



# A Science Statement for Western Australia

GROWING WESTERN AUSTRALIA

APRIL 2015



**Medicine and Health**



**Radio Astronomy**



**Mining and Energy**



**Biodiversity and  
Marine Science**



**Agriculture and Food**

## ACKNOWLEDGEMENTS

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Government of Western Australia  
Department of the Premier and Cabinet  
**Office of Science**

# FOREWORD

Science is fundamental to our society and affects every part of our life, from the food we eat, the medicines we take, to the technology we use. It has underpinned our social and economic wellbeing, improving our quality of life immeasurably.



The knowledge and application of science is what underpins new and diverse concepts and ideas. Science enables communities to take steps forward in the way they run businesses, the way they protect the environment and the way they educate their children.

**HON COLIN BARNETT MLA**  
PREMIER,  
MINISTER FOR SCIENCE

As we look forward, science will continue to be at the heart of our prosperity. It is the key to unlocking Western Australia's potential.

Western Australia is a vast State endowed with rich natural resources that have long provided us with the opportunity to grow our prosperity. We have embraced these opportunities, developing our economic strengths around key commodities in minerals, energy, agriculture and fisheries.

Our State is also blessed with unique and internationally recognised biodiversity. Western Australia is home to some of Australia's most important environmental assets such as the Ningaloo reef system and the Kimberley. In addition, the South West region is one of 35 global biodiversity hotspots recognised by Conservation International.

Underpinning all of this has been a proud history of achievement in scientific research and development, helping us to drive technological innovation and efficiencies in our economy, to better understand and manage our environment, and to improve our health, safety and security. These achievements provide a solid foundation on which to expand our social and economic prosperity.

With an economy that is largely export based and subject to external influences, we need to continue our focus on broadening the State's economy. This must be done in a targeted way, building on our natural advantages to expand exports and provide opportunities for businesses, creating jobs in the process. Furthermore, the economic development of our State cannot proceed responsibly without appropriate strategies to manage and conserve our rich biodiversity.

The State Government has identified five areas in which the advancement and application of science can help us broaden the economy and create a new generation of jobs. Western Australia's potential is huge, but our resources are finite and these priorities seek to focus effort on our areas of comparative advantage.

**These areas are:**

- **mining and energy**
- **medicine and health**
- **agriculture and food**
- **biodiversity and marine science**
- **radio astronomy.**

## FOREWORD

By focusing on these areas, we can achieve tangible goals, such as increasing crop yields, ensuring the sustainability of our food sources, lowering the cost of mining and finding cures for medical conditions.

Western Australia can be a scientific leader in our region, but to do so we need to continue strengthening our collaborations and create genuine partnerships between universities, research institutes, industry and Government, locally, nationally and internationally.

Our geographical location places us in an ideal position with our Asia Pacific neighbours, and we can leverage off established relationships based around mining, energy and agriculture to build stronger relationships across our priority areas.

This Science Statement is a first step in recognising and acknowledging the importance of science to our future prosperity. While setting priorities for science in Western Australia, it is hoped that the Statement will also increase community awareness of our scientific capabilities and the importance of science to our economic and social well-being.

The next step will be to develop long-term strategies that build on our capabilities. Achieving this requires industry, universities, research institutes and Government working together in partnership to identify, invest and deliver on strategies that take full advantage of our opportunities. The Office of Science, established in 2013, will play a key role in this, working with the Chief Scientist of Western Australia and across the sector to develop science strategies, strengthen partnerships, engage the community with science, and coordinate science activities and programs throughout Western Australia.

This is a Statement for all of Western Australia, not just the State Government. It is a clear signal and recognition of the role that science plays in a modern, sophisticated economy and a safe, healthy society.

**Hon Colin Barnett MLA**  
PREMIER;  
MINISTER FOR SCIENCE



Science has been vital for the development of Western Australia, and it will be crucial for the future of the State. A clear direction for science is essential, based around research priorities to harness a 'Team WA' approach and maximise the use of precious resources.

**PETER KLINKEN**  
CHIEF SCIENTIST



# A BRIEF HISTORY OF SCIENCE IN WESTERN AUSTRALIA

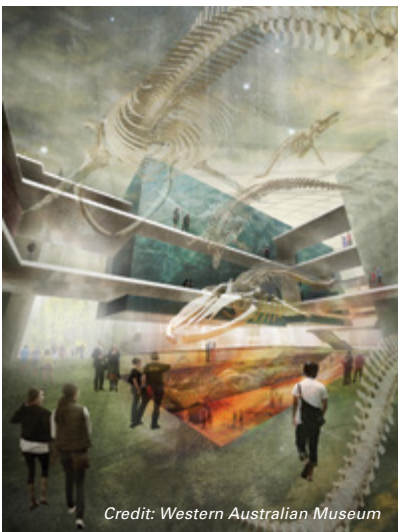
When HMS Beagle entered King George Sound on 2 March 1836, the young Charles Darwin had already spent four years at sea, including almost two months in eastern Australia. In the brief period Darwin spent in Albany, he collected plants and native animals and made the first scientific record of the Australian Bush Rat.



Credit: Western Australian Museum

▲ The 160 year old Perth Gaol has been a museum since 1891 when it was renamed the Geological Museum and used to store a collection of geological specimens.

In many ways, Darwin's visit to Albany set the scene for science in Western Australia for much of the nineteenth century. During the 1800s, local scientific research was focused on cataloguing the rich diversity of species previously unknown to western science. An interest in the geology of the State was spurred by the discovery of gold at Toodyay in 1849, leading to further gold discoveries during the 1880s and 1890s.



Credit: Western Australian Museum

▲ An artist's concept of themed use of internal space incorporating the blue whale skeleton. The new Western Australian Museum is to be opened in 2020.

In 1891, a series of geological collections were amalgamated to form the Geological Museum, to which ethnological and biological exhibits were subsequently added. In 1897, the museum officially became the Western Australian Museum and Art Gallery. The importance of the Museum as a scientific institution continues today, with the 2012 announcement of a new Western Australian Museum with state-of-the-art research facilities for museum scientists.

The 1890s also saw moves to establish an observatory, and following the approval of funding in 1895, work commenced on construction of an observatory at Mount Eliza. The opening of the observatory in 1897 was celebrated as a grand civic occasion. According to the then Premier Sir John Forrest, the building of a museum and an observatory

*"... showed that in the time of our prosperity we were trying to elevate and improve the public mind and to do something for the encouragement of the arts and sciences in this colony ..."*



Credit: Department of Parks and Wildlife

▲ The site of the Perth Observatory at Mt Eliza was originally suited to both meteorological and astronomical work.

These sentiments continue today with the Western Australian Government's role in supporting the establishment of the massive Square Kilometre Array project, one of the greatest scientific endeavours of this century.



Credit: CSIRO

▲ In 2012, Australia was chosen as one of two sites to co-host the Square Kilometre Array project.

The years since the 1890s have seen the Western Australian economy grow thanks to the extraction and processing of our minerals and energy resources, as well as the cultivation of agricultural products.

