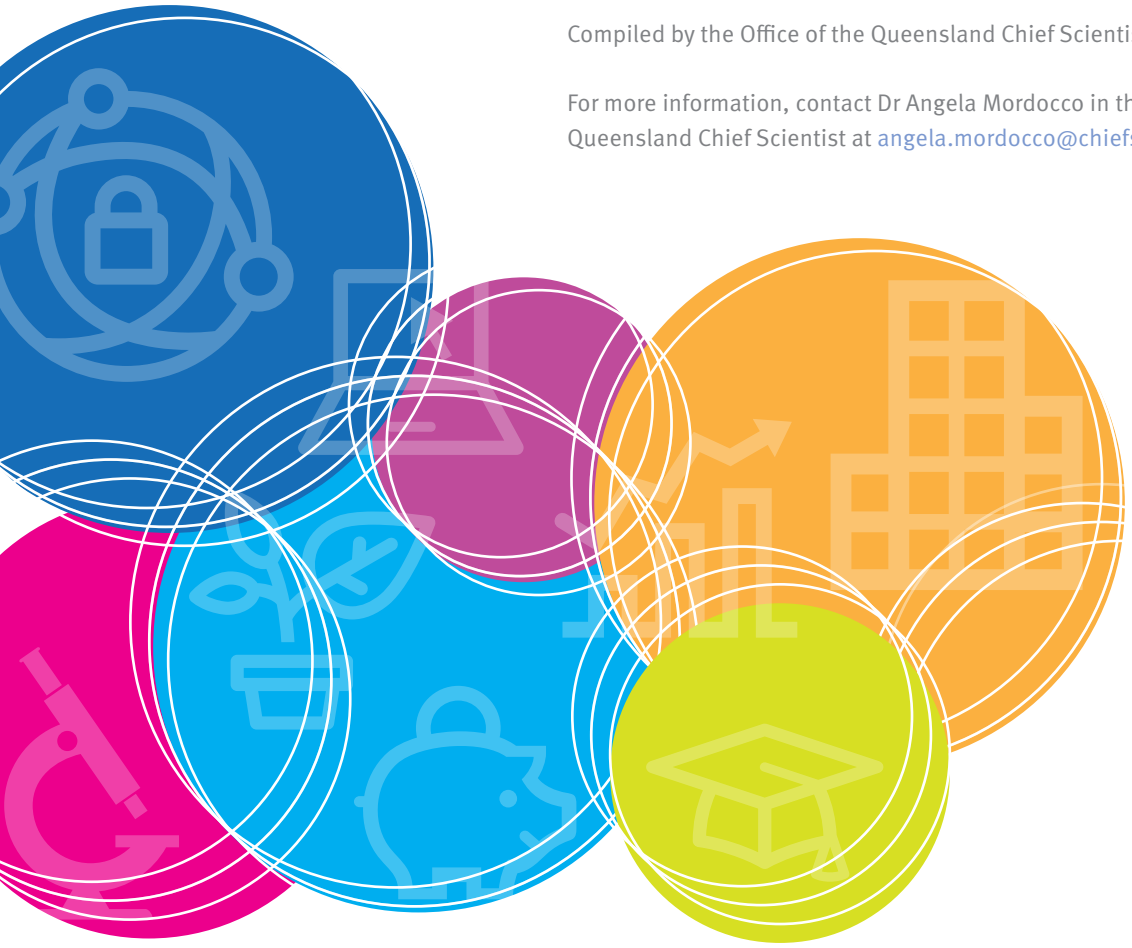
Office of the **Queensland Chief Scientist**

Queensland Government research and development **expenditure report 2014–15**

Compiled by the Office of the Queensland Chief Scientist

For more information, contact Dr Angela Mordocco in the Office of the Queensland Chief Scientist at angela.mordocco@chiefscientist.qld.gov.au.



