globally, Western Australia is unique.

"International companies have located in Perth not only to develop resource projects, but also to take advantage of the research and technology expertise that has contributed to the strength of the State's resource industry."

Oil and gas onshore and offshore developments in Western Australia combine the diverse expertise of more than 800 international and local companies, including global finance, business, legal, information technology, aviation, transport and logistics firms.

Through the development and growth of the State's resources sector, Perth has become a centre for scientific and technological innovation with state-of-the-art research facilities and collaborative work between government, industry, research institutions, universities and technical institutes.

"Expertise developed over decades of successful resource projects has attracted significant private and public sector investment in research and development and has propelled future advances in these industries," Mr McCulloch said.

"Western Australia is recognised as a global innovator in the mining sector, and an evolving innovator in the oil and gas sector."

Perth is home to the Australian Resources Research Centre, the National Resources Science Precinct and the Australian Energy Resources Growth Centre.

Perth is the acknowledged epicentre for advances in technology in the mining sector, through command and control centres using automation and remote

systems to operate equipment more than 1000 kilometres away – leaders in the field include companies with a local presence, including BHP Billiton, Rio Tinto, Fortescue Metals Group and Roy Hill.

As the resources sector expands its interest in big data and data analytics, several data infrastructure projects have developed, or are developing, in parallel, based in Western Australia.

These include part of the Square Kilometre Array (SKA) Project (a global science and engineering project involving institutions from over 20 countries), the Cisco Internet of Everything Innovation Centre (an industry and research collaboration established with Curtin University and Woodside Energy) and the Pawsey Supercomputing Centre, located in Perth.

Many of the advances in mining-related software have originated from local companies and their links to research institutions.

One such collaboration is the Western Australia Energy Research Alliance, established by the CSIRO, Curtin University and the University of Western Australia (UWA) that has formed key industry partnerships with Woodside, Chevron and Shell.

Together with the Department of Mines and Petroleum, this collaboration was a major factor in bringing the National Geosequestration Laboratory to Western Australia.

Mr McCulloch said the development of the State's resources industry had created opportunities for collaboration and the application of skills and technology across both the METS and oil and gas service sectors.

"Western Australia has an abundance of natural resources and has a well-regarded reputation internationally in the resources sector," Mr McCulloch said.

"This, coupled with industry expertise, has propelled the State forward to become a global leader in developing technologies, including remote mining methods, carbon capture and storage, and offshore technologies in the oil and gas sector.

"Perth is a fully functioning part of the global resource industry and now hosts companies and research bodies active in both the METS and LNG sectors, with scope for further expansion and collaboration." ■



Perth: a global gas city

- Perth is a founding member and Australia's only member of the World Energy Cities Partnership, a network of 19 cities influential in the global energy sector.
- Perth has become a centre for oil and gas education, training and industry development through institutions such as the UWA Energy and Minerals Institute, Curtin School of Mines, and Challenger Institute's Australian Centre for Energy and Process Training (ACEPT).
- Perth's selection as the host of the 18th International Conference & Exhibition on Liquefied Natural Gas (LNG 18) in April 2016 further cemented its reputation as a major corporate and energy capital in the Asian region. Perth is the only city to host the LNG triennial event twice.
- Western Australia will be home to the Australian Energy Resources Growth Centre, part of the Australian Government's A\$248 million Industry Growth Centres Initiative.
- According to McKinsey Global Institute, Western Australia is engaged in research and innovation at the forefront of eight out of twelve identified technologies that will matter between now and 2025:
 1. Automation of knowledge work
 2. Advanced robotics
 3. Autonomous and near autonomous vehicles
 4. Energy storage
 5. Advanced oil and gas exploration and recovery
 6. Advanced materials
 7. Renewable energy
 8. "Internet of Things" (IoT).



Permian Poole Sandstone unconformity overlies Grant Group sandstone at Mount Hutton (Fitzroy Trough, northern Canning Basin). The unconformity lies at the top of the sandstone package at the base of the hill.

PETROLEUM AND GEOTHERMAL INDUSTRIES BENEFIT FROM EIS

While the Western Australian Government's A\$130 million Exploration Incentive Scheme (EIS) is widely recognised as contributing to mineral discoveries, the State's petroleum and geothermal industries have also benefitted.

EIS funding, administered by the Department of Mines and Petroleum (DMP), is contributing to a major system redevelopment of the Western Australian Petroleum Information System (WAPIMS) database.

The ready availability of open-file seismic and well data have been found by the internationally-recognised Fraser Institute to encourage new petroleum explorers.

Respondents to the Fraser Institute's annual petroleum survey voted WAPIMS as the best government petroleum database in the world in 2010–12, but DMP is improving the system further.

The new public query module of WAPIMS was released in September 2015, and the initial response to that has been universally positive. The extensive back-end development of WAPIMS is due for completion by 30 June 2016, and will deliver further improvements in functionality.

EIS is also funding major geophysical and geochemical surveys across many parts of the State, 3D prospectivity mapping, and strategic research with industry.

The scheme includes deep crustal seismic surveys. One of the most impressive was the Canning Coastal deep seismic survey conducted by Terrex Seismic in 2014 for DMP and Geoscience Australia.

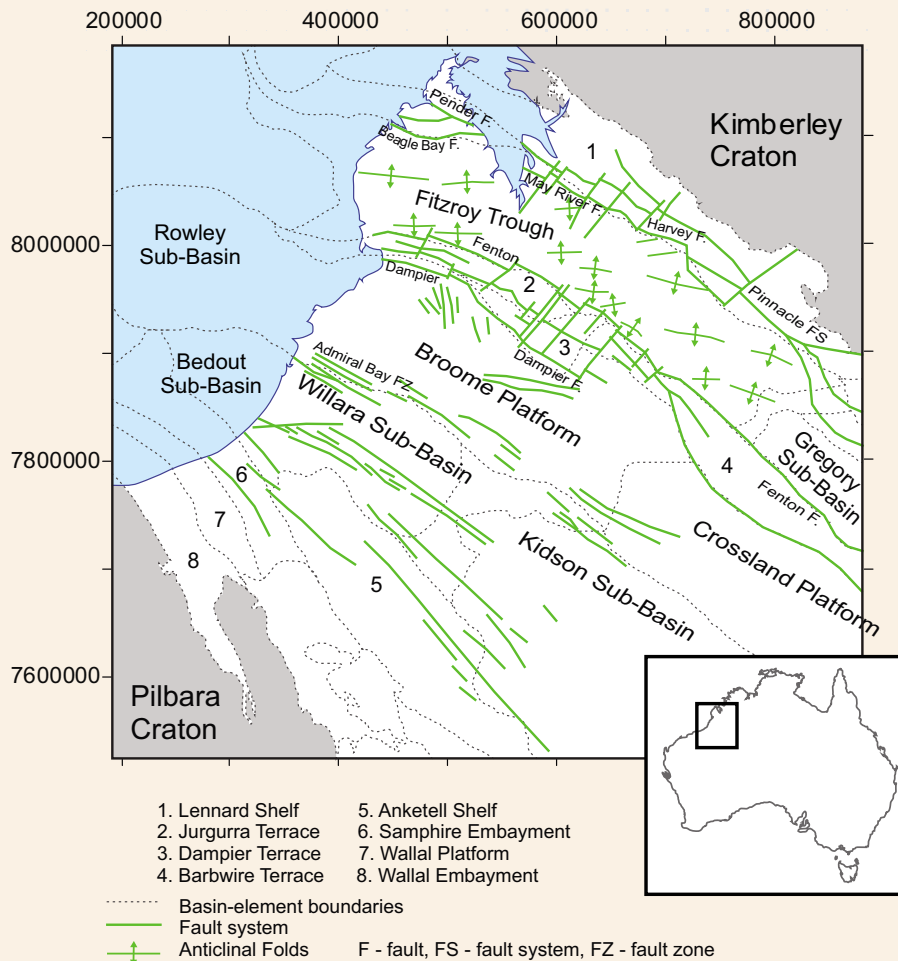
The A\$3.65 million, 700km survey stretched across the Canning Basin from the Pilbara Craton to the Kimberley Craton, and recorded data down to 20 seconds.

The processed data was officially released by the Minister for Mines and Petroleum Bill Marmion at the 2015 Geological Survey of Western Australia (GSWA) Open Day, and can be downloaded free of charge through WAPIMS.

The objectives of the survey were to obtain a better understanding of the subsurface geology of the region, and how the Australian continent was assembled as a result of plate tectonic processes over billions of years, and subsequently the break-up of Gondwana.

Such knowledge also assists in identifying areas of petroleum, mineral and geosequestration potential.

Petroleum explorers used the data immediately upon its release – particularly the data for the top few kilometres of the crust. GSWA is continuing to interpret the deeper data down to approximately 40 kilometres.



What is WAPIMS?

The Western Australian Petroleum and Geothermal Information Management System (WAPIMS) is a petroleum exploration database containing data on wells, geophysical surveys, titles, and other related exploration and production data.

The system also contains the Core Library (Perth and Kalgoorlie) database. Go to www.dmp.wa.gov.au/wapims to access the system.

Tectonic map of the Canning Basin showing tectonic elements and major structures. Faults, fault zones, and fault systems, and fold axial surfaces are shown in green. Grid in meters, coordinate system GDA 94 UTM zone 51. Modified from Kennard et al. (1994a).

EIS funding has also allowed the completion of a collaborative project with The University of Western Australia on 3D modelling of the Canning Basin. The primary purpose of the study was to determine the style and timing of tectonic events across the Basin.

The result was the publication in 2014 of GSWA Report 140: Regional structural and stratigraphic study of the Canning Basin, Western Australia.

The study included a series of basin-scale transects based on integrated interpretation of seismic reflection and potential field data constrained by geological data from wells.

It also resulted in the creation of a digital geological model comprising maps of major stratigraphic surfaces and structures in the Fitzroy Trough.

Further work funded by the EIS in the Canning Basin included an assessment of the geosequestration potential of the Carboniferous–Permian Grant Group and Permian Poole Sandstone in the northwest Canning Basin.

This was conducted jointly with the University of Western Australia and the Commonwealth Scientific and Industrial Research Organisation (CSIRO), and published as GSWA Report 139 in 2015.

Another report, published by GSWA on geosequestration potential, included Report 126 the Western Australia carbon dioxide geological storage atlas and the accompanying extensive digital data set, prepared by 3D-Geo Pty Ltd. A specific assessment of the CO₂ storage potential of the onshore western Eucla Basin was prepared for GSWA by Frogtech Pty Ltd.

Geothermal energy is another potential future resource and GSWA commissioned Hot Dry Rocks Pty Ltd to assess the geothermal potential of selected areas in the Carnarvon, Bonaparte, Officer and Browse Basins.

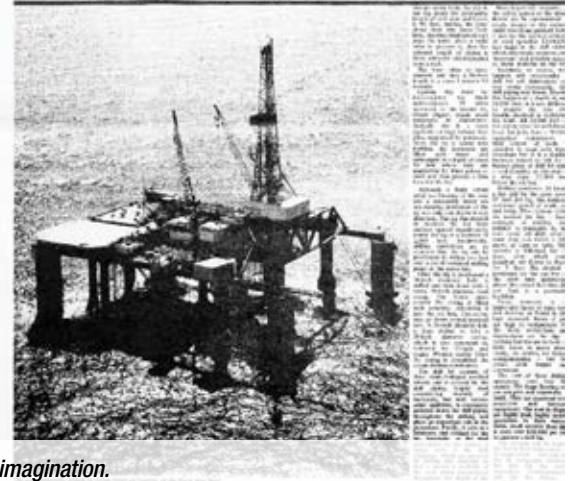
The Amadeus Basin is a large and economically important Neoproterozoic to Paleozoic depositional system in central Australia.

However, the Western Australian portion of the Basin is much less known and explored than its counterpart in the Northern Territory, where proven and probable hydrocarbons are known.

GSWA is remapping the region and also commissioned the CSIRO to prepare a 3D model based on interpreting gravity and magnetic data. That report (Report 154) was released in late 2015 and is providing fresh interpretations for petroleum explorers. ■



Riches under the sea



The Rough Range discovery made front-page news across the nation and captured the public's imagination.

THE SEARCH FOR OIL AND GAS

Australia's oil and gas history may have started on the east coast, but it was a discovery on the west coast that captured the nation's imagination and would lay the foundations for a billion dollar petroleum industry of international renown.

In 1886, Australia produced and sold its first petroleum product – kerosene from oil shale originating from the Blue Mountains in New South Wales. Until then, the search for oil and gas had been largely unsuccessful.

These deposits were worked for thirty years until they were replaced by imported conventional oil.

At the start of the 20th century a significant amount of gas was discovered during drilling of a Government water well in the Queensland town of Roma.

By 1904, the gas was flowing at 70,000 cubic feet per day.

In 1906, the town started using the gas to power its street lights. Just 10 days after connecting the gas to the street light power supply, the flow of gas stopped.

The nation's first oil field was discovered in the Gippsland Lakes area of Victoria in 1924. It was, however, another three decades until the first significant discovery of flowing oil was made in Australia.

While early exploration centred on the Eastern States, this discovery was made on the opposite side of the continent, in a small region called Rough Range, situated just a few kilometres inland from the Exmouth Gulf on the west coast of Western Australia.