A BRIEF HISTORY OF SCIENCE IN WESTERN AUSTRALIA



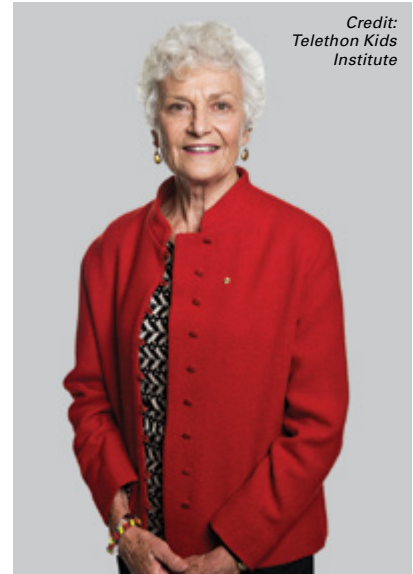
Credit: The Office of the Nobel Laureates

▲ Professor Barry J. Marshall AC and Dr J. Robin Warren AC were named as the 2005 Nobel Laureates in Physiology or Medicine.



Credit: Fiona Wood Foundation

▲ Professor Fiona Wood AM, 2005 Australian of the Year, is renowned for her work treating burn victims including victims of the 2002 Bali bombings.



Credit: Telethon Kids Institute

▲ The recipient of the prestigious Australian of the Year award in 2003, Professor Fiona Stanley AC was the founding Director of the Telethon Kids Institute.

International demand for our resources has created an export focused economy operating in a competitive global market, and scientific research has been integral to maintaining our competitiveness.

While the State has a long history of supporting scientific research, Western Australia’s achievements would not have been possible

without the support of and collaboration between industry, universities, research institutions and Government. This collaboration has led to the establishment of institutes such as the Minerals Research Institute of Western Australia, the Harry Perkins Institute of Medical Research, the Telethon Kids Institute and the Western Australian Marine Science Institute.

As a community, we can be proud of our scientific history that has led to innovations and achievements in various industries. For example:

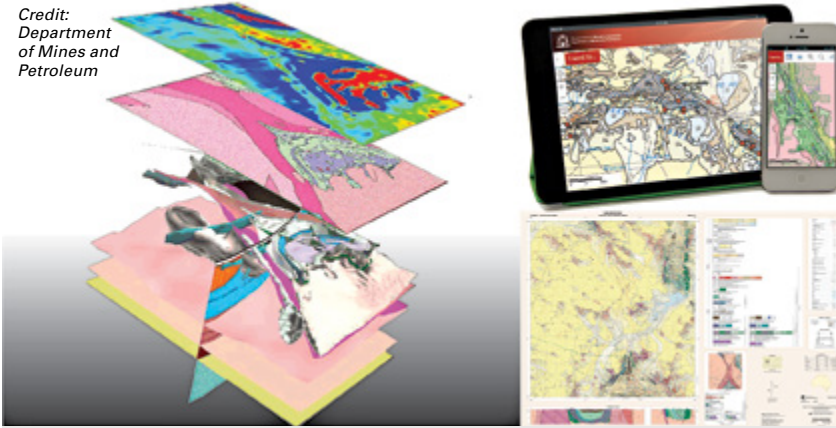
- **Nobel Laureates Professor Barry Marshall and Dr Robin Warren** transformed the treatment of peptic ulcers; **Professor Fiona Wood** pioneered the use of novel techniques for the treatment of burns and **Professor Fiona Stanley** has led the use of population data in disease prevention.
- **The Pink Lady™ and Sundowner™** apples are great success stories of Western Australian agriculture. Developed in the 1970s as part of a breeding program by John Cripps AM at the then Department of Agriculture Western Australia, these apples are now sold throughout world.
- Our fisheries are recognised as being some of the most sustainable in the world. The **Western Rock Lobster fishery** was the first in the world to be certified as sustainable by the Marine Stewardship Council.



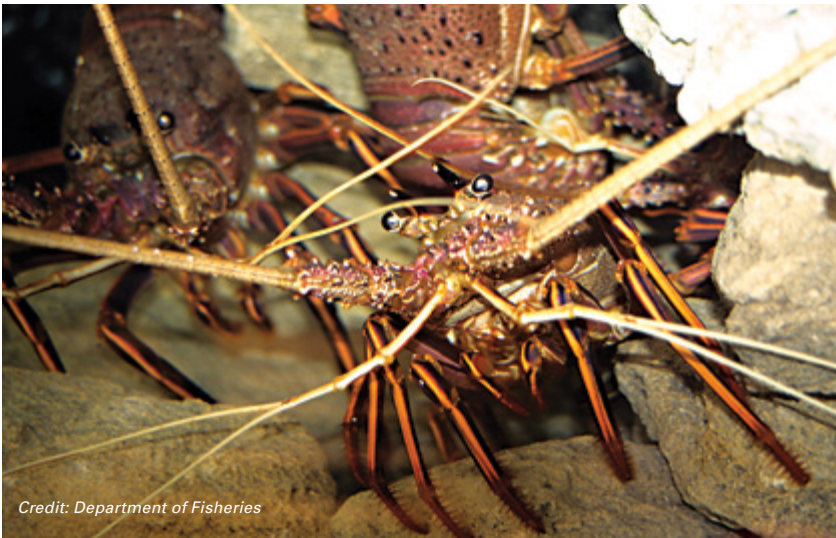
Credit: Department of Agriculture and Food WA

▲ A new apple variety, ANABP 01 developed here in Western Australia, could be as successful as the Pink Lady™ and Sundowner™ apples that were developed by the Department of Agriculture and Food Western Australia.

Credit: Department of Mines and Petroleum



▲ The Geological Survey WA has been collecting and publishing information on the State's geology since the 1880s.



Credit: Department of Fisheries

▲ The Western rock lobster is the most valuable wild stock single-species fishery in Australia and through the efforts of the Department of Fisheries is now one of the most sustainable in the world.

Credit: Department of Parks and Wildlife



▲ Dr Adrian Wayne from the Department of Parks and Wildlife releasing a woylie after checking its health. Monitoring programs are crucial to maintaining and improving the conservation status of endangered native species.

It achieved this world-class status from predictive science dating back half a century. It is one of a handful of fisheries today in Australia where a long-term scientific program has provided sufficient detailed information to predict stock levels in advance.

- **The Geological Survey of Western Australia**, part of the Department of Mines and Petroleum (the Geological Survey WA), is an example of the State acting as the catalyst for industry development through its work to gather, synthesise and publish information on the

State's geology and mineral and petroleum resources since the 1880s. This information has facilitated the development and exploration of the State by investors, explorers, miners and prospectors.

- With a number of Western Australia's unique animals facing significant threat from feral predators, the Department of Parks and Wildlife has for many years dedicated scientific research to the development of specifically designed toxic baits that are effective in fox and feral cat control, but do not affect native animals.

The development of **Probait(r) and Eradicat(r)** have been significant advances in the protection of Western Australia's threatened animals.

These examples demonstrate how science has played an integral role in the development of Western Australia, a role that can only continue to grow into the future.