Queensland Government

Image attributions

Page 27:
Image courtesy of Department of Education and Training

Page 28:
Image courtesy of QIMR Berghofer Medical Research Institute

Page 29:
Image courtesy of the Mater Research Institute—University of Queensland (MRI–UQ)

Page 30:
Image courtesy of the Australian Research Centre for Aerospace Automation

Table of contents

Highlights

- In 2014–15, the Q**ueensland Government spent $354 million on research and development** (R&D) (including leveraged funds). This is similar to the previous year's spend of $363 million.
- **$180 million (51%)** of this money came directly f**rom the Queensland Government**. The remaining **$174 million was leveraged funds**.
- For **every dollar invested by the Queensland Government an additional $0.96 was secured from other sources**, including the Australian Government, universities and businesses.
- Total spend on **infrastructure was similar to the previous year**, up $3 million to **$11 million in 2014–15**.
- **The Department of Agriculture and Fisheries (DAF) was the largest funder of R&D, spending $91 million**, $61 million of this was its own funds and the remaining $29.8 million was leveraged from external sources.
- There was significant investment in one **Queensland Science and Research Priority area**, with **28% of total spend** ($101 million) aligned to 'Delivering productivity growth and jobs for Queensland by developing **enhanced production technologies, tools and practices** particularly in the **agricultural, mining, advanced manufacturing** and supporting sectors including **engineering services**'. This was due to the significant investment seen in the agriculture and engineering sectors.
- Research intended for use in the area of **health is still the primary focus** of activities funded and/or performed by the Queensland Government. A total of **45% ($160 million)** is spent on R&D intended for use in the health area.

The report

About this document

The Queensland Government's investments in science and research, particularly over the last 15 years, have laid a strong foundation from which we can address future challenges. We have established a global reputation for science excellence and research capability, and achieved some outstanding results including the QIMR Berghofer Medical Research Institute's manufacturing facility and Q-Gen being awarded regulatory approval to produce clinical grade cellular therapies for cancer treatment.

Each Queensland Government department invests in R&D to support and address their respective priorities and develop key capabilities, talent and critical infrastructure. Agriculture, health, the environment, water quality and resources development are just some of the research areas the government has invested in over the years. As a result key capabilities, talent and infrastructure have been established. The government also invests in public good research, research that improves the way we live our lives in education, road safety, and disaster response. The importance of maintaining the momentum we have developed is critical.

Since 2004 the Office of the Queensland Chief Scientist (OQCS) has been working with Queensland Government departments to collect detailed information on the money spent by government on R&D. These reports assess our investment in R&D and explore the partnerships and the research priorities that exist across government. Research Highlights (Appendix A) lists the various types of research performed and funded by the many departments and organisations that have contributed to this report.

This report is based on information supplied by Queensland Government agencies on their research and development expenditure for 2014–15. We would like to thank the staff, both within government and external, for their assistance and continued collaboration in collecting research and development data.

Scope of the report

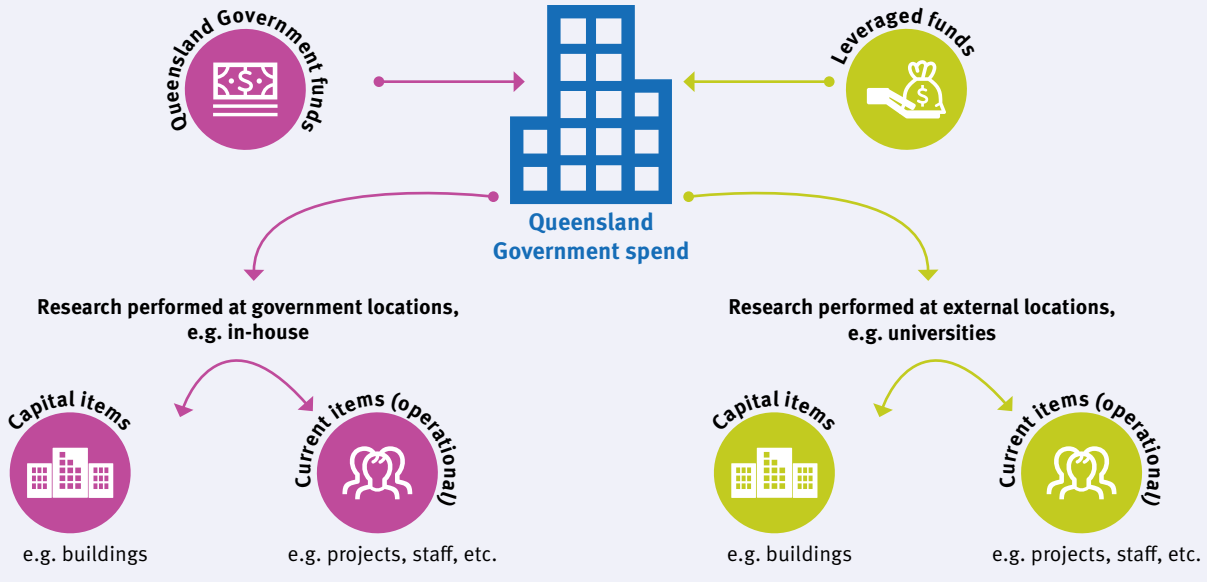
The Queensland Government performs and funds a variety of research across many departments (Appendix A). This report provides information on the Queensland Government's R&D expenditure during 2014–15 and the additional money leveraged from external sources. Detailed definitions are available in the glossary at the back of this document.