Western Australian Petroleum, or WAPET, formed by AMPOL and Caltex in 1952, found oil with its first well at Rough Range on 23 November 1953.

The discovery made front page news across the nation. It was later described by author and former geologist, Rick Wilkinson, as the "most fantastic hole-in-one in the history of oil exploration".

Companies clamored to list on the stock exchange to fund their own oil searches. Australasian Oil Exploration, Cable Oil Syndicate, Kalgoorlie Goldfields Petroleum and Esperance Oil Syndicate were just some of the newly minted oil explorers looking to find their own Rough Range in Western Australia.

The early drilling success at Rough Range created a surge in stock market speculation on these newly listed oil and gas companies.

In its editorial on 24 July 1954, *The West Australian* newspaper stated that “speculative interest in oil shares has been assuming dangerous dimensions.”

It suggested that “without starting a panic, everything possible should be done by those responsible to damp down the present fever of speculation”.

Another article in *The West Australian*, less than a month earlier, highlighted one of the more curious side effects of the Rough Range discovery.

Women working at the AMPOL offices in Sydney were being “swamped with marriage proposals” thanks to the company shares they owned. One reported two proposals in a single day, while another received three over a weekend.

As history shows, *The West Australian* was right to urge caution to speculators – whether they were investing in shares or proposing marriage.

Despite the early encouraging signs, the Rough Range exploration program did not produce a commercial oil field.

However, it did play a role in capturing the imagination of the Australian public and its leaders.

Out of Range

The Rough Range discovery prompted the Federal Government to introduce a Commonwealth subsidy for stratigraphic drilling in 1957. Two years later, this was expanded to include other types of drilling and geophysical surveys.

This culminated in the discovery of Australia’s first commercial oil field at Mooney Ponds in Queensland and prompted subsequent discoveries across Australia.

Despite the commercial failure at Rough Range, WAPET continued to play a critical role in further discoveries across Western Australia.

Eleven years after Rough Range, WAPET announced it had discovered oil on Barrow Island.

Production started in 1967, which coincided with the appointment of a young naturalist, Harry Butler, to oversee environmental management at Barrow Island (story page 12).

In the meantime, the company had also made Western Australia’s first commercial gas field discovery at Dongara in 1966.

This growth in activity prompted significant change at Western Australia’s then Department of Mines to oversee the petroleum industry.



Petroleum Engineer and first Director of the Petroleum Branch John Sharp.

In September 1968, A.J. (John) Sharp, a 37-year-old from England, became the department’s first dedicated petroleum engineer. Six years later, a stand-alone Petroleum Branch was formed within the department, with Sharp at the helm.

The 1964 discovery on Barrow Island was the first petroleum found within the North West Shelf.

While undoubtedly significant, it would pale in comparison to the massive natural gas deposits that lay beneath the waters of the North West.

In the 1970s, WAPET would discover several gas fields within the North West Shelf, including the Greater Gorgon gas fields.

In 1963, directed by Chief Geologist Dr Nicholas Boutakoff, Woodside secured a number of offshore areas within the North West Shelf beyond the areas held by WAPET.

This acreage would yield Woodside, and its joint venture partners, massive gas deposits including the Angel, Goodwyn and North Rankin gas fields in the 1970s.

But it did not come cheaply. It was the biggest petroleum exploration program in Australia’s history at the time. A\$150 million was spent over ten years on exploration and appraisal work, including data acquisition from 80,000 kilometres of seismic survey lines.

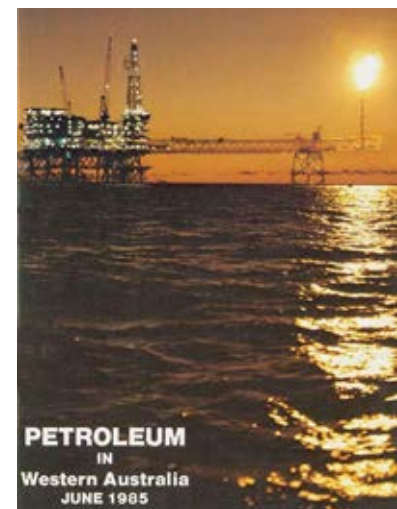
While exploration proved successful, there were complexities around bringing these resources into production.

It would require political bipartisanship, considerable international investment and

world-class engineering expertise to come together, before the massive potential of the North West Shelf could begin to be realised.

However, when it did come together, it created Australia’s largest engineering project and confirmed the North West Shelf as one of the world’s premier hydrocarbon producing regions.

For more than 30 years, the project has produced the majority of Western Australia’s domestic gas supplies, and more than 25 years of international liquefied natural gas (LNG) exports. It was, and still is, the project that put the North West Shelf on the international map.



The cover of the June 1985 edition of Petroleum in Western Australia.

Gaze turns to Gorgon

Chevron’s massive Gorgon project is once again putting the international spotlight on Western Australia’s North West Shelf.

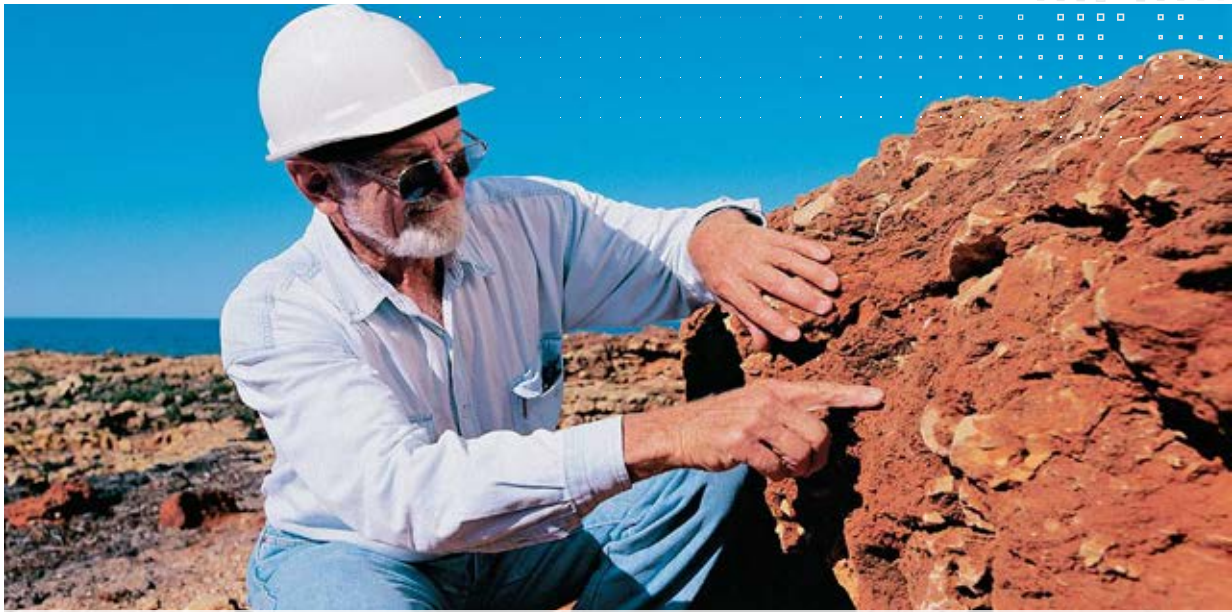
Due for completion later this year, it is one of the largest natural gas projects ever undertaken in the world and the largest single-resource development in Australia’s history.

Gas production from Macedon, Wheatstone, Devil Creek and Pluto, all using gas from fields in the North West Shelf, further emphasise the scale of the resources found off Western Australia’s North West coast.

At the time, it was thought that the unexpected oil find at Rough Range could reshape Australia.

That wasn’t to be, but it did ultimately lay the foundation for an industry now worth billions of dollars to Western Australia and the nation.

The history of the North West Shelf indicates that, perhaps, the early enthusiasm at Rough Range was justified after all. ■



Dr Harry Butler was an Australian naturalist and conservationist. Photo: Chevron Australia

HARRY BUTLER: A UNIQUE ENVIRONMENTAL VOICE

The popularisation of science and natural history in Australia owes much to the quintessentially Australian naturalist and conservationist Harry Butler.

Dr Butler was renowned for bringing the wonders of Australia's wildlife and natural environment onto Australians' screens with his *In the Wild* television series on ABC in the 1970s and early 80s.

For Western Australia's resources industry, it was Dr Butler's role as an environmental consultant that highlighted the importance of collaborative partnerships to help protect Australia's unique environment.

He first arrived on Barrow Island in 1967 as an environmental consultant for Western Australian Petroleum (later Chevron) and was critical in ensuring the island maintained its status as a class A nature reserve.

Dr Butler maintained a long association with Barrow Island. In a 2011 video for Chevron he spoke about the island's importance.

"Barrow Island is unlike anything else you have ever seen. It is the most remarkable place," Dr Butler said.

"We've lost no species, no plants, no animals, no eco systems.

"It's not luck, it's not by accident, it's because we planned it. Because we managed the island in such a way that everything was cared for."

On its website, Chevron said it owes much of its worldwide reputation for environmental management on Barrow Island to Dr Butler's work.

It was his belief that development and conservation could co-exist that set Dr Butler apart from some of his colleagues. He once observed that he had "achieved more by working with mining companies and other developers than I ever would have lying down in front of bulldozers."

As a champion for collaboration, it was natural that Dr Butler would be involved in the Department of Mines and Petroleum's Golden Gecko Awards for Environmental Excellence.

The department's Environment Division Executive Director Dr Phil Gorey said the awards were established in 1992 to recognise best practice and innovative environmental projects in the resources sector.

"Dr Butler was part of the inaugural selection committee and played an important role in the early days of the Golden Gecko Awards," Dr Gorey said.

"He provided the selection committee with a wealth of personal knowledge and experience when assessing projects."

In 1996, Dr Butler received his own Golden Gecko for his contribution to environmental management in Western Australia.

"Dr Butler used his public image to introduce the concept of multiple land use and environmental management at a practical level," Dr Gorey said.

"His work helped shift the way companies manage environmental issues and he leaves a proud environmental legacy in this State. His contribution made him a worthy recipient of a Golden Gecko."

Dr Butler was named the Australian of the Year in 1979 and, in 2012, his name was added to the National Trust of Australia's National Living Treasures list.

In 2012, he was made an Officer of the Order of Australia for "distinguished service to the community through the promotion of public understanding of natural history and wildlife conservation, to the development of collaborative environmental partnerships with industry, and to the community."

Dr Butler died in Perth on 11 December 2015. ■



The commissioning cargo has arrived and cool-down of the LNG storage and loading facilities is in progress at the Chevron-operated Gorgon Project. Photo: Chevron Australia

GORGON MOVES TOWARDS LNG EXPORTS

The Chevron-operated Gorgon natural gas project reached a significant milestone in January with the company announcing the start of the cool-down of the liquefied natural gas (LNG) export system.

The milestone saw the Chevron-operated LNG vessel, Asia Excellence, deliver the commissioning cargo to cool-down the LNG storage and loading facilities ahead of the project's first LNG export cargo, planned in early 2016.

Chevron is developing the Gorgon and Jansz-Lo gas fields, located within the Greater Gorgon area, between 130 and 220 kilometres off the northwest coast of Western Australia.

The project includes the construction of a 15.6 million tonne per annum LNG plant on Barrow Island and a domestic gas plant with capacity to supply 300 terajoules of gas per day to Western Australia.

Gorgon LNG will be off-loaded via a 2.1 kilometre loading jetty for transport to international customers. Domestic gas will be piped to customers on the Western Australian mainland.

The Chevron operated Gorgon Project is a joint venture between Chevron (47.3 per cent), ExxonMobil (25 per cent), Shell (25 per cent), Osaka Gas (1.25 per cent), Tokyo Gas (1 per cent) and Chubu Electric Power (0.417 per cent).