# SETTING PRIORITIES

This Science Statement is driven by the need for a more strategic approach to scientific research in Western Australia. If the State is to build on its comparative advantages, a set of priorities for research investment must be defined. Setting priorities is not new, but is necessary. It will enable research efforts across the State to be aligned at a State and national level, making better use of available resources.



▲ Her Excellency the Honourable Kerry Sanderson AO, appointed Governor of Western Australia in 2014, is a passionate advocate of science in Western Australia. She is seen here visiting the Harry Perkins Institute of Medical Research with Chief Scientist of Western Australia, Professor Peter Klinken.



▲ From left to right: Former Chief Scientists of Western Australia, Adjunct Professor Bruce Hobbs AO, appointed to the position in 2003 and Professor Lyn Beazley AO, appointed in 2006, with Western Australia's current Chief Scientist, Professor Peter Klinken, appointed in 2014.

This Statement identifies **five science priority areas** for Western Australia, chosen because of the State's natural advantages and established strengths in each area.

This Statement identifies five science priority areas for Western Australia, chosen because of the State's natural advantages and established strengths in each area. Examples in each area highlight the level of activity already being undertaken. The Statement also identifies several opportunities that if realised, can enable the State to achieve greater outcomes across each of the five priorities.

Accompanying this Statement are a series of "Snapshots" of significant research activities currently underway across Western Australia. It is not the intention of the Snapshots to capture every science activity across the State. That would be a considerable undertaking given the amount of research that is conducted in Western Australia. Instead, the Snapshots highlight a number of initiatives, drawn from examples provided by industry, research institutes, universities and Government to indicate the quality of research being undertaken.



## OUR CAPACITY

Western Australia's economy is highly export-oriented. The agricultural sector has long been a mainstay of the economy, and agricultural commodities have historically accounted for a significant proportion of the State's exports. More recently, Western Australia has become a global centre for mining and energy. The State's achievement in these sectors would not have occurred without strong scientific capabilities within Western Australia's universities and investment by industry and the State Government.

With an economy based on natural resources, Western Australia is heavily dependent on science. The State is a world leader in mining technology, with a critical mass of research and technology expertise developed over decades of successful mining and energy projects. We are also a world leader in dryland farming, exporting our technical expertise to Africa, the Middle East and Asia.

Achievements such as these are a reflection of the significant collaboration between the State's research base and industry, including small and medium enterprises, with appropriate support from Government. Western Australia's universities and research institutes are staffed

with some of the best scientists in the world, working alongside industry on complex problems that have pushed the boundaries of our capacity. These collaborations have led to the establishment of world-leading research centres and attracted significant presence from national research organisations such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

Collaboration is also an important factor in promoting a culture of innovation and a critical driver of productivity and economic growth. The applications of science, research and technology are major components of innovation, and ongoing collaborations between the State's world-class research

and industrial bases are key to unlocking future innovations. This is essential if Western Australia is to remain competitive in its international markets and to continue building on its prosperity.

The following five science priorities were identified based on areas where Western Australia already has a comparative advantage and an appropriate base of research and industrial capability.

These areas are:

- mining and energy
- medicine and health
- agriculture and food
- biodiversity and marine science
- radio astronomy.



**Professor Ian Small**, former WA Fellow and WA Scientist of the Year. He played a key role in establishing the world leading Australian Research Council Centre of Excellence in Plant Energy Biology. His discoveries have provided the basis for efficiencies in large food production, with implications for agriculture and the environment.



**Professor Mark Jessell** is a geophysicist and current WA Fellow. His Fellowship focuses on advancing 3D modelling of Western Australia's geology, which will assist industry to discover new minerals and to understand the environmental impacts of mining these deposits.



**Professor Peter Quinn**, former WA Fellow, WA Scientist of the Year and current Director of the International Centre for Radio Astronomy Research, is a world-renowned astrophysicist whose efforts to develop the State's radio astronomy capabilities played a central role in bringing the Square Kilometre Array to Western Australia.



**Professor Shaun Collin**, former WA Fellow, is a neurobiologist and world expert in the behavior of sharks and other aquatic species. His Fellowship investigated sensory systems of vertebrates to study the evolution of light detection and the impacts of light on biodiversity, sustainability and health.



**Professor Carole Jackson** is an astronomer and current WA Fellow. Her Fellowship focuses on generating scientific outputs from the Murchison Widefield Array radio telescope and facilitating development of the low-frequency component of the SKA, including technical oversight of the design and engagement with industry.

## OUR CAPACITY

# MINING AND ENERGY

Western Australia has a significant endowment of minerals and energy resources. The minerals and energy industry has grown to become the largest contributor to the State's economy, with export values surpassing \$100 billion which represents around 30 percent of Gross State Product.



*Credit: Woodside Energy Ltd*

▲ The Karratha Gas Plant has one of the world's most advanced integrated gas production systems. It forms part of the North West Shelf Project facilities.

The minerals and energy industry in Western Australia is now a global centre for scientific and technological innovation, operating at the forefront of research and development and constituting about 75 percent of industry funded research in the State. Many of the major mining, energy and associated service companies have a significant presence here and with the State's natural advantages, Western Australia is well placed to be a global leader in technologies such as remote mining methods, carbon

capture and storage, and offshore technologies in the oil and gas sector.

Western Australia's international reputation for resource science is marked by an active collaboration between universities, technical institutions and industry. These collaborations include the **Australian Resources Research Centre (ARRC)**, a petroleum and minerals centre of expertise and a major initiative of the State Government, CSIRO, Curtin University and The University of Western Australia (UWA).

Importantly, the ARRC was developed in conjunction with the petroleum and mining industries.

Since its inception in 2001, the ARRC has grown its capabilities and provided a strong foundation for the development of the **National Resource Sciences Precinct**, hosting more than 400 research staff supported by advanced resources-oriented research infrastructure. Physically, the Precinct is located across a number of established sites within a six kilometre radius of Perth's city centre.

This has led to a Commonwealth Government grant to establish the **Advanced Resource Characterisation Facility**, which draws together state-of-the-art equipment for geoscience and resource characterisation.

Similarly, the **Western Australia Energy Research Alliance**, established in 2003 by CSIRO, Curtin University and UWA has formed with 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.

The State Government has a long history of supporting capacity building in the minerals and energy sector.



Credit: Andrew Ross, CSIRO

▲ The National Geosequestration Laboratory using medical X-ray technology to image the interior of rock samples. Understanding the permeability and porosity of rock is critical for carbon dioxide storage.

Since the 1880s, the Geological Survey WA has been gathering, synthesising and publishing information on the State's

geological and mineral and petroleum resources.