Data has been collected from all departments, government bodies and statutory authorities, and HHSs (hospital and health services) that perform R&D. All R&D funding has been attributed back to departments that existed at the beginning of this financial period (i.e. July 2014) and those that funded the research, rather than performed it.

The report includes a breakdown and analysis of the Queensland Government spend on R&D (Figure 1) including the:

- level of R&D expenditure reported by Queensland Government agencies, government bodies, and hospital and health services
- alignment of R&D by funding source (the organisation that provided the funding). This is separated into two types: 'Queensland Government funding' is the collective term for money spent by departments and 'leveraged funds' is the collective term for money invested by external organisations such as businesses, universities and the Australian Government.
- alignment of R&D by location (the sector which performed the R&D, including universities, business, private non-profit, e.g. Mater Medical Research Institute Limited, and departments)
- alignment of R&D expenditure with the Queensland Government's science and research priorities
- alignment to the Australian Bureau of Statistics (ABS) classification system (Appendix B).

Figure 1: Breakdown of R&D expenditure included in the report[1]



1. Queensland Government R&D expenditure reported here differs from that reported by the Australian Bureau of Statistics (ABS), which refers solely to Queensland Government in-house R&D (funded by the Queensland Government and external sources).

Data collection and analysis

In September 2015 OQCS began collection of the 2014–15 R&D expenditure data from Queensland Government departments. In addition, all HHSs were asked to provide expenditure data. Queensland Government bodies, authorities and commissions that perform R&D were also included.

Data was not collected from government-owned corporations[2], which for R&D reporting purposes are considered a business and are therefore captured as business expenditure on R&D.

Collection and finalisation of data is an extensive process that requires R&D liaisons to collect and finalise a whole-of-department dataset from across their department. Once sent to OQCS for inclusion a process to confirm and finalise the dataset begins.

Data from this collection and previous expenditure collections (2012–13 and 2013–14) is available on the Queensland Government data website.