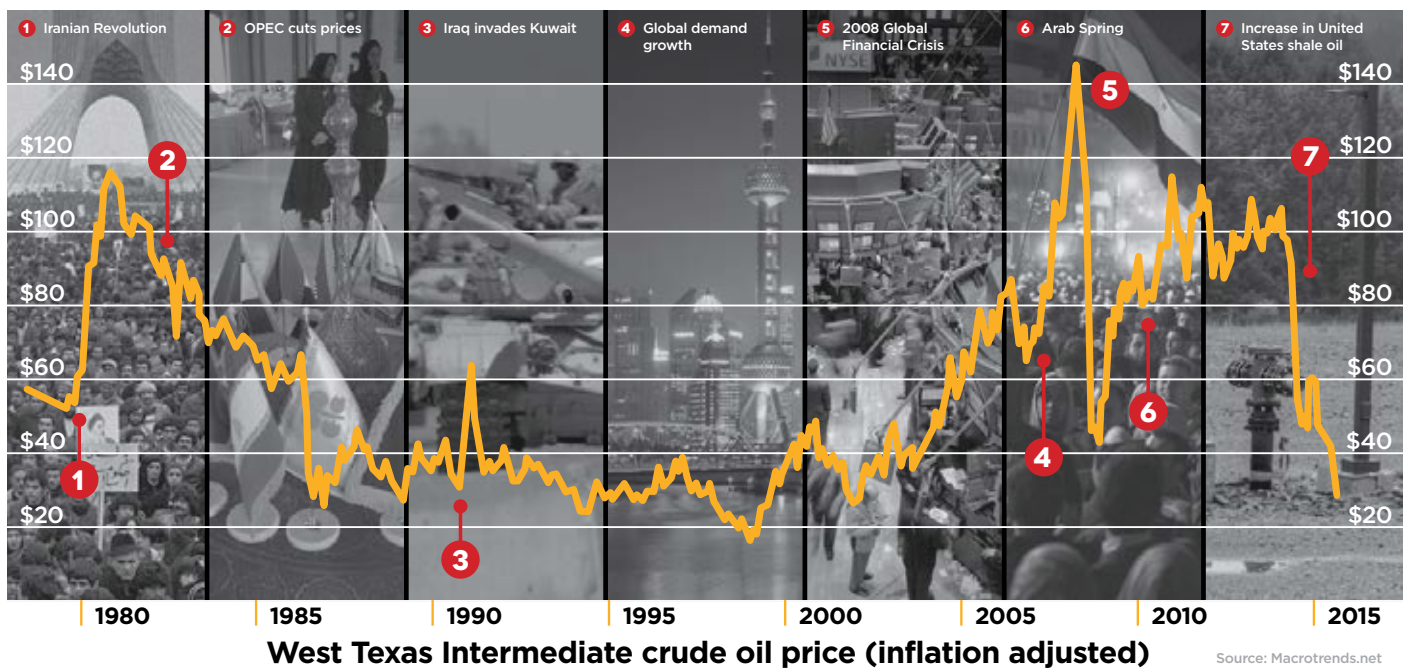
Chevron Australia's Managing Director Roy Krzywosinski said the commissioning cargo was essential for the final testing of critical systems and to efficiently cool down the plant prior to the start of LNG production.

"As the largest single-resource development in Australia's history, this is a significant milestone for Gorgon," Mr Krzywosinski said.

"Gorgon will be a long-term supplier of natural gas to our customers in the Asia-Pacific region and in Australia, delivering energy security as well as significant long-term economic benefits to Australia for decades to come." ■

- **Liquefied natural gas (LNG) is natural gas that has been cooled to -162 degrees Celsius (-260°F), the point where it condenses to a liquid.**
- **Liquefaction reduces the volume by approximately 600 times, making it more economical to transport between continents in specially designed ocean vessels.**

LONG-TERM LOOK PROVIDES PERSPECTIVE



The graph above shows how much oil has dropped in the past couple of years, but also how it relates to longer term averages.

In a recent editorial for the *Australian Financial Review*, Rod Simms, Chairman of the Australian Competition and Consumer Commission, encouraged perspective when looking at current commodity prices.

In the article Mr Simms highlighted that the 40-year average oil price is US\$58.

This figure takes into account the significant highs experienced over the past decade.

Department of Mines and Petroleum Policy and Coordination General Manager Richard Borozdin said such a statistic provides considerably more perspective than two or three-year charts possibly can.

“It is also important to recognise the long-term nature of investment decisions made around the current mega-projects being developed in Western Australia. These projects will typically have a production life of 40-years or more,” Mr Borozdin said.

“Their decisions are based around a much longer timeframe.”



Investment in large projects such as Gorgon are based on a long-term perspective.
Photo: Chevron Australia

Another factor in recent volatility has been the rise of oil as a tradable commodity.

“This has provided a degree of separation from the usual economic laws of supply and demand,” Mr Borozdin said.

“Increasing speculation by traders has magnified the short-term volatility of oil prices and weakened the usual role of physical supply and demand.”

Mr Borozdin also highlighted the fact that despite concerns around growth in China, recent figures showed the country imported a record 6.7 billion barrels a day of oil in 2015.

“China’s energy needs will continue to grow in the future and petroleum products will have an important role to play in meeting those energy demands,” he said. ■



*Goodwyn A gas platform, North West Shelf Project, Western Australia.
Photo: Woodside Energy Ltd*

NORTH WEST SHELF PROJECT GROWS

The North West Shelf project located in Western Australia, 125 kilometres north of Karratha, was Australia's first export project and remains one of the world's largest liquefied natural gas (LNG) projects.

The project has been Western Australia's largest supplier of domestic gas for over 30 years.

In March 2015, the Western Australian Parliament passed an amendment to the *North West Gas Development (Woodside) Agreement Act 1979 (WA)* approving the export of a further 86 million tonnes of LNG by the North West Shelf (NWS) Joint Venture and securing the reservation of the equivalent of 15 per cent of the energy value of this volume for domestic gas.

This reservation obligation is consistent with the State's Domestic Gas Policy, through which the Government is securing Western Australia's future energy needs.

The amendment also allows for the processing of third party gas through the NWS facilities, requires third parties to adopt the Domestic Gas Policy and allows the NWS Joint Venture to export LNG from new field developments.

The Joint Venture approved the development of the Greater Western Flank 2 (GWF-2) Project in 2015.

Woodside, as operator of the NWS Joint Venture, announced that the GWF-2 Project will develop 1.7 trillion cubic feet of raw gas from the combined Keast, Dockrell, Sculptor, Rankin, Lady Nora and Pemberton fields using subsea infrastructure and a 35 kilometre pipeline connecting to the existing Goodwyn A platform.

The total investment for the project is expected to be approximately US\$2 billion, with initial project start-up expected in the second half of 2019.

Gas delivery will initially commence from five wells in the Lady Nora, Pemberton, Sculptor and Rankin fields, followed by the remaining three wells in the Keast and Dockrell fields in the first half of 2020.

The GWF-2 Project is the fourth major gas development for the NWS Project in the past seven years, demonstrating a continued focus on maximising value from this asset by delivering sanctioned projects and developing reserves.

Woodside CEO Peter Coleman said "The GWF-2 Project is economically robust and will deliver significant value by leveraging Woodside's substantial experience in delivering major subsea tieback projects".

Along with gas from the Gorgon and Wheatstone projects, domestic gas commitments attached to new developments from the NWS Project are an important source of energy supplies for the domestic market in the coming decade. ■



BHP Billiton Petroleum's Pyrenees Floating Production, Storage and Offloading facility, Western Australia. Photo: BHPBP

WA COMPANY HOSECO GOES FROM STRENGTH TO STRENGTH

Western Australian company Hoseco has gone from strength to strength in the international oil and gas sector, recently winning a contract with BHP Billiton Petroleum (BHPBP).

Established in Perth in 1999, Hoseco (WA) Pty Ltd is a specialty hose, fittings and hydraulics supplier that now operates from three locations across Australia and services a wide range of markets, including oil and gas, mining and mineral processing, agriculture, manufacturing and transport.

In addition to supplying industrial, hydraulic and specialised resources and hose fittings, Hoseco provides hydraulic componentry, hose management and on-site containerised workshops.

In November, Hoseco announced it had been awarded a contract with BHPBP for hose management services for the company's Pyrenees oil field development, off the coast of Exmouth in Western Australia's Gascoyne region, as well as the Macedon Gas Plant, located in Onslow in the State's Pilbara region.

Hoseco Managing Director John Holt said the company was, "extremely excited" for the opportunity to partner with a company such as BHP Billiton Petroleum.

"Having an ongoing partnership with a company of this ilk is fantastic for Hoseco," Mr Holt said.

The contract work with BHPBP, which commenced in November last year, follows Hoseco's previous contract success on big gas projects – the company was previously awarded a contract with Samsung Heavy Industries for work on the A\$34 billion Inpex Ichthys liquefied natural gas project.

The contract with Samsung Heavy Industries commenced early last year and saw the company supply utility station hose and hose reels, with further hose assemblies following the completion of final engineering work.

For a local company that began in a 200 square metre factory in Midvale, to now offering a range in excess of 15,000 different items and servicing the oil and marine industries, the contract awards are a significant achievement.

With an approximate value of A\$3.1 million, Mr Holt said the Samsung Heavy Industries contract was a positive achievement for the State on the international stage as well as for the company.

"It's a win for Western Australia and for a small business of 20 staff, especially to be competitive on the world stage," Mr Holt said.

"It is a small contract in global scales but nonetheless important."

The contract included writing documentation, data sheets, engineering and design work for the Ichthys project, based in the Browse Basin (located off the coast of Western Australia's Kimberley region).

The project includes a new build floating production, storage and offloading (FPSO) facility, a central processing facility, and onshore facilities to be built in Darwin.

An 850 kilometre pipeline will transfer the gas to the onshore facility from the North West Shelf of Western Australia to the onshore facility to be built at Wickham Point in the Northern Territory.

"This contract indicates how far our company has come with regards to dealing with large resource companies," Mr Holt said.

"Resource companies quite rightly are very demanding when it comes to compliance, certification, processes and procedures and we have spent a lot of time getting our business in a position to be able to comply with these demands.

"We are very proud of what we have achieved and we are grateful for the opportunity Inpex have given us."

Hoseco received assistance in approaching Samsung Heavy Industries through the Western Australian Government's International Trade and Investment Office in Korea.

Business Development Manager Alec (Sung-Hoon) Kim said the Korea office had assisted in providing Hoseco with a market mission program – assisting the company with right points of contact and providing advice on their business approach on the international stage.

"Our office has been deeply involved in assisting Hoseco from the beginning stage, with right points of contact at Samsung Heavy Industries headquarters here in Korea, and providing a market mission program for Mr Holt when he visited Korea in June last year," Mr Kim said.

"Since then, Hoseco has been specified as an approved Australian vendor for the project.

"Our office made a tangible outcome assisting an SME supply chain of Western Australia's heavy industry sector by acting as a "bridge" and helping to connect them – it is great news for a Western Australian company."

Mr Holt thanked the Korea Office for their assistance, describing their "face-to-face" work at the beginning of the process as "invaluable for us to start the communication".

For more information on the Western Australian Government's International Trade and Investment Offices, visit the Department of State Development's website www.dsd.wa.gov.au ■



AWE's Senecio-3 exploration well is located on Irwin Park Farm near Dongara, Western Australia. Photo: AWE Limited

WAITSIA GETS THE GO-AHEAD

It's not just offshore gas discoveries that are contributing to Western Australia's world-class petroleum industry.

In January this year, joint-venture partners AWE Limited (operator) and Origin Energy Limited announced a Final Investment Decision (FID) for the first stage of the Waitsia onshore gas project in the northern Perth Basin.

Recently discovered in September 2014, the 484 billion cubic feet of gas Waitsia field is considered to be Australia's largest onshore conventional gas discovery for three decades.

The joint venture partners will initially spend A\$18 million to bring the first stage of the project online by mid-2016 with production of 10 terajoules per day.

AWE's Managing Director and CEO Bruce Clement said the decision was a landmark for AWE and would reinvigorate the potential for onshore gas production in Western Australia.

"The Waitsia gas project is incredibly exciting for AWE and represents another significant step-up in the company's growth potential," Mr Clement said.

"First stage production from Waitsia will provide early cash flow from mid-2016 as well as valuable data that will help us optimise our plans for full field development."

When fully developed, AWE anticipates that production from the Waitsia Field could be increased from the 10 terajoules per day at start up to more than 100 terajoules per day when fully developed.

This represents approximately 10 per cent of Western Australia's daily domestic consumption.

"The Waitsia development will deliver substantial benefits to the local Mid West community through additional direct investment, supplier agreements and employment opportunities," Mr Clement said.

"At the same time it will add significant volumes to domestic gas supply and contribute substantial royalties to the WA Government over the project life."

AWE is also evaluating the potential for co-developing the nearby Senecio/Synaphea/Irwin tight gas fields.

"Together, these tight sandstone reservoirs are estimated to contain an additional gross 237 billion cubic feet of gas," Mr Clement said.

"Once developed the onshore Waitsia gas project's low operating costs, in a historically strong west coast gas market, will likely see AWE become the low cost gas producer in Western Australia," Mr Clement said.

Department of Mines and Petroleum Executive Director Petroleum Division Jeff Haworth said the decision highlighted the potential of the Perth Basin.

"The Perth Basin is an area that has been somewhat overlooked in the recent past," Mr Haworth said.

"We have seen a number of small successes in the past five years, however, Waitsia represents a significant discovery for the Perth Basin."

"While these discoveries are small when compared to the giant fields of the North West Shelf and the Browse Basin, they are much closer to infrastructure and cheaper to bring on line."

The discovery of Waitsia comes 50 years after Western Australia's first gas field was found at Dongara in the Perth Basin.

"Waitsia is a perfect example of the potential the Perth Basin offers even after more than half-a-century of exploration and development," Mr Haworth said. ■



Mines and Petroleum Minister Bill Marmion with APA Group CEO Mick McCormack at AngloGold Ashanti and Independence Group's Tropicana Gold Mine for the commissioning of the Eastern Goldfields Pipeline extension.

EMERGING MINERAL PROVINCE TURNS ON THE GAS

The future of the Eastern Goldfields as an emerging mineral province has been boosted with the completion of APA Group's A\$140 million, 293km gas pipeline extension that will eventually service a number of mines in the region.

The reliable supply of cheap energy to a region that already has proven gold, uranium and rare earth deposits comes at a time when exploration spending is at its lowest level in almost a decade.

The pipeline extends from the current Murrin Murrin/Yarraloola terminus to AngloGold Ashanti's Sunrise Dam Gold Mine and on to the Tropicana Gold Mine.

The pipeline extension, which was completed ahead of schedule, was officially opened on 10 February by Mines and Petroleum Minister Bill Marmion.