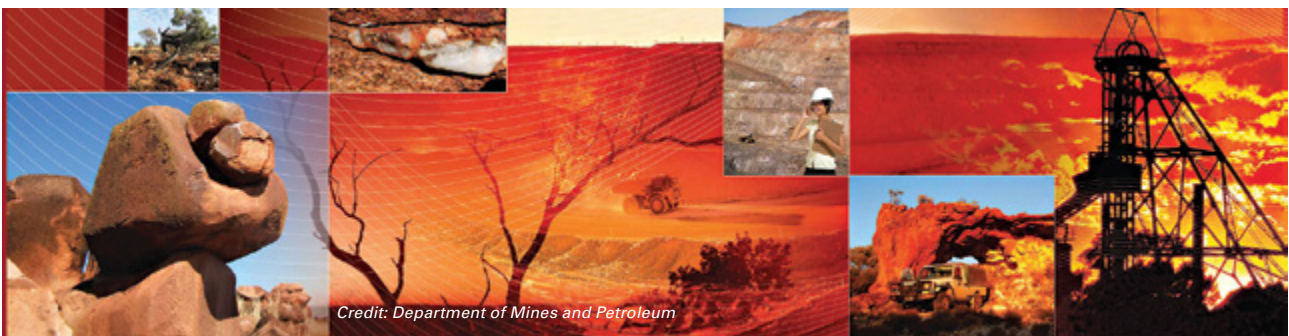
Since 2009, the Exploration Incentive Scheme has been encouraging exploration in Western Australia and adding to the stock of high-quality geoscience information provided by the Department of Mines and Petroleum, including the Geological Survey WA.

This support continues today through the **Minerals Research Institute of Western Australia**, a statutory body established with a focus to stimulate minerals research that supports investment in, and operation of, a globally competitive minerals industry in Western Australia.



Credit: UWA

▲ The O-tube Program is leading research on pipeline stability design and sediment transport. It is one of many collaborative projects at the National Resource Sciences Precinct.



Credit: Department of Mines and Petroleum

▲ The Department of Mines and Petroleum provides geoscientific data to the exploration industry to improve the efficiency of exploration in Western Australia.

## OUR CAPACITY

## MEDICINE AND HEALTH

Western Australia is well placed to build on its successful history in medical and health research, a heritage that has been recognised by Nobel Prizes, Australian of the Year awards, and international prizes and fellowships. This tradition is underpinned by extensive collaboration between the State Government, universities, medical research institutes and private health providers.



*Credit: Department of Health*

▲ Fiona Stanley Hospital is Western Australia's newest flagship tertiary hospital that was opened in 2014. Equipped with leading edge medical technology, it is set to be one of the best public hospitals in Australia.

Recent years have seen a \$7 billion investment in health infrastructure by the State Government to create a world-class public hospital and health system in Western Australia anchored by the major health clusters. The **QEII Medical Centre** has been boosted by new pathology, cancer and research facilities. In addition, the completion of a new \$1.2 billion **Perth Children's Hospital** on the site will cement its position

as the State's biggest medical, research and educational campus. The opening of the \$2 billion **Fiona Stanley Hospital** in 2014 marked the commencement of an integrated health, education and research centre for Perth's south. Together with St John of God Hospital, Murdoch University and new research facilities, the health precinct will maximise opportunities for translational research and improve health outcomes.

The State Government's investment builds on an already impressive base of medical and health research, with a recent boost of \$30 million over four years under the **Future Health WA** initiative adding to the \$58 million committed over the same period to health and medical research programs administered by the Department of Health.



Credit: Department of Health

▲ The new Perth Children's Hospital will be a world leading facility for childhood disorders. Located at the QEII Medical Centre, the hospital will form part of a centre of excellence for health and research.



Credit: Harry Perkins Institute of Medical Research

▲ The Harry Perkins Institute of Medical Research is Western Australia's premier adult medical research institute. The State contributed \$50 million to new facilities, which were recently opened in 2014.



Credit: Telethon Kids Institute

▲ Professor Jonathan Carapetis was appointed Director of the Telethon Kids Institute in 2012. The Institute will celebrate its 25th anniversary in 2015.

The **Harry Perkins Institute of Medical Research**, focusing on adult health, has recently opened two new facilities: Perkins north, a \$120 million facility located on the QEII Medical Centre campus; and Perkins south, a \$70 million facility located at the Fiona Stanley Hospital health campus in Murdoch.

The **Telethon Kids Institute**, focusing on child health, will soon have a new home at the Perth Children's Hospital. A number of other institutes with specific areas of focus, such as the **Lions Eye Institute**, are internationally competitive. Western Australian universities have strong medical and science faculties recognised for their activities in medical, nursing, allied health and health services research.

Western Australia is also recognised for its longitudinal population health studies, with the **Busselton Health Study** and the **Raine Study** continuing to provide unique data sets that bring together some of Australia's leading researchers and international collaborators.



Credit: Harry Perkins Institute of Medical Research

▲ The Harry Perkins Institute of Medical Research has been successful in attracting high skilled international medical researchers.

These programs include the longstanding **Medical and Health Research Infrastructure Fund**, which provides infrastructure to support researchers, and the **Clinician Research Fellowships program** which encourages clinicians to undertake health and medical research while still continuing clinical duties.

There are many areas of research excellence across the Western Australian health system, particularly in the teaching hospitals.

The State has well established and internationally renowned research institutes.

Moving forward, the Department of Health has established the **Western Australia Health Translation Network**, bringing together the major hospitals, medical research institutes and universities to integrate research across multiple institutions and capitalise on the State's substantial new capital investment. The depth of this collaboration will ensure Western Australia's admirable tradition of research discoveries are translated into ground breaking improvements in patient care or changes in health policy internationally.

## OUR CAPACITY

## AGRICULTURE AND FOOD

Agriculture and food industries such as cropping, livestock production, horticulture, fisheries and aquaculture represent the State's second biggest export industry and are integral to Western Australia's economic and social prosperity.

*Credit: Department of Agriculture and Food WA*



▲ The Western Australian grains industry is a major contributor to the agrifood sector. 80 percent of annual grain production is exported to more than 50 countries worldwide, including Indonesia, China, Japan and the Middle East.

Western Australia is one of the most pest and disease free agricultural production areas in the world, providing a significant advantage to the export based agricultural and food sector. **Proximity to the leading markets in Asia** presents an excellent opportunity for Western Australia to capitalise on the demand for safe, high quality food products and services. The State's ability to do so depends very much on the market competitiveness and productivity of the sector.

Western Australia is a **world leader in dryland farming**, and the State's grain growers have led the nation in productivity growth over the last three decades, resulting in a major export industry that harvested a record 17 million tonnes in 2013-14 worth \$5.3 billion.

There are strengths in other food sectors. High quality fisheries and pristine waters have given Western Australia an international reputation as a **producer of premium quality seafood**. The State's lobsters, prawns and pearls are renowned throughout the world.



*Credit: Department of Fisheries*

▲ Pawning is one of the State's most valuable commercial fishing industries. The Department of Fisheries has worked with industry to improve prawn quality and size to maximise economic returns.



Credit: Department of Agriculture and Food WA

▲ Field crop research undertaken by Department of Agriculture and Food helping to improve farm management practices and responses to extreme weather events.



Credit: Department of Agriculture and Food WA

▲ Local grains research and development has helped Western Australian farm businesses to be among the most efficient in the world.

Western Australia's **flock of about 14 million sheep** produces high-quality meat and some of the world's finest wool. International collaborations include areas of advanced biotechnology, genetic management systems and identification such as tracking systems to ensure biosecurity and food safety risk management.