2. For example, CS Energy Ltd, Energex Ltd, Gladstone Ports Corporation Limited and Queensland Rail Limited.

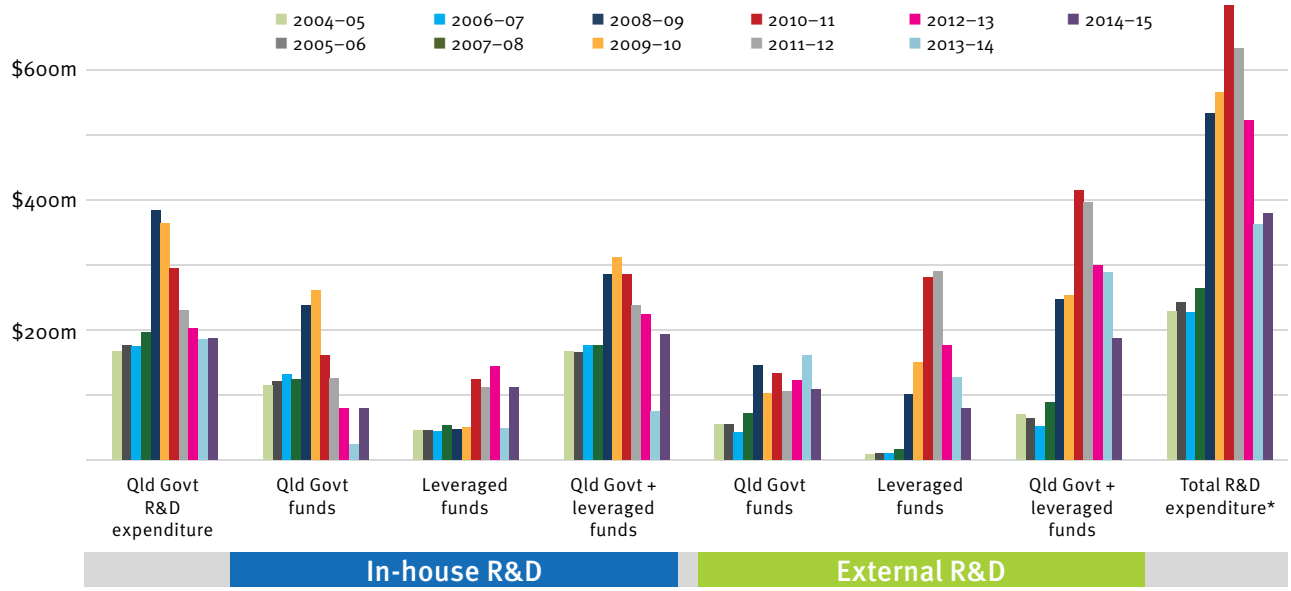
1. Historical spending on R&D

Since 2004 the OQCS has been working with Queensland Government departments to collect detailed information on the money spent by government on research and development (R&D). These reports provide financial information on Queensland Government R&D investments and align these investments with the Queensland Science and Research Priorities, as well as exploring the partnerships and collaborations that exist across government and external to government.

Total Queensland Government spending on R&D has been consistent for the last two years with a total spend of $354 million in 2014–15, compared to $363 million in 2013–14 (down 3%). This spend is sourced from Queensland Government funds (57%) and externally sourced funds (43%). In 2013–14 there was a strong focus on research spending supporting external locations leaving only 13% of Queensland Government money for in-house research. In 2014–15 the largest portion of the Queensland Government spend ($103 million, 57%) was for in-house R&D (Figure 2).

The Queensland Government R&D expenditure of $180 million (money spent by the Queensland Government on in-house and external research) is similar to the past two years' investment and the expenditure of 2007–08 ($196 million), and as such is returning to similar values experienced before the Smart State investment period. Our total spend of $354 million (Queensland Government plus leveraged sources) is above the values seen in the 2007–08 period and prior, suggesting ability to leverage additional funds has improved.

Figure 2: Total Queensland Government R&D expenditure from 2004–05 to 2014–15*



* Total R&D expenditure = Queensland Government + leveraged funds, in-house + external ($m)

Table 1: Total Queensland Government R&D expenditure from 2004–05 to 2014–15 across in-house and external locations (note: numbers have been rounded, resulting in individual amounts not always adding up to totals)