The infrastructure will allow Tropicana to source gas from Karratha in the State's Pilbara region, more than 1800km away.

Speaking at the ceremonial event at Tropicana Gold Mine, APA Managing Director Mick McCormack paid tribute to the focus and commitment of all parties involved in bringing the project from concept to reality.

"As an engineering project the Eastern Goldfields Pipeline is a great success story that exceeded all production and safety targets, an achievement we take pride in," Mr McCormack said.

"It is also a shining example of what can be done when industry partners, a progressive government and supportive local authorities and communities collaborate so effectively."

Mr McCormack also acknowledged the integral roles played by AngloGold Ashanti and the Department of Mines and Petroleum in the development of the pipeline.

There is also the potential for the pipeline to be expanded to service other mines, with eight proposed or potential mining projects in the region.

Gold Fields Australia Pty Ltd has contracted APA Group to connect to the Eastern Goldfields Pipeline at its Granny Smith mine site.

Dacian Gold is soon to make a final investment decision on its Mt Morgan gold project. The pipeline, en route to Sunrise Dam, passes within 16km of the Red October project.

Gold Road Resources' Gruyere deposit, about 150km northeast of the new pipeline, could also benefit from an extension.

The deposit was discovered in 2013 and is now estimated to contain at least 5.6 million ounces of gold.

This rivals the significance of the Tropicana gold deposit, discovered in 2002, which now has an estimated resource of seven million ounces of gold.

Minister Marmion opened Tropicana nearly two years ago and said it was fitting to be back at the mine to see the continued growth of the region and completion of this important infrastructure project.

"The growth of the Eastern Goldfields has been assisted by the State Government's Exploration Incentive Scheme (EIS) with funding of a deep seismic survey, airborne geophysical surveys of the area, and co-funded drilling," he said.

"This data is giving us a better understanding of the region's geological structures at depth and prospectivity."

The Minister also praised the lead agency role of the Department of Mines and Petroleum in the approvals process.

The Chamber of Minerals and Energy of Western Australia welcomed the opening of the pipeline extension which Chief Executive Reg Howard-Smith said would underpin the future of the Yilgarn mining province.

"The delivery of additional infrastructure to isolated parts of the region will support the feasibility of projects which were previously considered to be unviable," he said.

There is also the potential for future gas supply to prospective uranium and rare earth projects, with Mulga Rock the second

largest uranium resource in WA, only 83km south of the pipeline, and the Mt Weld rare earth mine only 21km north.

Mt Weld is the world's richest known deposit of rare earths, and was the first mine to produce rare earth elements outside of China in many years. ■

Pipeline facts

- The 293km Eastern Goldfields pipeline comprises 16,500, 18m lengths of pipe
- Primary gas customers will be the Tropicana and Sunrise Dam Gold Mine operations, run by AngloGold Ashanti
- The new pipeline will extend the Goldfields gas system to almost 1800km
- WA's Department of Mines and Petroleum played the lead agency role in the approvals process
- Potential for future gas supply to uranium, rare earth and other gold projects
- A\$140 million project completed in December 2015, ahead of schedule.

MID WEST ONSHORE PETROLEUM ROUNDTABLE

The onshore petroleum industry in the State's Mid West was the topic of discussion at a stakeholder workshop the Department of Mines and Petroleum took part in late last year.

DMP Deputy Director General Michelle Andrews and Petroleum Division Executive Director Jeff Haworth joined representatives from the Department of Water, Irwin Shire, the Mid West Development Commission, the Northern Agricultural Catchments Council, AWE Limited and Origin Energy Limited for the workshop held in December.

Ms Andrews congratulated the Mid West Development Commission for hosting the workshop which focussed on how industry, government and the community are working together to ensure positive outcomes for all stakeholders.

"It was an opportunity to look at how we can better identify and address concerns from the community and other stakeholders," Ms Andrews said.

"Effective stakeholder engagement enables better planned and more informed policies and projects to be delivered by the department and industry.

"It also ensures the department's responsibilities and expectations of industry are clear."

Mr Haworth provided the group with a summary of petroleum exploration and operations in the Mid West.

"The industry started in the Mid West in the 1960s with the discovery of gas at Dongara in the Perth Basin," he said.



**Jeff Haworth, Executive Director
Petroleum Division
Department of Mines and Petroleum.**

"To date, more than 200 wells have been drilled in the northern Perth Basin."

Mr Haworth said the figure included the eight wells that have been hydraulically fractured since 2005.

"The State combines its current regulations for oil and gas with international knowledge and technology, to ensure high safety and environmental standards are enforced, consistent with relevant State and Federal legislation, regulations and policies," Mr Haworth said. ■

ALL EYES ON WESTERN AUSTRALIA AS LITHIUM DEMAND SURGES

Already a key player in the global lithium industry, Western Australia is poised to become a dominant force with two mines starting operations this year and renewed exploration activity in the Pilbara region.

Construction is under way on a new spodumene ore mine at Mt Marion near Coolgardie and the mothballed Mt Cattlin spodumene-mica-tantalite mine near Ravensthorpe is gearing up for a restart.



Spodumene ore.

The Mt Marion mine (Neometals Ltd and Mineral Resources Limited) and the Mt Cattlin mine (General Mining Corporation Ltd and Galaxy Resources Ltd) are both expected to be producing lithium concentrate by the middle of this year.

Lithium Australia NL and Pilbara Minerals Limited have extended their joint exploration of the emerging Pilgangoora province in Western Australia's Pilbara region to evaluate the commercial potential of the area's lithium micas and clay deposits.

Regarded by industry watchers as one of the world's most exciting lithium production projects, Neometals' Mt Marion mine will host the largest hard rock lithium concentrator in the world.

Neometals recently sold another 18.1 per cent stake in the Mt Marion project to Jiangxi Ganfeng Lithium for \$US27.15 million, bringing China's leading lithium producer's stake to 43.1 per cent.

The purchase is seen by analysts as a strong endorsement of the project being operated by Perth-listed mining and contracting company Mineral Resources, which owns a 30 per cent interest.

Announcing the sale in February, Neometals' Managing Director Chris Reed said that it would help fund Neometals' longer term plan to construct a downstream plant to upgrade Mt Marion concentrate into higher-value lithium compounds for the lithium battery market.

Neometals is developing a patented process to produce high purity battery grade lithium hydroxide.

First production at Mt Marion is expected by mid-2016 and the project has been designed to produce more than 280,000 tonnes per annum of chemical grade spodumene concentrate.

Mr Reed told *Prospect* that many people assumed the future of lithium batteries lay with the new generation of electric vehicles, such as the Tesla model S and X, which had been the initial spark for global lithium demand.

"But as I have said before, the car is the sizzle – the steak is renewable energy storage," he said.

"China's leading the way and we're going to feed her," he said. "Neometals has retained the option to produce downstream ourselves but we can't do that straight away because we've got to finish our definitive feasibility study and then do a pilot study ahead of a final decision in 2017."

"As the safest jurisdiction for lithium production in the world, WA has a massive part to play in delivering this energy to the world.

"We're proud to be part of the next industrial revolution."

Closed for more than three years, the Mt Cattlin mine near Ravensthorpe will restart in late March 2016 as part of a A\$7 million commitment by General Mining, which has taken a 50 per cent stake in the mine.

"... the car is the sizzle – the steak is renewable energy storage."

Neometals Managing Director Chris Reed.

The Tesla Roadster 2.5 – one of the new breed of electric vehicles powered by lithium batteries.

"At the moment all the demand for lithium is coming from the car batteries particularly in China, but we think the next wave of demand will come from renewable energy storage – like the Tesla Power Wall and the Power Pack – rather than from building the electric cars."

Mr Reed said he and many others in the industry had thought the take-off point for lithium of about \$US250 a kilowatt hour would arrive in 2020 (the price in 2014 was \$US800), but Elon Musk's Tesla Motors had already brought out products such as the Power Wall and Power Pack at the \$US250 mark.

"To put it into perspective, look at the most successful product lunches of all time," he said. "It took 12 months in 2007 when Apple released the iPhone to get its first \$US1 billion in sales. It took Viagra three financial quarters to get its first billion in sales. It took Tesla two weeks."

Mr Reed sees China as the main force behind the growth of the world's lithium industry.

General Mining and Galaxy Resources have an exclusive offtake agreement with Mitsubishi Corporation for all sales over the next four years.

Talison Lithium and its predecessor companies have been producing lithium from the Greenbushes spodumene hard rock mine for more than 25 years.

The Greenbushes mine has attracted serious investment in the past few years and is now owned by major players in the global lithium market.

In a sign of the increasing world demand for lithium, the Chinese company Chengdu Tianqi acquired 100 per cent of Talison in 2012, outbidding one of the world's largest lithium raw material producers, Rockwood Holdings Inc.

Rockwood negotiated a 49 per cent holding in 2014 before being acquired by chemicals giant, Albemarle Corporation. ■



L-R: Mines and Petroleum Minister Bill Marmion and Premier Colin Barnett speaking with COMESA Secretary General Sindiso Ngwenya.

DMP has also committed to compiling a guide to the policy principles that form the basis for Western Australia's *Mining Act 1978*. The guide will provide COMESA country representatives with a broad framework on leading practice mining legislation and policy for a transparent regulatory framework.

"Western Australia has continued to share its experience in encouraging investment and the responsible development of mineral and petroleum resources with COMESA," Dr Griffin said.

In December, representatives from DMP and Murdoch University travelled to Kenya and Mauritius in an effort to raise awareness of the potential collaboration opportunities which are available as a result of the MoU.

Throughout their 10-day visit, that had a focus on environmental regulation, the delegation provided information sessions with government, industry and academic representatives.

DMP Executive Director Environment Division Dr Phil Gorey, who was part of the visiting delegation, said the trip had generated a lot of interest as these two countries expand their fledgling resources sectors.

"The information sessions highlighted the mineral and petroleum expertise that DMP and Murdoch University are able to offer to COMESA countries as a result of the existing MoU arrangements," Dr Gorey said.

"All government agencies expressed an interest in learning from the Western Australian example and a number of collaborative opportunities with the Western Australian Government and Murdoch University are now being explored as a direct result of this visit."

Developing agriculture and food security projects, as well as strategies to minimise crop and livestock losses, has also been a major focus of the MoU.

Last year, a number of meetings took place between Western Australia and COMESA representatives to help promote further agricultural development.

This resulted in the two jurisdictions embarking on programs to help develop COMESA's biosecurity and biosafety capacity, which included meetings in Perth during the ADU Conference and in Lusaka, Zambia.

A two-day program of agriculture meetings and field trips for representatives of the COMESA Secretariat's Comprehensive Africa Agriculture Development Program also identified several opportunities for further collaboration. ■

WA STRENGTHENS COMMITMENT TO COMESA

The Western Australian Government has continued to strengthen its ties with members of the Common Market for Eastern and Southern Africa (COMESA) through a recent delegation.

In 2014 a Memorandum of Understanding (MoU) was established between the Western Australian Government and COMESA to provide a framework of cooperation in relation to resources, agriculture, training and capacity building.

The MoU is managed jointly in Western Australia by the Department of Mines and Petroleum (DMP) and the Department of State Development (DSD).

DMP's Deputy Director General Dr Tim Griffin said it was hoped that the success already achieved would now be built on to establish greater levels of cooperation in the future.

"The MoU offers a number of benefits to COMESA and its member states, including the development of mining laws, systems of administration, standards of work safety and environmental regulations," Dr Griffin said.

"Establishing consistent and transparent systems such as these will also help encourage increased interest by Western Australian companies to expand their businesses in Africa."

Over the past 12 months, meetings have taken place between COMESA representatives and the State Government which have helped to further strengthen the ties between the two jurisdictions.

This included a round of meetings in Cape Town during the 2015 Indaba Conference, and an official State breakfast during the 2015 Africa Down Under (ADU) Conference.

This involved discussions about the importance of robust policies and legal frameworks for a sustainable resources industry, and mechanisms to provide capacity training in Africa.

Representatives from DMP and DSD also hosted a series of training and capacity building workshops in resources sector regulation at the conference.

These sessions saw experts from the Western Australian Government provide an overview of Western Australia's mineral and petroleum regulatory system, and explain the State's approach to resource development and royalties.

During ADU 2015, the Central Institute of Technology invited members of the COMESA secretariat to learn about its vocational education and training capabilities and remote courses.

Discussions on agricultural issues, particularly leading practice in biosecurity, have also taken place.

GSWA OPEN DAY 2016

DATA, DRILLING AND 3D LEAD TO DISCOVERIES



Geological Survey Senior Geoscience Editor Dr Marie Ferland at the Open Day.

The three most important “D” words in mineral exploration are data, drilling and 3D.

That was the message delivered by Mines and Petroleum Minister Bill Marmion when he opened the 2016 Geological Survey of Western Australia (GSWA) Open Day on 26 February in Fremantle.

“A century ago, explorers on horseback and camels relied on incomplete paper maps and a lot of luck to make discoveries,” Mr Marmion told the audience.

“Explorers these days still need luck, but they can do a lot of their exploration in front of a computer screen and download invaluable data that has been interpreted by GSWA.

“They can download raw data too if they want to do their own interpretation.”