Credit: Department of Agriculture and Food WA

▲ The Department of Agriculture and Food is working with the sheep industry to boost productivity to meet the growing demand for sheep products.

With established capacity in agriculture and food, it is important to ensure that the industry, including its many family farm businesses, is positioned to capitalise on the growing international demand for high quality and safe agricultural products. The State Government's **Seizing the Opportunity initiative** includes research programs to boost grain productivity and identification of new groundwater resources to support the sustainable expansion of regional primary industries.

Scientific expertise and capability resides in State Government departments such as the Departments of Agriculture and Food, Fisheries and Water, supplemented by CSIRO. Western Australian universities have large pools of high-level scientific skills and capabilities, world-class teaching facilities and research laboratories. Centres such as the Centre of Excellence in Plant Energy Biology (UWA), the Centre for Crop and Disease Management (Curtin University), the Western Australian State Agricultural



Credit: UWA Centre for learning Technology

▲ The Centre of Excellence in Plant Energy Biology at UWA is progressing work to understand how agricultural plants can more efficiently use energy for greater yields.

Biotechnology Centre (Murdoch University) and the Centre for Fish and Fisheries Research (Murdoch University) contribute strongly to agriculture and fisheries research.

## OUR CAPACITY

## BIODIVERSITY AND MARINE SCIENCE

Western Australia has one of the world's greatest diversities of plant and animal life. Two of Australia's four marine based World Heritage areas and two of five bioregions are off our coasts. Western Australia is also home to eight of Australia's fifteen biodiversity hotspots.

*Credit: WAMSI*



▲ A diver from the Western Australian Marine Science Institution collects data to improve our understanding of marine ecosystems. This is crucial to enhancing the protection of the marine environment and improve the productivity of Western Australia's marine industries.



▲ The Keiran McNamara Conservation Science Centre, opened in 2013, is equipped with world-class facilities for cutting-edge plant research and houses Western Australia's extensive plant specimen collection.



*Credit: Department of Parks and Wildlife*

The State's biodiversity is an asset that needs to be protected for the enjoyment of future generations. The development of this State through mineral exploration and production, agriculture and urban development can only proceed responsibly through a robust scientific understanding of the environment.

The State Government has a major role in managing the State's biodiversity. A key initiative is the \$81.5 million **Kimberley Science and Conservation Strategy**, the centrepiece of which will be the creation of the State's largest interconnected system of marine and terrestrial parks.

Several initiatives are being progressed to provide greater structure to the protection, conservation and management of Western Australia's important biodiversity.

This includes **new biodiversity conservation legislation** which will provide tougher penalties for harming threatened and non-threatened species, and a modern framework for the management and recovery of biodiversity in Western Australia.

Future generations will also benefit from a greater understanding of the State's biodiversity and the biological processes that underpin it. This knowledge can be harnessed to pursue advances in medicine, agriculture, aquaculture and environmental management to provide the economy with a broader base from which to grow. To facilitate this, the State Government is currently developing legislation which will set out policies and processes for research organisations or individual researchers to access biological materials in Western Australia, and

their obligations should a biological resource be discovered and commercialised. This will provide legal certainty to this new and emerging sector.

Western Australia has a significant biodiversity research base. In marine science, the **Western Australian Marine Science Institution (WAMSI)** is currently delivering two of the largest integrated marine research programs in Australia: the Kimberley Marine Research program and the Dredging Science Node. The Kimberley Marine Research Program is the research component of the Kimberley Science and Conservation Strategy. WAMSI is a collaboration of 15 partner organisations that include State, Commonwealth, industry and academic organisations working together to deliver large-scale marine research in a multi-disciplinary and holistic way.



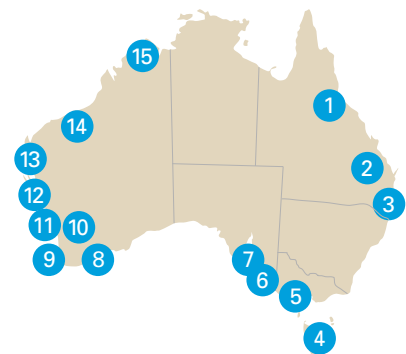
Western Australia’s terrestrial biodiversity knowledge and research activity is significant and a **new institute, to be established in 2015** with support from the State Government, will align and coordinate the existing knowledge system to support more informed and timely decision-making. This will ensure that funding and research effort are prioritised towards the areas of greatest conservation need and that responsible decisions are being made around the economic development of the State.

The State Government’s conservation and environment agencies have considerable expert science capabilities, reflecting the vital role that science plays in effectively managing the marine and terrestrial ecosystems, as well as responsible and sustainable development.

This capability is supplemented through the State’s universities with their dedicated science groups, bolstered by the presence of Commonwealth Government research groups with substantial capability such as CSIRO and the Australian Institute of Marine Science.

The State Government also has a significant repository of marine and terrestrial records in a variety of agencies, including the collections of the Western Australian Museum, the Department of Parks and Wildlife, the Botanic Gardens and Parks Authority and the Department of Fisheries.

**Biodiversity Hotspots**



▲ With more than half of Australia’s biodiversity hotspots, Western Australia supports a diverse and unique range of natural life, much of it found nowhere else on earth.



*Credit: Allan H. Burbidge, Department of Parks and Wildlife*

▲ The Birriliburu Indigenous Protected Area extends over 6.6 million hectares of desert along Western Australia’s Canning Stock Route. Encompassing sand dune, salt pan and sandstone mountain ecosystems, the area is culturally significant and is being surveyed for biodiversity by the Department of Parks and Wildlife, the Birriliburu Native Title Claimants and Central Desert Native Title Services.



*Credit: Botanic Gardens and Parks Authority*

▲ Seeds of plant species native to the Pilbara, which will be used to rehabilitate land post-mining activities as part of the Restoration Seedbank Initiative between the Botanic Gardens and Parks Authority, BHP Billiton and UWA.

## OUR CAPACITY

# RADIO ASTRONOMY

Western Australia's unique physical characteristics and sparsely populated regional areas make it a premier location for radio astronomy. The Murchison region has been selected as a co-host site with South Africa, for the international Square Kilometre Array (SKA) project, scheduled to commence construction in 2018.



*Credit: SKA Organisation*

▲ Around 130,000 of these antennas will make up the SKA1-Low telescope in Western Australia (artist's impression). SKA1-Low will probe the very early universe, allowing the first observations of the very first stars and galaxies.

The SKA project is a global science and engineering project to build the world's largest radio telescope. As **one of the largest scientific endeavours in history**, it will bring together some of the world's finest scientists and engineers, working together with industry to develop new technologies on an unprecedented scale. Phase one will cost €650 million with 11 countries, including Australia, as members of the SKA Organisation.

The Murchison Radio-astronomy Observatory is already home to two world leading SKA precursor radio telescopes, the \$51 million international Murchison Widefield Array and CSIRO's \$180 million Australian SKA Pathfinder telescope. Staff are located at the Murchison Support Facility in Geraldton, with CSIRO planning to relocate more staff from the east coast to Western Australia ahead of SKA operations.