Qld Govt R&D expenditure ($m)	In-house R&D ($m)			External R&D ($m)			Total R&D expenditure ($m)
	Qld Govt funds	Leveraged funds	Qld Govt + leveraged funds	Qld Govt funds	Leveraged funds	Qld Govt + leveraged funds	
2014–15* 180	103 (57%)	98 ($0.95)	201	77 (43%)	76 ($0.98)	153	354
2013–14* 185	24 (13%)	49 ($2.04)	74	161 (87%)	128 ($0.80)	289	363
2012–13* 203	80 (39%)	144 ($1.80)	224	123 (61%)	176 ($1.43)	299	523
2011–12 231	126 (54%)	112 ($0.89)	237	105 (46%)	291 ($2.76)	396	634
2010–11 295	161 (54%)	125 ($0.78)	286	134 (46%)	281 ($2.09)	415	701
2009–10 365	262 (72%)	50 ($0.19)	312	103 (28%)	151 ($1.48)	254	566
2008–09 385	239 (62%)	47 ($0.19)	286	146 (38%)	101 ($0.69)	247	533
2007–08 196	123 (63%)	53 ($0.43)	176	72 (37%)	17 ($0.23)	89	265
2006–07 174	132 (76%)	44 ($0.33)	176	42 (24%)	10 ($0.25)	52	228
2005–06 176	121 (69%)	45 ($0.37)	166	55 (31%)	10 ($0.18)	65	243
2004–05 168	115 (68%)	52 ($0.45)	167	53 (32%)	9 ($0.18)	70	229

* From 2012–13 to 2014–15 data includes government bodies and statutory authorities that perform R&D

(#%) Percentage of Queensland Government expenditure

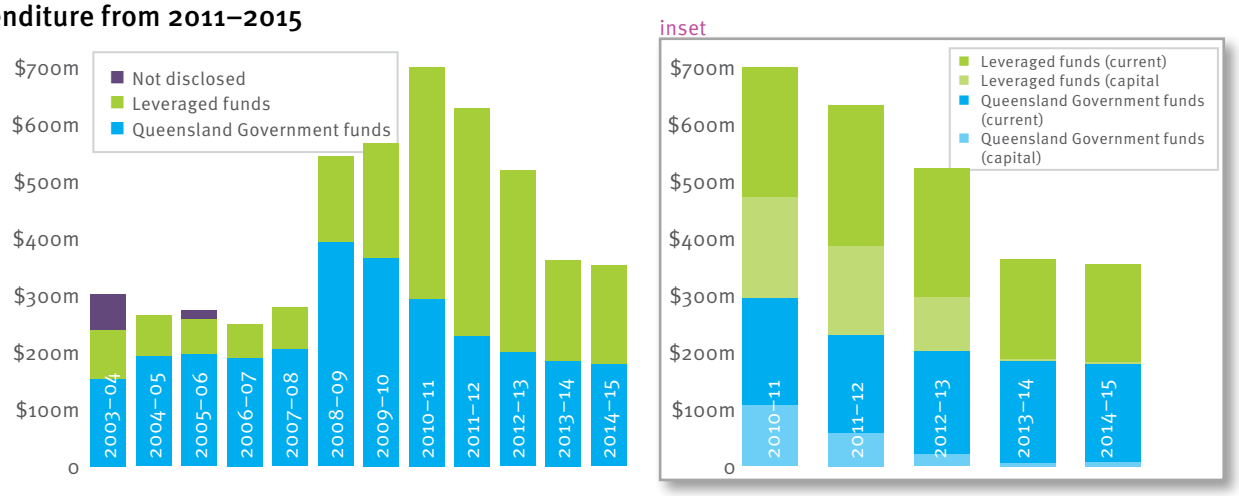
($#) Leveraging rate

2. Queensland Government funding and leveraged funds

Funding for research and development is sourced from two major sources, the Queensland Government and leveraged sources. Queensland Government funding is a collective term for money spent by departments. Leveraged funds is the collective term for money invested by external organisations such as businesses, universities and the Australian Government.

In 2014–15, the Queensland Government spent $180 million on R&D, on both external projects and in-house research needs (a 2.7% decrease from last year). There has been a decline in total investment since 2008–09 (after the Smart State period) but Queensland Government commitment to R&D has been similar for the last two years (Figure 3).

Figure 3: Total R&D expenditure by funding source (CPI adjusted), 2003–04 to 2014–15 with detailed expenditure from 2011–2015



Note: Capital and current expenditure data matched to funding source has only been collected since 2010–11.