Announcing Round 13 of the Exploration Incentive Scheme’s (EIS) flagship Co-Funded Drilling Program, the Minister acknowledged the ‘geoscientific sleuthing’ that led to discoveries.

Mr Marmion said that the program had offered funding to more than 590 projects, of which over 300 have been drilled, resulting in more than 450,000 metres of drilling across the State.

“But the EIS does a lot more than provide the money for the program,” he said.

“GSWA has taken bold strides into the world of 3D geological modelling and recently released its first two geomodels the Windimurra igneous complex and the Sandstone greenstone belt in the northern Yilgarn Craton.

“These regions have known deposits of vanadium and gold, and the models will enhance future exploration potential for more gold, platinum group elements, nickel and copper.”

Mr Marmion said that the geomodels utilised the full spectrum of GSWA’s geological mapping and geophysical data acquired through the incentive scheme to create complete packages supplied on USB drives that include full suites of current 2D information.

“The Exploration Incentive Scheme funding has also been largely responsible for Western Australia’s strong participation in the AMIRA Roadmap for Exploration Under Cover project,” he said.

“GSWA works closely with industry, Geoscience Australia and the other State and Territory geological surveys, CSIRO and Australian university research leaders in this vital resource for the Australian minerals industry.”

The Minister said that the project’s emphasis was on innovative pre-competitive geoscience programs that see through the cover of soil, sand and sedimentary basins obscuring 80 per cent of Western Australia’s economic bedrock.

“The aim of the Roadmap is to deliver major new mines by locating and unlocking future mineral wealth,” he said.

Mr Marmion said the open day delivered a “feast of geophysical datasets and products”.

“They match, and in some cases even surpass, the best in the world,” he said.

The Minister highlighted:

- The release of a 100-metre line-spacing airborne magnetic and radiometric survey around the Yalgoo area that includes the world-class Golden Grove copper lead and zinc mine.
- The Ngurrupa gravity survey south of Balgo, in very remote desert country on the Western Australian border with the Northern Territory.
- A gravity survey across the Mid West, Wheatbelt, Peel, South West and Great Southern regions that gives insight into the crustal structure of the south-western area of the highly prospective Yilgarn Craton.
- The release of processed data and images of the Eucla–Gawler deep crustal seismic reflection and magnetotelluric survey.

The open day also marked the release of the drilling reports and the wireline logging data from the South West Hub Carbon Capture and Storage project.

DMP has drilled three wells in the Harvey-Waroona area between December 2014 and June 2015 to produce data on the potential carbon dioxide reservoir within the Lesueur Sandstone formation.

During a morning session, Professor Eun-Jung Holden and Assistant Professor Jason Wong presented a talk on the release of the first public version of the Integrated Exploration Platform.

The platform aims to improve utilisation of GSWA datasets to support explorers operating in Western Australia.

It is being developed as a collaborative project between the Centre for Exploration Targeting and GSWA.

In one of the afternoon sessions, Dr Martin Wells from CSIRO gave a presentation on the results from a joint CSIRO/GSWA study on integrated spectral mapping of gold and base metal mineral footprints in the Pilbara.

This presentation cast more light on a major fault system that hosts the historic Paulsens Gold Mine, now owned by Northern Star Resources Limited.

Earlier, Dr Huaiyu Yuan presented new information on the structure and evolution of the Western Australia craton.

Dr Yuan has been called the 'Earthquake Man' because of his work interpreting earthquake data as part of acquiring passive seismic array data, thereby generating a great deal of interest in his data from the Capricorn Orogen.

In other sessions, the audience learned about the CSIRO's report on the structure of the Amadeus Basin, mineral system studies for gold distribution in the Yilgarn Craton, nickel in the Eastern Goldfields, and rare earth elements at Browns Range.



L-R: Mines and Petroleum Minister Bill Marmion, Dr Eun-Jung Holden (CET), Geological Survey 3D Geoscience Manager Dr Klaus Gessner and Dr Jason Wong (CET).

Results from GSWA's ongoing pre-competitive geoscience program were also on show at the open day.

The latest hard copy and digital map products included high-quality 1:100,000 and 1:250,000 geological series maps that are updated each year from across the State.

GSWA also showed off its updated, seamless digital Geological Information Series products for the Capricorn, East Yilgarn, South Yilgarn, Murchison, Musgrave, Tanami and Kimberley regions.

New business systems were also demonstrated, including the latest updates for GeoVIEW.WA, GSWA's award-winning, state-of-the-art geoscientific web application. ■

A MAP FOR THE 21ST CENTURY

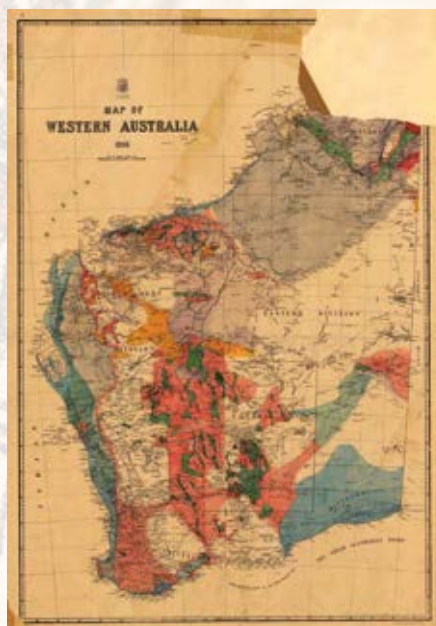
The first new geological map of Western Australia since 1998 was officially launched by Mines and Petroleum Minister Bill Marmion at the Geological Survey of Western Australia (GSWA) Open Day at the Esplanade Hotel in Fremantle on Friday, 26 February.

The flagship product of the GSWA is the culmination of 15 years' work that has dramatically reshaped how the survey delivers its geoscience data and products.

The map has 1:500,000 scale spatial accuracy across Western Australia and is the first to be entirely digitally compiled rather than assembled by hand using pre-existing maps and then digitised to create the final product.

The map has been produced about every eight years since 1894.

However, annual or bi-annual updates to its 1:500,000 and 1:2,500,000 digital datasets will now ensure that the State map is always current, eliminating the long delays in the release of new data in the past.



The 1916 Brockman map features in *Mapping Western Australia: State geological maps 1894–2015*.

The new map has been published 100 years after the Survey's least known map of Western Australia was compiled by Acting Surveyor General Frederick Slade Brockman.

Only one copy exists today. It is badly torn and large tracts of the interior are blank spaces with no interpretation (see image).

The Brockman map, and fascinating stories behind every other map drawn by the survey since 1894, features in the book *Mapping Western Australia: State geological maps 1894–2015*, which was launched at the open day alongside the new State map.

The launch of the new map was accompanied by the release of the Explanatory Notes System (ENS) search tool on GSWA's state-of-the-art geoscientific web application, GeoVIEW.WA.

ENS is a digital repository that integrates lithostratigraphic units within the digital map layers with links to all tectonic units and geological events recognised in Western Australia.

ENS will build into an online virtual book, providing a scale-less and seamless, continuously updated summary of the geology of Western Australia. ■

SIGNIFICANT PROGRESS IN MANAGING WA'S ABANDONED MINES

Recent milestones in the ongoing efforts to manage and rehabilitate Western Australia's abandoned mine sites have highlighted the State's ability to generate improved environmental and community safety outcomes.

Since 2010, the Department of Mines and Petroleum (DMP) has implemented a number of significant environmental reforms relating to mine closures.

This has included creation of the award-winning Mining Rehabilitation Fund (MRF), a pooled funding source which can be used to help with rehabilitation of the State's existing and future abandoned mine sites.

A new Abandoned Mines Policy was also published in January this year which provides a robust framework to help inform decisions about the prioritisation, management and rehabilitation of the State's abandoned mine sites.

DMP's Executive Director Environment Dr Phil Gorey said the new approach would ensure MRF funds are allocated to abandoned mines that deliver the best outcomes for Western Australia.

"It is neither practical nor desirable to rehabilitate all of the State's abandoned mine sites," Dr Gorey said.

"As a result, it is important we have a framework in place to make sure that all decisions are taken in a strategic manner which considers the risks, cost, potential value and benefit that rehabilitating a mine site will bring."

The groundbreaking MRF project was developed following extensive stakeholder consultation.

Funds can be used for rehabilitation purposes where the tenement holder fails to meet their rehabilitation obligations, and every other effort to recover funds from the operator has been exhausted.

WA RATED WORLD'S TOP INVESTMENT DESTINATION

Western Australia has been ranked as the world's most attractive mining investment destination, according to the internationally respected Fraser Institute's Annual Survey of Mining Companies: 2015.

Mines and Petroleum Minister Bill Marmion said the State Government's innovative resources policies and WA's abundant natural resources were a winning combination.



Mines and Petroleum Minister Bill Marmion.

"There is never a bad time to be the world's best, but it is particularly important at this stage in the resources cycle," Mr Marmion said.

"This is a win-win situation for responsible development and all West Australians. Investor confidence means projects are more likely to get the financial go-ahead, which means more jobs to build Western Australian communities."

"What really hits home are quotes from industry, praising the streamlining of landmark mining projects that are now supporting major employment."

"Mines have been built from discovery to production faster than anywhere."

Mining Company President
Fraser Institute Annual Survey of
Mining Companies 2015

One respondent is quoted as saying mines have gone from discovery to production faster than anywhere in the world. Another cited a three-year start-up period, praising the support of the State Government and local communities.

"We are processing approvals in record times, while driving new discoveries through our \$130 million Exploration Incentive Scheme, WA's significant investment in research and technology, and the creation of Australia's biggest core library," the Minister said.

"The benefits of our world-leading Mining Rehabilitation Fund are also flowing through, cutting costs and encouraging rehabilitation, after returning \$1.1 billion to the industry from the old bond system."

Mr Marmion said while red tape reduction and innovation had boosted resources industry confidence, it had not compromised environmental standards. ■

Top 5 Worldwide Investment Attractiveness Rankings

- | | |
|----|-------------------|
| 1. | Western Australia |
| 2. | Saskatchewan |
| 3. | Nevada |
| 4. | Ireland |
| 5. | Finland |



The Ellendale Diamond Mine (pictured) was the first site gazetted as an abandoned mine site under the Mining Rehabilitation Fund Act 2012.

The interest generated from the MRF funds can also be used to rehabilitate historical abandoned mine sites throughout Western Australia.

In December 2015, the former Ellendale Diamond Mine became the first site to be gazetted as an abandoned mine site under the *Mining Rehabilitation Fund Act 2012*.

DMP has subsequently undertaken on-ground works at the site to ensure it is safe, stable and non-polluting. Signage around the site was also erected in February 2016 to deter the public from accessing the site.

In addition, DMP has consulted with the Shire of Derby/West Kimberley and local police regarding the site.

The MRF team has also created a register to ensure further access to the site is managed in a safe and coordinated way. This includes for individuals who have purchased items from the site.

“The introduction of the MRF is the first time that there has been allocated funding available to rehabilitate the State’s historical abandoned mines,” Dr Gorey said.

“It also means that Western Australian communities will not pay for the rehabilitation activities at the former Ellendale site, or any other mining operation that may become abandoned in the future.

“DMP intends to ensure that Ellendale remains a sustainable development option for Western Australia. As a result, the site will not be fully rehabilitated, or closed, as it remains a viable resource project.” ■

.....

COLLABORATION THE KEY FOR NEW PROJECT

.....

A new pilot project between the Department of Mines and Petroleum (DMP) and the Office of the Environmental Protection Authority (OEPA) will improve and enhance the OEPA’s spatial data.

The project is headed up by DMP’s Title Spatial Services General Manager Kathlene Oliver and will assist the OEPA to back-capture and audit spatial data.

“After joining the department in May last year, I became aware of some of the challenges facing the OEPA in regard to its spatial data,” Ms Oliver said.

“I approached the OEPA to see if the department could assist it in providing solutions to these challenges.”

The spatial data is used by the OEPA to define area boundaries to assess and

analyse proposals, and can be critical in ensuring legislative and regulatory compliance.

“If the data isn’t accurate, it can have serious implications for government agencies and create regulatory uncertainty,” Ms Oliver said.

The project, which is expected to take approximately six months to complete, has been endorsed by both agencies.

“Collaboration between government agencies on projects such as this creates opportunities to share information, benchmark practices and policies, and build strong relationships across government agencies,” Ms Oliver said.

“This project will help OEPA and DMP reduce approval timelines and operational risks, and enhance transparency in decision-making.”