The State Government has invested more than \$96 million into building radio astronomy research capacity, capability and infrastructure, including the establishment of the **International Centre for Radio Astronomy Research (ICRAR)**, a joint venture between UWA and Curtin University.

In less than a decade, ICRAR has built a world-class centre of excellence in astronomical science, engineering and information technologies.



▲ Western Australia's Pawsey Supercomputing Centre is at the forefront of data processing and analytics and is underpinning the Murchison Widefield Array and the Australian SKA Pathfinder projects. More than four petabytes of data has been produced by the Murchison Widefield Array since 2013.



▲ The Murchison Widefield Array is an international low frequency radio telescope. It commenced operations in 2013, paving the way for the SKA in the State's Mid West.

The \$80 million Pawsey Centre in Kensington, the **Southern Hemisphere's most powerful supercomputer**, is used by a wide range of disciplines beyond radio astronomy, including medical research and the minerals and resources sector.

New techniques developed to process the SKA's unprecedented data requirements are expected to deliver major benefits across a range of industries, including financial, mining, energy, environmental monitoring, health, remote sensing and communication industries. Having the Murchison region as a co-host site will position Western Australia advantageously in relation to the global big data industry, estimated to be worth close to \$50 billion by 2018.

Having attracted world renowned scientists and students from all over the world, ICRAR is now one of the largest radio astronomy research groups in Australia with more than 120 researchers leading the State's science efforts for the SKA. ICRAR is also working collaboratively with industry, including small and medium enterprises, and a number of Western Australian based companies are participating in the international SKA design effort.

# OPPORTUNITIES

Cutting across each of the five science priorities are areas of opportunity that can help Western Australia achieve greater outcomes: Fostering a culture of science in Western Australia through **Education and Engagement** initiatives; developing Western Australia’s emerging capability in **Data** intensive science; building on the State’s **Water** science expertise; and strengthening partnerships for **Effective Collaboration**.



Credit: UWA

▲ Young visitors explore plant cells during a UWA Plant Energy Biology Meet the Scientist session at Scitech.



Credit: Scitech

▲ Scitech is increasing awareness, interest, capability and participation in science, technology, engineering and mathematics, impacting almost 500,000 people per year.

## EDUCATION AND ENGAGEMENT

People are the most important resource in Western Australia when it comes to building a healthy and safe society, as well as a productive and competitive economy. The State’s future depends on having people with a good mix of skills, training and knowledge in multiple disciplines.

**Science, technology, engineering and mathematics (STEM)** are important elements of this mix.

For Western Australia to realise its vision of becoming a regional centre of scientific and technical excellence, the State needs to address the declining proportion of students and workforce participants in STEM related fields. This is a responsibility of all Western Australians. Industry, academia and Government all have a role to play in this.

Community attitudes are a significant factor in shaping the values of the next generation; we must encourage recognition of the importance of science to our social and economic well-being. Support for our scientific institutions in communicating science to engage the community and inspire young people to pursue studies and careers in STEM related fields is critical. We must also ensure that career paths are well articulated and encourage opportunities for students to engage in work experience.

**Scitech** is a good example of how industry, academia and Government can come together to support outreach and engagement programs. As Western Australia’s dedicated science education and engagement centre, Scitech reaches almost 500,000 people annually and works with almost 90 percent of Western Australia’s schools, teachers and students.



Credit: Department of Parks and Wildlife

▲ The Department of Parks and Wildlife’s Bush Rangers WA program supports young Western Australians to take an active role in the conservation of the environment.



*Credit: Harry Perkins Institute of Medical Research*

▲ The Lotterywest BioDiscovery Centre at the Harry Perkins Institute of Medical Research enables school students and community members to take part in hands-on experiments.



*Credit: Perth Zoo*

▲ Perth Zoo Discovery and Learning staff deliver a unique range of professional learning experiences for teachers.



*Credit: Botanic Gardens and Parks Authority*

▲ Kings Park Education provides hands-on programs to inspire understanding of Western Australia's unique plants.



*Credit: ICRAR*

▲ Thousands of Western Australians enjoy the night sky and interactive activities at Astrofest, an annual community celebration of astronomy and science.

It has been successful in engaging the community at all levels, from building the scientific enquiry skills of school students, young children and their parents, to empowering educators to improve the quality of teaching and learning. The State Government has committed \$15 million towards a new home for Scitech that will provide greater opportunities to engage and educate children in science. This is in addition to over \$40 million in operational funding committed over the 2013-18 period.

The State Government will also breathe new life into one of the State's oldest scientific institutions, committing over \$400 million towards a **new Western Australian Museum** (WA Museum). The WA Museum has been at the forefront of enhancing the appreciation of the State's unique natural environments and cultural heritage for over 120 years. The new WA Museum will showcase the incredible stories about Western Australia, display its unique collections, and will be ground breaking in its interpretative and engagement techniques. This will be particularly powerful in the areas of biodiversity, geodiversity, planetary sciences and conservation science.



*Credit: ChemCentre*

▲ The ChemCentre's annual open day showcases the role that science plays in safeguarding the community, industry and environment.



*Credit: Department of Fisheries*

▲ The Department of Fisheries provides interactive school education programs drawing on science and data from its Research Division.

A significant opportunity exists to increase awareness of the range of science education and engagement activities undertaken across the State, from organisations such as the Botanic Gardens and Parks Authority, ChemCentre, Department of Fisheries, Earth Science Western Australia, Gravity Discovery Centre, Harry Perkins Institute of Medical Research, the International Centre for Radio Astronomy Research, Department of Parks and Wildlife, Perth Observatory, Perth Zoo, Telethon Kids Institute, the State's universities and a number of private sector organisations, as well as individual scientists and researchers outside of formal programs. Industry, including small and medium enterprises, invests significantly in STEM education and engagement initiatives in Western Australia.

OPPORTUNITIES



Credit: Pawsey Supercomputing Centre

▲ Magnus is the most powerful supercomputer in the Southern Hemisphere. It is part of the Pawsey Supercomputing Centre's new facility in Kensington.

DATA

In today's information age, data is an important resource. Creating meaning from data and applying that meaning to social, industrial and environmental processes is critical to a modern society that is safe, healthy and competitive. Data is fundamental to each of the State Government's five priority areas.

Data production is increasing exponentially. The ability to analyse information will undoubtedly provide a competitive advantage. Crucially, this will depend on having skilled people and appropriate infrastructure. Governments and industries across the world are already investing in big data analytics, the process of extracting valuable information from very large amounts of data.

The challenge of **big data**, to uncover hidden connections among huge masses of information, has been made possible through technological advances, including the development of supercomputers capable of operating at the petascale level.

The SKA project is poised to change the way we think about data, how it is collected, stored, processed and analysed. The amount of data that is expected to be collected every day in the fully operational SKA project is anticipated to be ten times the current global internet traffic. New technologies, skills and workforce capabilities will be needed to comprehend these massive datasets, and the flow-on benefits

to other sectors of the economy will be significant.