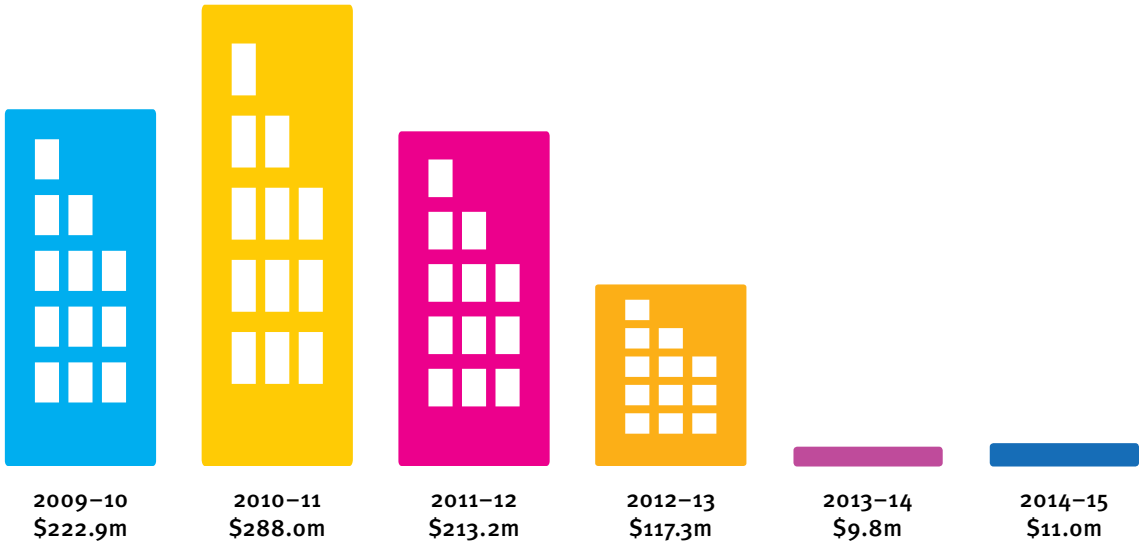
External commitment to R&D comes in the form of business support for research, university consultancies and Australian Government grants, among other things. In 2014–15 $174 million was sourced from external organisations, down only $3 million from the previous year. This included $55 million of R&D investment obtained from universities and businesses. This equates to an additional $0.96 being secured from external sources for every dollar invested by the Queensland Government. The partnerships and collaborations that develop from these associations are integral to the success of the R&D and translation of this research into real outcomes for Queensland.

Commitment to R&D projects, people and skills has remained at similar levels since 2010-11. This is for both Queensland Government commitment and leveraged sources. It is the level of expenditure for capital R&D commitments that has declined since 2010–11 causing the largest changes (decline) to total expenditure (Figure 3 inset).

3. Current (operational) and capital (infrastructure) spend

Capital expenditure for the 2014–15 financial year was again at a low with $11 million spent on infrastructure (Figure 4). This is similar to the investment made in 2013–14 and is expected as significant investments made during the Smart State era have been completed and the government continues to focus on people, projects and skills. As part of the Advance Queensland program the government has focussed on building a culture of collaboration between research bodies and business to translate ideas and research into products, processes, service outcomes and jobs.