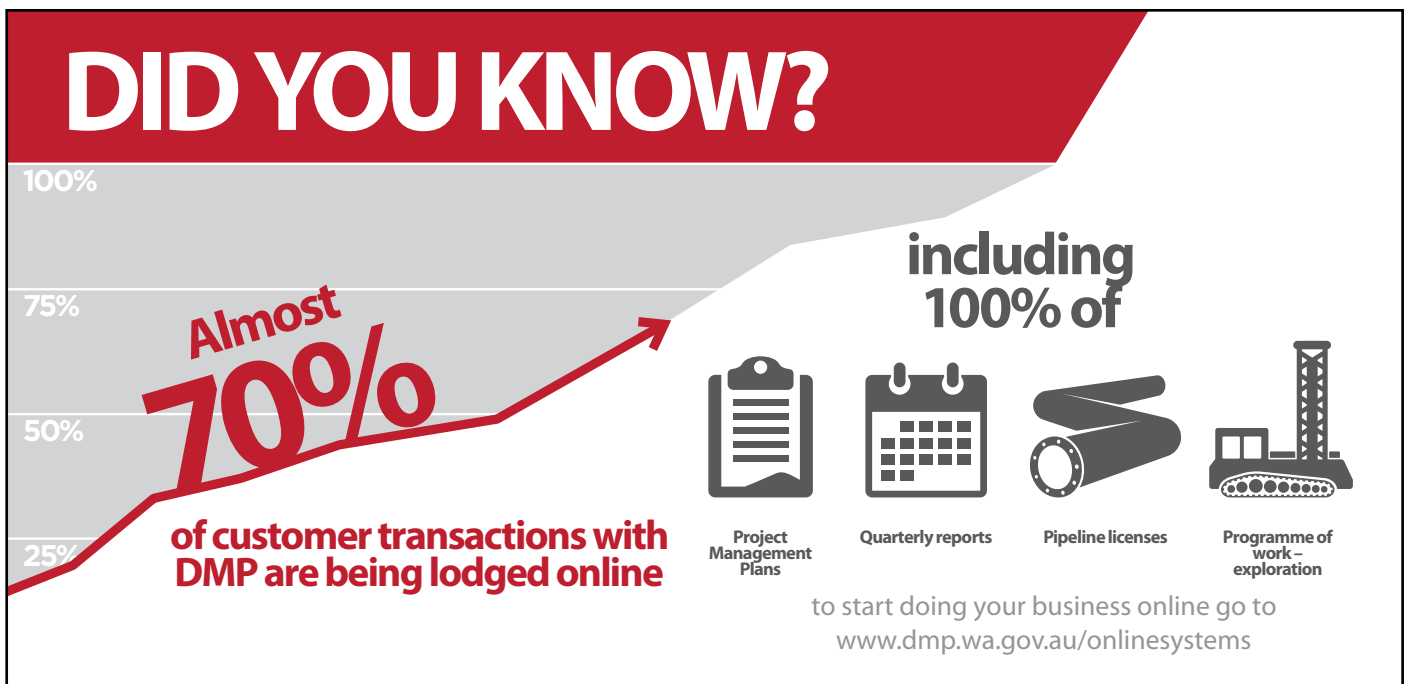
Ms Oliver said the project also aligned with the objectives of the State Government’s Information Communication Technology (ICT) strategy.

The development of a whole-of-government strategy was an important part of ICT reforms announced by Premier Colin Barnett and Finance and Mines and Petroleum Minister Bill Marmion last year.

“With a spend of at least A\$1 billion a year on ICT, there needs to be better co-ordination, consolidation and prioritisation of these resources across State Government,” the Premier said when announcing the reforms.

“Information Communications Technology reform will drive innovation, improve the way we deliver services to the community and deliver better value for the taxpayer.” ■

DIGITAL TRANSITION BRINGING BENEFITS



DMP has made a number of approval processes available online.

It has been almost seven years since the Department of Mines and Petroleum (DMP) took its first steps towards online lodgements.

It began in 2009 with online lodgement and tracking for mineral exploration Programme of Work applications. By 2012, the bulk of the department's key approval processes were available online.

"Two years later, more than 70 per cent of all mineral and petroleum applications were being lodged online," DMP Director General Richard Sellers said.

"It was also in 2014 that we launched our first complete online system for the introduction of the award-winning Mining Rehabilitation Fund (MRF).

"This required people to register, submit data and process payments for the MRF entirely online.

"Its success is a clear demonstration that putting DMP transactions online is an achievable reality."

Mr Sellers said it was important for the department to keep pace with a changing world.



DMP Director General Richard Sellers.

"People increasingly expect that they will be able to do business online," Mr Sellers said.

"They want it because it's convenient, faster and offers certainty."

Mr Sellers said the department had already seen a number of benefits from introducing its current range of online systems.

"It has improved timelines and reporting, reduced paperwork and costs, and enabled 24 hour access for all our stakeholders," he said.

Statistics show that the department's transition to online lodgements has been well-supported by industry across a number of areas. See chart 1.

"The number of applications being lodged online has increased markedly over the past three years," Mr Sellers said.

"This includes exploration licences, environmental plans and mining proposals."

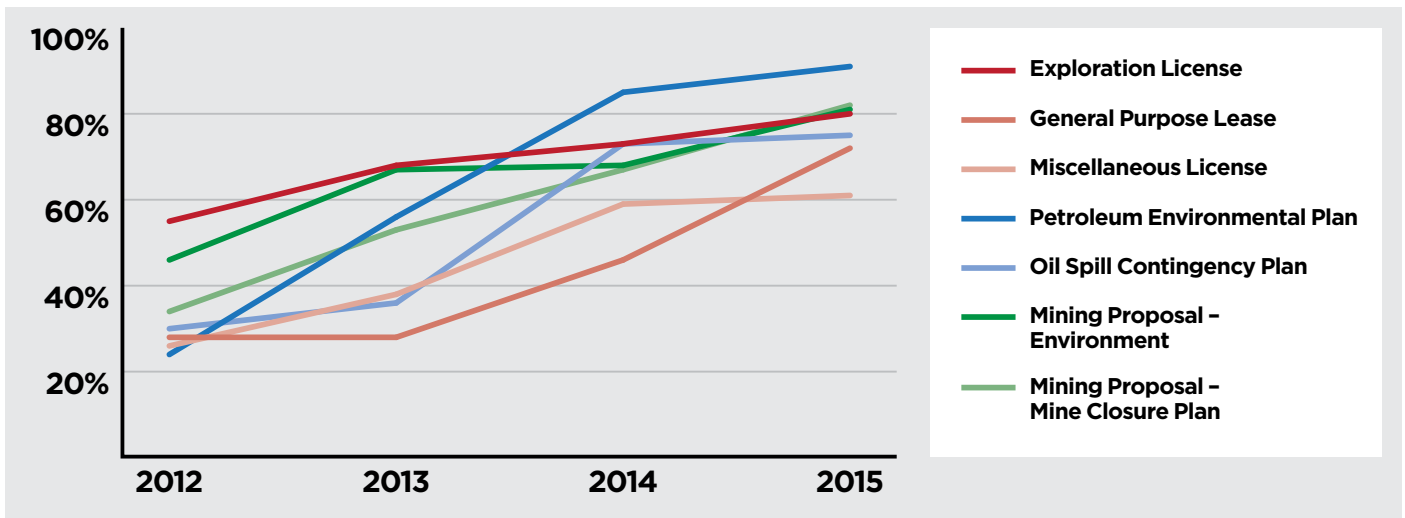


Chart 1: Increase in online lodgement since 2012.

The shift online is also creating clear benefits for assessment timelines.

"It is no coincidence that as online lodgement has increased, the department's assessment timelines have decreased," Mr Sellers said.

"In 2010, about 84 per cent of mineral title applications were being finalised within target timelines. Last year it reached 97 per cent." See chart 2.

The 2015 year result included the best ever quarterly performance by the department in the December quarter.

"As we continue to increase the services the department offers online, we will continue to see improvements in assessment timelines," Mr Sellers said. ■

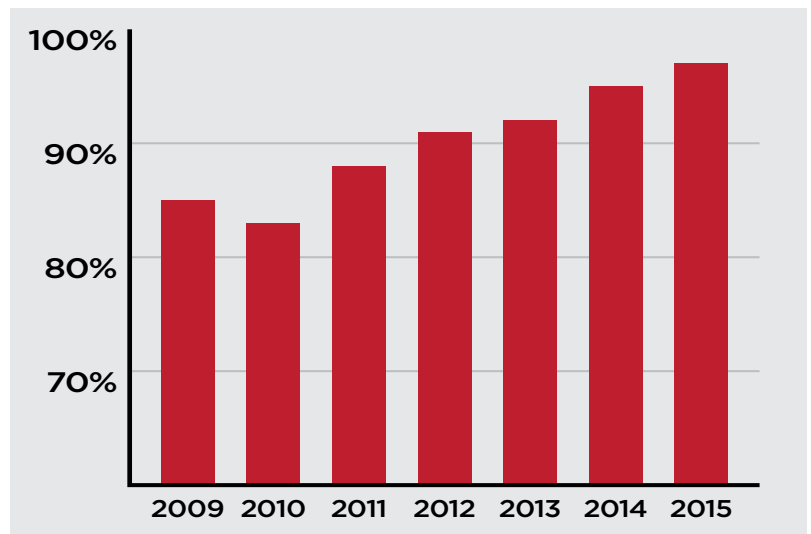


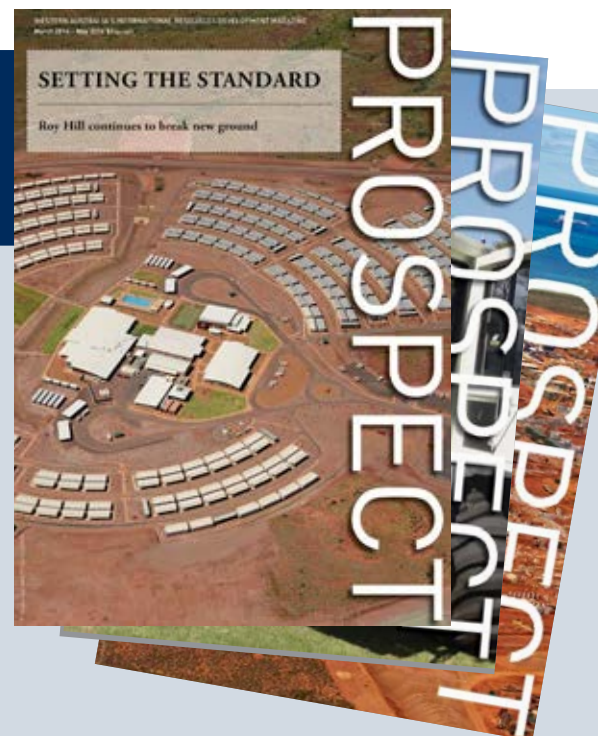
Chart 2: DMP assessment times 2010–2015.

Pay and subscribe to *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 DMP'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.

You can also register and pay for hard copy subscriptions on the *Prospect* webpage.





Community Partnership Resources Sector Award

COMMUNITY PARTNERSHIP AWARD 2016 – NOMINATIONS NOW OPEN

Community groups and resource companies from across Western Australia are being urged to put themselves forward for an exciting new award aimed at recognising innovative partnerships generating positive outcomes.

Last month the nomination process for the Department of Mines and Petroleum's (DMP) new Community Partnership Award was officially opened.

The award is designed to publicly celebrate the efforts of community groups and resource companies that work together to benefit the local area.

DMP Executive Director Mineral Titles Dr Ivor Roberts said the new Community Partnership Award would help to raise awareness of the benefits that positive community collaboration is having throughout the State.

"The purpose of this new award is to showcase the outstanding partnerships that have resulted in meaningful and positive outcomes for local communities throughout Western Australia," Dr Roberts said.

"By working together to address local concerns, resources companies and communities can help to build relationships that result in ongoing positive outcomes for all involved. This award will celebrate those achievements."

"It will also help build the reputation of resources industry organisations that are setting new benchmarks in community consultation and partnerships."

Throughout the nomination period, Dr Roberts and other DMP staff will be hosting information sessions about the new

award scheme at many of the department's regional offices located throughout the State.

Any community group, individual or company operating within Western Australia's minerals, energy resources or extractive industries, is eligible to enter a submission for the new Community Partnership Award.

All entries will be assessed against three criteria – leadership/innovation in engagement; benefits of the collaboration; and commitment to providing sustainable and enduring outcomes.

Submissions will be judged solely against these criteria, not other entrants' submissions.

This may result in multiple projects receiving a Community Partnership Award.

An assessment panel comprised of experts in resources management and community engagement will review all the nominations.

A selection committee consisting of three independent judges, and chaired by DMP Director General Richard Sellers, will then select the award recipients.

"The Community Partnership Award will honour companies and communities that develop positive community partnerships which promote strong guiding behaviour for future projects across Western Australia," Dr Roberts said.

"Winning projects will set an example to other industry organisations about the importance of effective community partnerships."

Mines and Petroleum Minister Bill Marmion will announce the winners at the annual DMP Awards for Excellence night, which will also incorporate the Golden Gecko Awards for Environmental Excellence.

Nominations for the Community Partnership Award 2016 close on Friday April 29. For further information on the new award visit www.dmp.wa.gov.au/communitypartnershipaward ■



L-R: DMP Executive Director Mineral Titles Dr Ivor Roberts, Coolgardie Mining Registrar Kathryn Bailey and Coolgardie Customer Service Officer Gill Kippin at the information session held in Coolgardie.

KEEPING THE FOCUS ON SAFETY



Workers taking part in the Newman leg of the 2015 Mines Safety Roadshow.

“The costs of not building safety into the way a company does business are counted not just in dollars and cents, but in lives lost and changed forever.”

So reads the introduction by State Mining Engineer Andrew Chaplyn in the most recent safety performance report released by the Department of Mines and Petroleum.

The statement is not just about educating industry, it reflects a tragic few years for Western Australia’s mining industry.

Between August 2013 and December 2015, 12 workers have been killed while working at Western Australian mining operations.

“For almost two years before that there had not been any work-related fatalities in the State’s mining industry,” Mr Chaplyn said.