**The Pawsey Supercomputing Centre** is assisting many organisations to achieve unprecedented results in scientific domains such as radio astronomy, geosciences, engineering, agriculture, bioinformatics and health sciences. The Centre is also helping to improve the skills of the next generation of data scientists and by the time the SKA commences operation, Western Australia will have over a decade of petascale experience, placing the State in a great position to become a hub for data science.

The State Government must also change the way Government data is accessed and used. With appropriate safeguards and controls, opening up access to Government data will enable the broader community, including Government itself, to apply data in a way that should lead to more informed decisions and improved service delivery. Linking various administrative data collections has the potential to provide new insights into factors that can influence the health and well-being of the community.



Credit: Pawsey Supercomputing Centre

▲ The Pawsey Supercomputing Centre manages world-class supercomputing and data storage hardware across its Perth facilities.



Credit: Busselton Population Medical Research Institute

▲ The Busselton Health Study commenced in 1966 and is globally recognised as one of the longest running population health research programs of its kind.



Credit: ICRAR

▲ Researchers in ICRAR's Data Intensive Astronomy Team are working on innovative data solutions for the SKA project.

Western Australia already has a competitive advantage with the breadth and depth of datasets such as the **Busselton Health Study** and the **Raine Study**. The Telethon Kids Institute's **Developmental Pathways in Western Australia Children Project** pioneered linkages of de-identified population level data across multiple Government sectors in Western Australia, creating a unique data resource for use by researchers and policy makers.

In today's information age, the ability to protect and secure sensitive data will provide another competitive advantage. Edith Cowan University's **Security Research Institute** is one of the leading digital security and forensics groups in the world, with capabilities in the area of computer and digital forensics, network and wireless security, information warfare, physical security, risk management and aviation security. The Institute has many ongoing collaborations with

various academic and commercial organisations in Australia and internationally.

Against the backdrop of opportunities presented by data are public concerns around safeguarding privacy, safety and security. These are important considerations around which strict protocols for data usage must be developed. However they should not act as barriers to unlocking the inherent benefits of data for the Western Australian community.



In today's complex world, societies need the best data to understand and guide decisions about the major problems it faces. Western Australia's record linkage capability rivals any internationally. We have the ability here to use up-to-date, relevant, population wide data to monitor, evaluate, research and understand almost ALL of the complex health and wellbeing issues that affect our citizens.

PROFESSOR FIONA STANLEY



Credit: CISCO

▲ Data scientists analyse patterns across large and diverse data sets. With the support of the State Government, Commonwealth Government, CSIRO and its university partners, the Pawsey Supercomputing Centre is helping to train the next generation of data scientists.

OPPORTUNITIES



Credit: The Peel-Harvey Catchment Council

▲ The Peel Harvey Estuary forms part of the a comprehensive strategic assessment of the Perth and Peel Regions being undertaken by the State Government and the Commonwealth Government.

WATER

Water is a key enabler for almost every economic activity in the State. Western Australia’s growing prosperity is dependent on secure and sustainable water supplies. This means knowing how water is supplied, where it is located and the quality of that water.

The Department of Water’s significant expertise in water resource science and management is already being harnessed to deliver the State Government’s **Water for Growth** strategy. This strategy will develop a comprehensive picture of water resources as an enabler for growth and development over the next 30 years.



Credit: Department of Water

▲ Fitzroy Valley groundwater investigations monitor the availability of water in the region. Part of the Water for Food program, the information will assist pastoral station owners to diversify their operations.

The strategy is based on a foundation of critical scientific information about the quality of water and where it is located. Cutting-edge science is being used to build an unprecedented knowledge bank of Western Australia’s valuable water resources, and is now being made publicly available. This information is crucial to support Government and industry decision-making around new projects and development.



Science is also helping to develop climate-independent drinking water supplies. **Western Australia was the first State in the country to develop seawater desalination as a major public water source.**

This was a key part of a broad response to a significant decline in rainfall over many years in the South West region that depleted the traditional sources: dams and shallow groundwater.

The Water Corporation's Perth Seawater Desalination plant and Southern Seawater Desalination plant, which together supply almost half of Perth's drinking water needs from the Indian Ocean, were the biggest of their kind in the world to source power from renewable energy, in their case wind and solar.

Effective management of water demand will be challenged by an increasing population, demand from the resources and energy sectors and growth in the agricultural and food sector. Against the background of a changing climate, the drying trend and rising salinity in the South West are likely to continue. Tackling these challenges is an opportunity for Western Australia to continue building its expertise in water resource science and management.

The Perth Seawater Desalination plant and the Southern Seawater Desalination plant supply almost half of Perth's drinking water needs.



*Credit: National Centre of Excellence in Desalination Australia*

▲ The State's expertise in desalination is supplemented by the National Centre of Excellence in Desalination located at Murdoch University's Rockingham campus.

## OPPORTUNITIES



Credit: UWA

▲ An artist's impression of the new Indian Ocean Marine Research Centre at UWA. The Centre will bring together four of Australia's leading research organisations working in and around the Indian Ocean: the Australian Institute of Marine Science, CSIRO, the State Government Department of Fisheries and UWA's Oceans Institute.



The real competition is global, not local. Therefore, the State must harness its talent and resources to promote a "Team WA" approach through collaboration.

**PETER KLINKEN**  
CHIEF SCIENTIST

### EFFECTIVE COLLABORATION

The benefits of collaboration are well established, from enabling access to complementary skills, knowledge and infrastructure, through to the creation of a critical mass of skills that enhance research opportunities. Collaboration is increasingly important given the scale and complexity of today's scientific challenges, many of which require interdisciplinary skills and access to expensive infrastructure.

Effective collaboration requires genuine partnerships between Government, industry and researchers.

There are numerous examples of this at a State, national and international level.

#### AT A STATE LEVEL:

- The Western Australian Marine Science Institution brings together 15 organisations across Government, industry and academia to deliver strategic programs of marine science for the entire State.
- The Western Australian Energy Research Alliance is addressing industry challenges through a long-standing collaboration between major energy companies and research partners.
- The Western Australian Health Translation Network is bringing together major hospitals, medical research institutes and universities to integrate research effort and capitalise on the State's substantial investment in new health infrastructure.

#### AT THE NATIONAL LEVEL:

- The Australian Export Grains Innovation Centre is an initiative of the State Government's Department of Agriculture and Food, and Australia's Grains Research and Development Corporation, aimed at increasing the competitiveness of Australia's export grain.
- Western Australia has significant involvement in The Cooperative Research Centre for Spatial Information (CRCSI) through Landgate and Curtin University. The CRCSI focuses on the creation of value through research and development in spatial information. It has over 110 partners that have collectively invested \$160 million in the centre.
- The Commonwealth and State Governments are working jointly on the SKA project, and are being supported by CSIRO and ICRAR.

#### AT THE INTERNATIONAL LEVEL:

- Murdoch University and the Chinese Academy of Agricultural Sciences are lead partners in the Australia-China Centre for Wheat Improvement.
- The Australia China Joint Research Centre for Energy has lead partners Curtin University and Taiyuan University of Technology collaborating to develop advanced energy technologies for improved energy security.
- Up to 50 Chinese PhD students will visit Western Australia over the next five years as part of an agreement between UWA and the Chinese Academy of Sciences, where they will work alongside top astrophysicists at the UWA node of ICRAR.
- Edith Cowan University's e-Agriculture Research Group collaborates with multiple partners in India and Thailand.