Figure 4: Total expenditure on capital (infrastructure) 2009–10 to 2014–15



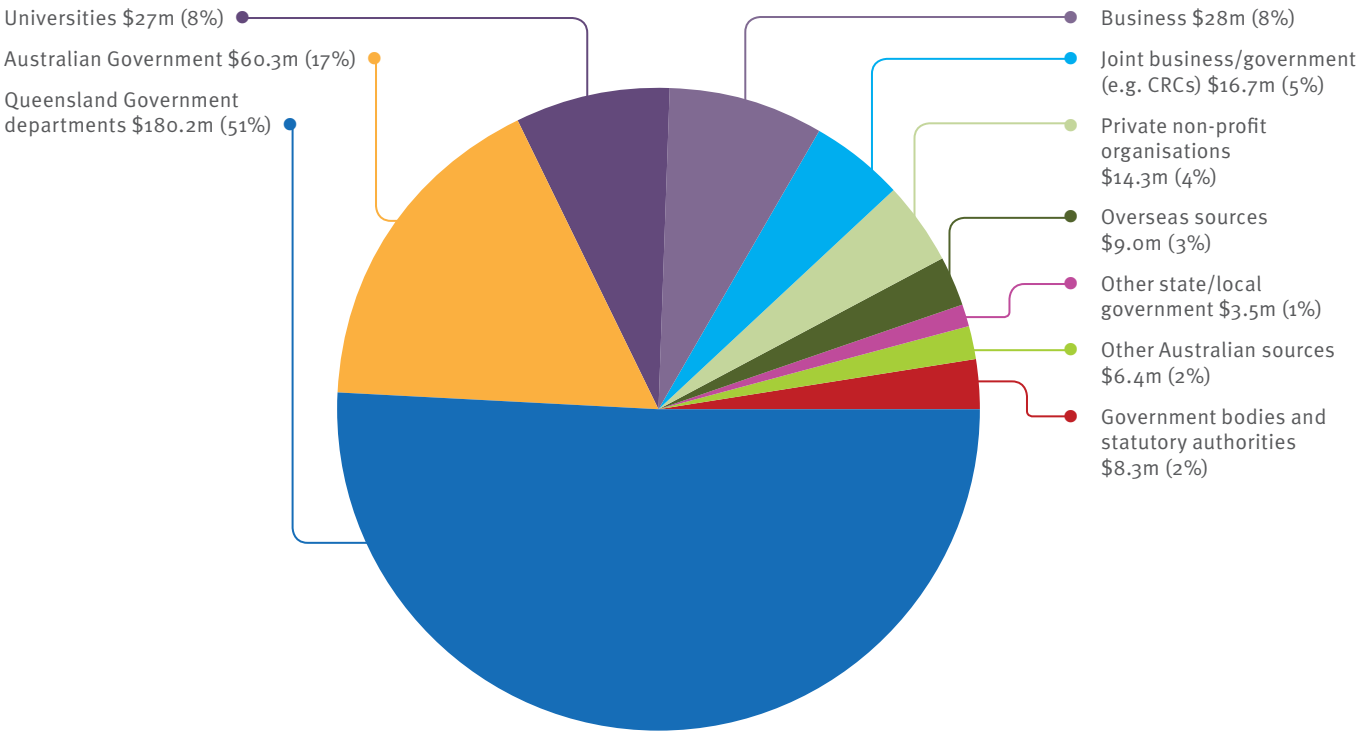
Commitment to infrastructure has not ceased and is a targeted process. Of the $11 million invested, $3 million is leveraged funds provided by the Australian Government, private non-profit organisations and overseas partners to mention a few. Continued investment in the Australian Institute of Tropical Health and Medicine at James Cook University is part of this total investment. Additionally, the QIMR Berghofer Medical Research Institute has invested almost $3 million in the ACRF Centre for Comprehensive Biomedical Imaging, and with additional Australian Government funding they are investing in the Bancroft Centre on the QIMR Berghofer website. Metro South Hospital and Health Service is investing in the Centre of Excellence in Indigenous Health at Inala.

4. Funding sources

In 2014–15, the majority of funding was sourced from the Queensland Government (Figure 5). This funding was used to support research performed within government and through external collaborations. A total of $180 million (51%) was provided from across Queensland Government departments. The largest external commitment comes from the Australian Government with 17% of funds ($60.3 million) and this is followed by both the business sector ($28 million) and universities ($27 million) each providing 8% of funds, a 2% increase for the business sector.

QIMR Berghofer Medical Research Institute again received the largest amount of funding from the Australian Government ($29.6 million) through competitive funding and non-competitive funding programs.