That’s not to say that there were no serious injuries or near-misses.

There were a number of incidents over that period that could have been a fatality but for a few centimetres or a matter of milliseconds.

“The fatalities we have seen over the last couple of years confirm the need to further improve work practices across our mining industry,” Mr Chaplyn said.

“An important part of the equation is continuing to work with industry to drive positive safety outcomes.”

In 2015 the department held the first Registered Managers Forum, targeting managers responsible for running Western Australia’s mine sites.

“It was an opportunity to bring together some of the key people that run day-to-day operations to highlight safety issues in the industry and the important role they play,” Mr Chaplyn said.

“The forum was in addition to our regular Mines Safety Roadshows, which have been held for more than a decade.”

In 2016, the forum and the roadshows will maintain the focus on priority safety issues.

One area that will see significant change this year is in the way the department collects and uses safety data.

In the past few years, the department has released reports analysing fatal incidents and serious injuries to identify causes, contributory factors and commonalities.

“Major changes are due for implementation in the next few months in this area,” Mr Chaplyn said.

“It is important we continue to enhance our ability to collect and analyse safety data to help guide positive change.”

This has included changes to the department’s Safety Regulation System (SRS).

Mr Chaplyn said information on mining operations and company structures will be available through the SRS.

“This will enable us to more easily analyse data,” he said.

“Other changes are already adding value and helping our inspectors to work with companies to discuss how their safety performance is tracking. They can also compare their indicators with industry performance.”

The proposed introduction of new legislation in 2017 will also influence safety.

“The legislation is really about using a risk management approach and promoting appropriate safety practice and resilient work cultures,” Mr Chaplyn said.

“Like any form of change, it will have early adopters and others that will require a lot of assistance.

“Some companies will already have appropriate systems, practices and personnel in place and the changes should not be difficult. For others, a suite of guidance material and information sessions will be available to assist with the transition.

“Ultimately though, industry is good at adopting new ideas as it strives for continual improvement.” ■

AGRICULTURE

East Kimberley – Ord – Ord/East Kimberley Expansion Project**WA STATE GOVERNMENT**

The State Government has invested \$322m to construct irrigation channels, roads and off-farm infrastructure on the Ord lands in the East Kimberley Region. A Development Agreement has been signed with Kimberley Agricultural Investment (KAI) for the lease and development of 13,400ha of irrigation land in the Goomig and Knox Plain areas. KAI, a subsidiary of China's Shanghai Zhongfu Group, proposes to establish a sugar industry in the Kununurra region and has begun its first round of cropping on the Goomig land. The State has recently released 5,000ha of Ord West Bank and Mantinea lands via a Request for Proposal process. Expenditure: \$322m.

HEAVY MINERAL SANDS

Keysbrook – Heavy Mineral Sands Mine**MZI RESOURCES LTD**

The Keysbrook Mineral Sands Project, located near the township of Keysbrook approximately 70km south of Perth, commenced heavy mineral concentrate (HMC) production on 29 October 2015, three weeks ahead of schedule. The project involved the construction of a new mine and wet concentration plant, and upgrades to the existing mineral separation (MSP) plant owned by Doral Mineral Sands in Picton, near Bunbury. Secondary processing of approximately 110,000tpa of Keysbrook HMC commenced at the Picton MSP plant in November 2015. The project is expected to produce 67,500tpa of leucoxene products and 28,700tpa of zircon concentrate, exported from the Bunbury Port. In late December 2015, the first shipment of zircon concentrate was exported to Tricoastal/Wensheng of China under a long-term offtake agreement. The first shipment of leucoxene product to US customer Chemours is expected to commence in early March 2016. The Keysbrook deposit has a mineral resource of 90.3Mt at an average grade of 2.2 per cent total heavy mineral (THM) and an ore reserve of 670,000t THM, which underpins the first 5.5 years of operations. Based on the total mineral resource estimate, the potential mine life could be more than 15 years. Expenditure: \$70m.

Employment: Construction: 100; Operation: 50

IRON ORE

Pilbara – Roy Hill Iron Ore Mine & Infrastructure**ROY HILL HOLDINGS PTY LTD**

The Roy Hill Iron Ore Project is located 115km north of Newman and owned by Roy Hill Holdings, a private company majority owned by Hancock Prospecting Pty Ltd, with key international investment partners. Capital expenditure for the project is \$10b. The project became operational on 4 February 2016, and will ramp up to full name plate production capacity of 55mtpa by early 2017. The project will produce high grade iron ore for 20 years following ramp-up. The project includes mine development, mine processing infrastructure, a 344km heavy haul railway, and significant new port facilities at the Port Hedland inner harbour. Expenditure: \$10b.

Employment: Construction: 5300; Operation: 2000

IRON ORE PROCESSING

Pilbara – Cape Preston – Sino Iron**CITIC PACIFIC**

The Sino Iron project is located at Cape Preston, 100km south west of Karratha. When completed, it will be the largest magnetite mining and processing development in Australia, with a mine life of more than 25 years. The first shipment of magnetite concentrate to China occurred in late 2013. Since then, optimisation of the first two production lines has occurred. Line 3 is currently in load commissioning, with Line 4 to follow shortly. Commissioning of the final two lines will commence in 2016. On completion, the project will comprise in-pit crushers, a 29km slurry pipeline, a pellet plant and annual capacity to produce up to 24 million tonnes of magnetite concentrate. The downstream processing facility has required significant investment in dedicated supporting infrastructure including a new port facility, a 51 giga litre desalination plant and a 450 megawatt combined cycle gas fired power station. Expenditure: \$11.1b.

Employment: Construction: 4000; Operation: 1000

OIL & GAS DEVELOPMENTS

Carnarvon Basin – Greater Western Flank Phase 1**WOODSIDE ENERGY**

The Greater Western Flank Phase 1 Project will develop the Goodwyn GH and Tidepole fields, via a subsea tie-back to the existing Goodwyn A Platform. First gas was produced from the Goodwyn GH field in late 2015 with further production from the Tidepole field expected from early 2017. Expenditure: \$2.5b.

Kalgoorlie – Tropicana Gas Pipeline Project**ANGLOGOLD ASHANTI/APA GROUP JOINT VENTURE**

APA Operations Pty Ltd, a subsidiary company within the APA Group (APA), has completed the construction of a \$140m 294km high pressure natural gas pipeline to convey gas from the Murrin Murrin gas lateral pipeline (licence PL 36) to the Sunrise Dam Gold Mine and to the Tropicana Gold Mine. Both gold mines are operated by AngloGold Ashanti Australia (AGA). The pipeline is called the Eastern Goldfields Gas Pipeline (EGP) and a pipeline licence (PL 108) was granted on 29 January 2015 under the *Petroleum Pipelines Act 1969*. Construction on the pipeline commenced in May 2015 and was completed in November 2015. Gas delivery to Sunrise Dam commenced in late November 2015 and gas delivery to Tropicana in December 2015. On 19 August 2015, the pipeline licence (PL 108) was varied to permit construction of a gas delivery station and associated pipework to enable the supply gas to Granny Smith Gold Mine. All government approvals are in place and construction of the station is scheduled to be completed by March 2016. Expenditure: \$140m.

Employment: Construction: 250

AMMONIUM NITRATE

Pilbara – Burrup Industrial Estate Site D – Yara Pilbara Nitrates**YARA INTERNATIONAL ASA**

Yara Pilbara Nitrates Pty Ltd (YPN) is an incorporated joint venture between Yara International ASA (Yara) and Orica Limited (Orica). YPN has executed an Engineering, Procurement and Construction contract for the construction of a world class circa 330,000tpa Technical Ammonium Nitrate

(TAN) plant to be located on the Burrup Peninsula. Ammonia feedstock will be supplied from Yara Pilbara Fertilisers Pty Ltd which owns and operates its facility directly adjacent to the proposed location for the new TAN plant. Yara will be the operator of the TAN plant and Orica will manage the product sales and distribution of the TAN product. It is intended that all manufactured product will be sold into the Pilbara region. Work on the project has commenced and it is expected that the new plant will be commissioned in 2016.

Expenditure: \$800m.

Employment: Construction: 500; Operation: 65

OIL & GAS DEVELOPMENTS

Carnarvon Basin – Greater Western Flank Phase 2**WOODSIDE ENERGY**

The Greater Western Flank Phase 2 Project will develop 1.6 trillion cubic feet of raw gas from the combined Keast, Dockrell, Sculptor, Rankin, Lady Nora and Pemberton fields via a 35km subsea tie-back to the existing Goodwyn A platform. Initial project start-up is expected in the second half of 2019. Expenditure: \$2.8b.

Expenditure: \$2.8b.

Carnarvon Basin – Persephone Project**WOODSIDE ENERGY**

Woodside Energy Ltd, as operator of the North West Shelf Joint Venture is developing the Persephone gas field. The development involves two subsea wells and an 8km subsea tieback to the existing North Rankin Complex. Fabrication activities and offshore brownfield work has commenced, with start-up expected in early 2018. Expenditure: \$1.2b.

Expenditure: \$1.2b.

Carnarvon Offshore Basin – Barrow Island – Gorgon Project**GORGON JOINT VENTURE**

The Gorgon Foundation Project on Barrow Island, now in its sixth year of construction, is a three train LNG development with a nameplate capacity of 15.6Mtpa and includes a domestic gas plant capable of delivering at least 300TJ/d of gas to the mainland. Cost estimates for the project construction have been reassessed at A\$55b (US\$54b) following a cost and schedule review conducted by Chevron in December 2013. 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 shipments of LNG are expected early 2016 with trains two and three being commissioned later in the year. Expenditure: \$55b.

Expenditure: \$55b.

Employment: Construction: 8000; Operation: 300

Pilbara – Wheatstone LNG Development**CHEVRON AUSTRALIA PTY LTD**

Chevron Australia Pty Ltd as Operator of the Wheatstone Project is currently working towards the construction of two LNG trains, a domestic gas plant and port facilities at the Ashburton North Strategic Industrial Area near Onslow. The Project will initially produce 8.9Mtpa of LNG and have a 200TJ per day domestic gas plant connected to the Dampier-to-Bunbury Natural Gas Pipeline. The Project is targeting first LNG by mid-year 2017. Expenditure: \$29b.

Expenditure: \$29b.

Employment: Construction: 6500; Operation: 400

POWER STATIONS

Boodarie Industrial Estate – South Hedland Power Station**TRANSALTA**

In July 2014, TransAlta Energy (Australia) Pty Ltd announced it will build, own and operate a 150 megawatt power station in South Hedland's Boodarie Industrial Estate. The plant will consist of a combined cycle gas plant, which is a reliable, highly-efficient, low-cost and clean process of generating electricity, featuring both natural gas and steam turbines. The \$570 million investment will help meet the future energy needs of the region through a 25-year agreement with both Horizon Power and Fortescue Metals Group. The plant is being designed to allow for expansion and there is a possibility that other customers may be added in the future. Construction commenced in February 2015 and is expected to create up to 250 jobs. Full commissioning is expected to be complete mid 2017.

Expenditure: \$570m.

Employment: Construction: 250; Operation: 20

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 1,000 hectares of ponds and supporting infrastructure. In Western Australia a processing plant is proposed for Kununurra, a founder stock centre in Exmouth. Seafarms is currently considering a number of alternative locations in relation to export facilities. The project will create approximately 700 direct jobs when fully operational. A Final Investment Decision on Stage 1 of the project is expected in mid-2016 and financial close by the end of 2016.

HEAVY MINERAL SANDS

Shark Bay – Coburn Zircon Project**STRANDLINE RESOURCES LIMITED**

Strandline proposes to develop the Coburn zircon project, located south of Shark Bay and approximately 250km north of Geraldton. It contains total ore reserves of 308Mt at an average grade of 1.2 per cent heavy minerals, all of which lie within the portion of the project area that has received government environmental approvals for mining. 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-leucocoxene over its 19-year mine life. The company has secured all of the approvals required to commence mining and processing operations at Coburn, and is continuing to pursue discussions with parties interested in becoming a strategic partner in the project.

Expenditure: \$173m.

Employment: Construction: 170; Operation: 110

INFRASTRUCTURE

Bunbury – Multi-User Bulk Terminal Facility – Port of Bunbury**LANCO RESOURCES AUSTRALIA PTY LTD**

Lanco Resources Australia Pty Ltd proposes to construct a 15Mtpa multi-user bulk terminal facility located at the Berth 14A site within the inner harbour of the Port of Bunbury. The facility will include ship loading for up to 85,000 tonnes, fully covered and dust suppressed conveyor galleries, a storage shed, with internal stacker reclaimers, up to 750m LOA, 140m wide and 40m high. The train unloading and rail loop load in facility will be able to accommodate coal, iron ore, bauxite and other bulk ore materials. The terminal will have capacity to expand. Environmental approvals have been obtained with construction expected to commence by early 2017 ready for operation in 2020. Expenditure: \$400m.

Employment: Construction: 750; Operation: 100

Dampier Peninsula – Browse LNG Precinct**WA STATE GOVERNMENT**

The State Government is developing the Browse Liquefied Natural Gas (LNG) Precinct approximately 60km north of Broome. By focussing development at a suitable location, the Precinct will minimise the environmental footprint of gas processing and any social impacts in the region while maximising opportunities for the local community to benefit from development of the Browse Basin gas fields. The Precinct will have the capacity to accommodate at least two LNG processing operations, with a combined capacity of up to 50Mtpa. The State Government has acquired the land for the Precinct and will secure all relevant approvals to ensure the Precinct is 'project ready'.