▲ The iPREP WA program provides industry experience for PhD students. iPREP WA is a joint initiative of all five Western Australian universities and the Department of the Premier and Cabinet.



▲ The Hon Colin Barnett MLA, Premier of Western Australia with the then Governor of Zhejiang Province, China, Mr Xia Baolong, at celebrations for the 25th year of the Sister State relationship (in 2012).

OPPORTUNITIES



▲ The ChemCentre provides high quality scientific services to protect, support and develop the community. Its expertise is used in mining and energy, agriculture and food, health and medicine and biodiversity and marine science. ChemCentre works extensively with industry, Government and universities across these sectors.

Sharing a time zone with 60 percent of the world's population in the emerging economies of Asia is a major advantage, and the State Government will pursue this opportunity by continuing to strengthen existing relationships with longstanding trading partners in the Asia Pacific, while building new ones with Indian Ocean rim nations.

At the Commonwealth level, an opportunity exists for Western Australia to take advantage of the growing awareness of the importance of science and research to Australia's future prosperity. The newly established Commonwealth Science Council strongly supports the value of establishing national science priorities. **The priorities listed in this Science Statement align well with the national priorities developed by Australia's Chief Scientist, Professor Ian Chubb.**

This presents a wonderful opportunity for greater collaboration with the Commonwealth Government, aligning research effort and increasing scale to meet State and Commonwealth needs.

Collaboration at the State and national level is crucial if Western Australia is to remain competitive and to attract the research and development investment necessary to develop a knowledge-based economy that will deliver highly-skilled jobs. It is also crucial if we are to continue to attract international research partnerships. **Western Australia aspires to be a scientific leader in the region by increasing collaboration with countries in the Asia Pacific region.**

Sharing a time zone with 60 percent of the world's population in the emerging economies of Asia is a major advantage, and the State Government will pursue this opportunity by continuing to strengthen existing relationships with longstanding trading partners in the Asia Pacific region, while building new ones with Indian Ocean rim nations.



▲ ICRAR is a joint venture bringing together more than 120 researchers from the University of Western Australia and Curtin University.

# THE WAY FORWARD AND THE ROLE OF GOVERNMENT

Western Australia can be justifiably proud of its rich history of scientific endeavour and its contribution to the State's economy and society. The State has clear advantages around which economic and social prosperity has been built. This success is in no small part due to the application of scientific research and development in specific areas.



▲ The Premier of Western Australia announced Professor Peter Klinken as the new Chief Scientist of Western Australia on 10 June 2014.

The important contribution that science makes to Western Australia requires that the State Government play an active role in managing and strengthening the environment for science research and development across the State. This extends beyond simply funding research activity, and encompasses a leadership role that:

- focuses Western Australia's science capability to priority areas
- coordinates science activities to achieve a critical mass that supports economies of scale
- sets policy and legislative frameworks to support scientific research and development activity

- promotes the visibility of the State's science capability at a national and international level
- paves the way for new industries and sectors to emerge.

The five science priorities in this Science Statement were identified based on areas where Western Australia already has a comparative advantage and an appropriate base of research and industrial capability. **A clear Statement of the State Government's priorities is needed to align research effort across industry, universities, research institutes and Government and to concentrate resources in those areas where a competitive advantage will be further developed.**

**The next step will be to develop science strategies** that reflect the long-term vision for the State in each of the priority areas, and to identify the challenges that Western Australia faces to achieve its goal of broadening its economic base.

The work required to be undertaken is significant and will require coordination that links the State's significant scientific and industrial capacity. The Office of Science will facilitate these links through partnerships with industry, universities, research institutes and State Government agencies.

**The Chief Scientist will provide leadership by guiding the development of the science strategies.**

Accompanying this Science Statement are "Snapshots" of significant activities that are currently underway across Western Australia. Industry, universities, research institutes and Government are all playing key roles in contributing to the State's success in each of the priority areas. The Snapshots highlight some of the current programs of excellent work underway in Western Australia. They also provide some of the 'building blocks' for longer term strategies that will ensure the prosperity of Western Australia for future generations.

## THE WAY FORWARD AND THE ROLE OF GOVERNMENT

### OFFICE OF SCIENCE

The Office of Science was established in 2013 as a stand-alone office within the Department of the Premier and Cabinet, reflecting the importance of science and a science culture to the future development of the State.

#### Role:

Provide a long-term strategic context for the delivery of research and development programs across Western Australia.

Support the coordination of research and development across Government Departments to enable efficiencies of scale and scope to be identified.

Facilitate linkages across Government agencies and between industry, research and academic organisations at a local, national and international levels.

Encourage and facilitate co-investment from the private sector, State and Commonwealth Government and other national funding bodies.

#### Key priorities over the next two years:

- Facilitate links across the State's significant scientific and industrial capacity to support the development of strategies for the State Government's science priority areas.
- Strengthen existing links with the Commonwealth Government and support the building of stronger links with international science organisations, including across the Asia Pacific region.
- Support State Government agencies to understand their science needs and facilitate cross-Government linkages.
- Work with the Commonwealth Government and relevant State Government agencies to establish the Australian SKA site in accordance with agreed international timeframes.
- Maximise the economic and social benefits of the SKA project to Western Australia, including ensuring that Western Australia is best placed to exploit the opportunities in the data intensive sector.
- Work with Government and other organisations to develop a new data linkage model that builds on the pioneering population level data linkage system in Western Australia's health sector.
- Lead and facilitate collaboration across science education and engagement providers to maximise the impact of their activities in Western Australia.
- Support the identification of a new location for Scitech and strategic planning for the future of the organisation.

### CHIEF SCIENTIST

Professor Peter Klinken is the current Chief Scientist of Western Australia.

The Chief Scientist reports directly to the Minister for Science and provides independent, external advice to the State Government on:

- Science and innovation in Western Australia.
- Broadening the economy through science.
- Developing science industries in the State.
- Promoting Western Australia as a science leader in the Asia-Pacific region.

The Chief Scientist works closely with the Office of Science and plays a key role in:

- Enhancing collaborations locally, nationally and internationally.
- Attracting Commonwealth and industry investment into Western Australian science.
- Building leading-edge scientific capacity in the State
- Promoting science policies and initiatives at meetings across academia, industry, Government and the community.
- Acting as an ambassador for science, helping the State Government raise public awareness of the importance of science.

#### Key priorities for the Chief Scientist over the next two years:

- Work with the Office of Science to guide the development of science strategies underpinning the State Government's science priorities.
- Co-Chair the Marine Science Roundtables in support of the Blueprint for Marine Science 2050.
- Provide advice to the State Government on the Peel-Harvey estuary.
- Work with stakeholders to develop a long-term strategy for agricultural research in the State.





GOVERNMENT OF  
WESTERN AUSTRALIA