IRON ORE

Pilbara – Balla Balla Infrastructure Project**BALLA BALLA JOINT VENTURE**

The proposed Balla Balla Infrastructure (BBI) project by the Todd Corporation is located midway between Dampier and Port Hedland in the Pilbara region of Western Australia. It will provide for a combination railway and conveyor line totalling 170km distance from the Flinders Pilbara Iron Ore Project to the proposed greenfields Balla Balla Export Facility situated 100km east of Karratha. The proposed port facility will comprise a conveyor from a rail unloader to the port stock yard via a 9.8km causeway and conveyor, a 2.6km jetty and conveyor and a transshipment vessel loading wharf.

Expenditure: \$2.8b.

Pilbara – West Pilbara Iron Ore Project**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 to be transported by a 282km heavy haul railway for export via the proposed multi-user port at Anketell. Both facilities are proposed to be constructed and operated by Aurizon Holdings Ltd. 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: 3500; Operation: 900

NICKEL

Mt Windarra – Windarra Nickel**POSEIDON NICKEL NL**

Poseidon Nickel Ltd has submitted a project development proposal for the redevelopment of the Mt Windarra underground nickel mine and associated project infrastructure at Mt Windarra.

OIL & GAS DEVELOPMENTS

Canning Basin – Buru Canning Basin Tight Gas BURU ENERGY

The Buru Energy/Mitsubishi joint venture (JV) has recently completed its Laurel Formation Tight Gas Pilot Exploration (TGS) Program to test the commercial potential of the Laurel Formation, a large onshore natural gas resource located in the Canning Basin. This program involved the hydraulic stimulation of two wells on and near Noonkanbah Station in the Canning Basin. This follows the successful test hydraulic stimulation of the Yulleroo 2 well in 2010. During the most recent program, up to 100 people were involved in the works including more than 30 Traditional Owners from nearby Yunggora (Noonkanbah) community, with more than 13,500 hours of paid employment provided to community workers. Tests of the wells are ongoing to determine gas flows from the target reservoir. Preliminary results from the tests are encouraging. A groundwater monitoring program has been ongoing throughout the program and confirmed there have been no impacts of the program on groundwater. Should the resource prove to be commercially viable, gas from the Canning Basin will provide energy security to WA domestic and industrial markets. Under a State Agreement the JV, upon proving up sufficient reserves, is obligated to supply into the WA domestic market at least 1,500 petajoules of gas.

Expenditure: \$40m.

Employment: Operation: 30

URANIUM

Northern Goldfields – Yeelirrie – Yeelirrie Uranium CAMECO AUSTRALIA PTY LTD

Cameco Australia proposes to develop the Yeelirrie project in the North-eastern Goldfields, near Wiluna. The project entails open cut mining of shallow deposits of uranium ore, treatment in a plant to be established at the site, and development of associated infrastructure. The project will process up to 2.4Mtpa of uranium ore over about 17 years. The resultant uranium oxide will be transported to South Australia by road for export to overseas markets. The environmental assessment process has commenced. Cameco will advance the project at a pace aligned with market conditions.

Employment: Construction: 500; Operation: 225



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\$120 billion worth of projects either committed or under consideration for the State during the next few years. These would create more than 29000 construction jobs and more than 5000 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 2015

	Project Value (estimated A\$m)	Employment	
		Construction	Permanent
Iron and Steel			
API Management Pty Ltd – West Pilbara Iron Ore Project	6800	3500	900
CITIC Pacific – Cape Preston Mine & Processing Projects	11100	4000	1000
Roy Hill Holdings Pty Ltd – Roy Hill Iron Ore Mine & Infrastructure	10000	5300	2000
Sub Total	27900	12800	3900
Oil, Gas and Condensate			
Browse LNG Precinct	n/a	n/a	n/a
Buru Energy – Buru Canning Basin Tight Gas	40	n/a	30
Chevron – Wheatstone LNG	29000	6500	400
Gorgon Joint Venture Gas Processing Project	55000	8000	300
Woodside Energy – Greater Western Flank Phase 1	2500	n/a	n/a
Woodside Energy – Greater Western Flank Phase 2	2800	n/a	n/a
Woodside Energy – Persephone	1200	n/a	n/a
Sub Total	90540	14500	730
Other			
Cameco Australia – Yeelirrie Uranium	n/a	500	225
Lanco Resources Australia Pty Ltd – Multi-User Bulk Terminal Facility – Port of Bunbury	400	750	100
Ord East Kimberley Expansion Project	322	n/a	n/a
TransAlta – South Hedland Power Station	570	250	20
Yara International ASA – Yara Pilbara Nitrates	800	500	65
Yara International ASA – Yara Pilbara Nitrates	800	500	65
Sub Total	2092	2000	410
TOTAL	120532	29300	5040

All currency figures are in Australian dollars unless otherwise specified.

Abbreviations Key

b	billion	m	million
EPC	Engineering, Procurement and Construction	Mt	million tonnes
GL	gigalitres	Mtpa	million tonnes per annum
ha	hectares	MW	megawatts
JV	joint venture	t	tonnes
km	kilometres	THM	total heavy mineral
LNG	liquefied natural gas	TJ	terajoules
LOA	length overall	tpa	tonnes per annum

Pay and subscribe to *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 DMP'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.

You can also register and pay for hard copy subscriptions on the *Prospect* webpage.

Are your contact details up-to-date?

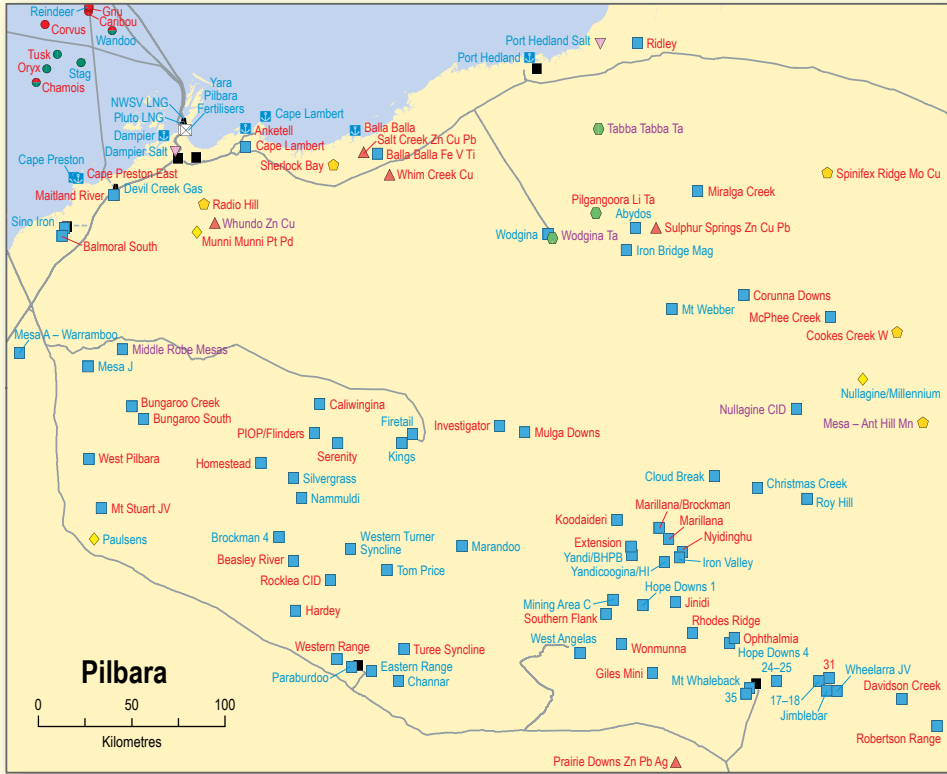
If your contact details are changing or have changed you can now update them online.

www.dmp.wa.gov.au/prospect



Major Resource Projects

March 2016



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)	Chert.....	Chert
◆	Base metal	Cu.....	Copper
◆	Alumina All sites are bauxite	Fe.....	Iron
●	Coal and lignite	Hem.....	Hematite
▽	Industrial mineral	K.....	Potassium
▽	Processing plant	Kln.....	Koolinite, Kaolin
◆	Petroleum symbols	Li.....	Lithium
●	Gas field	LNG.....	Liquefied natural gas
●	Oil field	LPG.....	Liquefied petroleum gas
●	Oil and gas field	Mag.....	Magnetite
◆	Significant gas discovery	MgCO ₃	Magnesite
▲	Processing plant	Mica.....	Mica
—	Oil / gas pipeline, operating	Mn.....	Manganese
- - -	Oil / gas pipeline, proposed	Mo.....	Molybdenum
■	Power plant	Ni.....	Nickel
▭	Irrigation / water / desalination	Pb.....	Lead
□	Port	Pd.....	Palladium
		Phos.....	Phosphate
		Pl.....	Platinum
		REE.....	Rare earth elements
		Sid.....	Silica sand
		Ta.....	Tantalum
		Tlc.....	Talc
		Ti.....	Titanium
		V.....	Vandium
		W.....	Tungsten
		Zn.....	Zinc
		Zr.....	Zirconium

Data for offshore Commonwealth controlled waters is up-to-date as of February 2016. Enquiries for latest information for Commonwealth controlled waters is available from the National Offshore Petroleum Titles Administrator (NOPTA) at <info@noppta.gov.au>



Project labels:

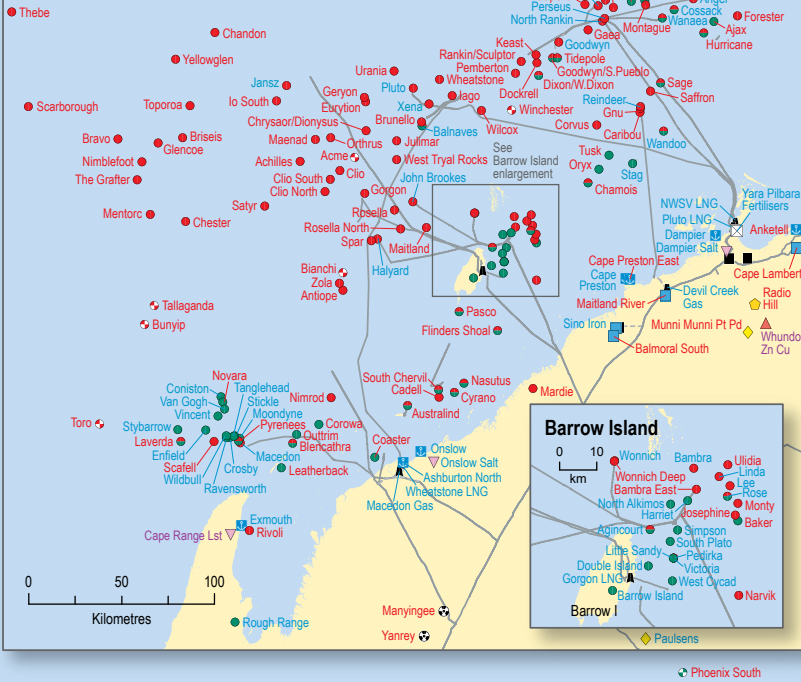
Projects operating or currently under development with an actual or anticipated value of production greater than A\$10 Million are shown in blue

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

Projects under care and maintenance are shown in purple



North West Shelf



Major Resource Projects

March 2016

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

Projects under care and maintenance are shown in purple



Commodities

- Ag..... Silver
- Au..... Gold
- Co..... Cobalt
- Cu..... Copper
- Dmd..... Diamond
- Fe..... Iron
- Fl..... Fluorite
- Gp..... Gypsum
- Gr..... Graphite
- Grt..... Garnet
- K..... Potassium
- Kin..... Kaolin
- Lst..... Limestone
- LNG..... Liquefied natural gas
- Mag..... Magnetite
- Mn..... Manganese
- Nb..... Niobium
- Ni..... Nickel
- Pb..... Lead
- Pd..... Palladium
- PGE..... Platinum group elements
- Pt..... Platinum
- REE..... Rare earth elements
- Ti..... Titanium
- V..... Vanadium
- W..... Tungsten
- Zn..... Zinc
- Zr..... Zirconium

Mineral symbols

- ☆ Precious mineral
 - ◇ Precious metal
 - ◆ Steel alloy metal
 - Speciality metal
 - ▲ Base metal
 - Iron
 - Alumina
 - Coal and lignite
 - ⊛ Uranium
 - ▽ Industrial mineral
 - ⊠ Processing plant
- ## Petroleum symbols
- Gas field
 - Oil field
 - Oil and gas field
 - Significant gas discovery
 - Significant oil and gas discovery
 - ▲ Processing plant
 - Oil / gas pipeline, operating
 - - - Oil / gas pipeline, proposed

Infrastructure

- Power plant
- ▽ Irrigation / water / desalination
- Port

Data for offshore Commonwealth controlled waters is up-to-date as of February 2016. Enquiries for latest information for Commonwealth controlled waters is available from the National Offshore Petroleum Titles Administrator (NOPTA) at <info@nopla.gov.au>



Government of Western Australia
Department of Mines and Petroleum