Figure 5: Total R&D expenditure ($354 million) by funding source, 2014–15



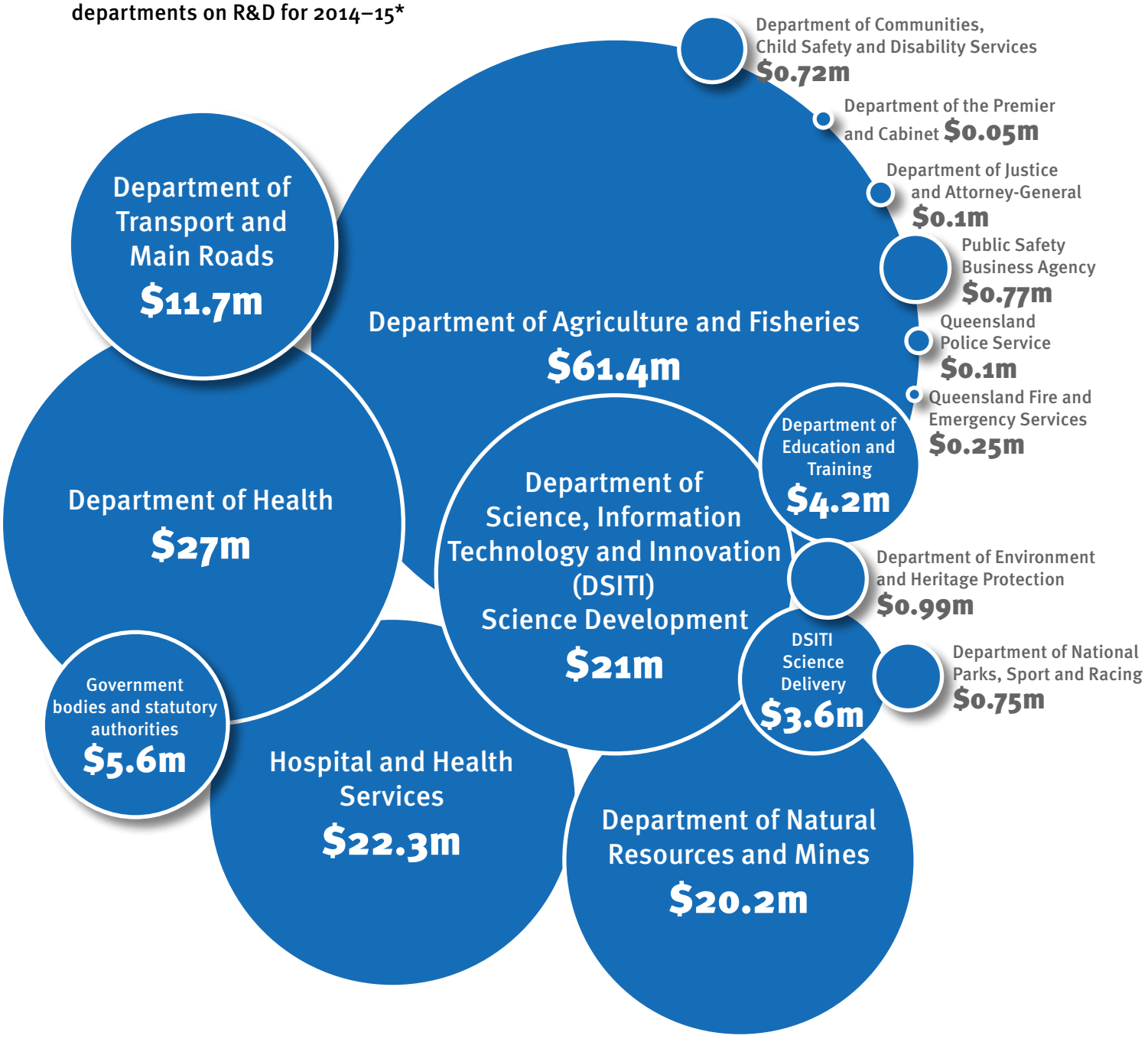
4.1 Department investment in R&D

Approximately half of the total Queensland Government investment is sourced from government departments, and the Department of Agriculture and Fisheries (DAF) is responsible for one third of this investment. This is a similar investment to last year for DAF ($61.4 million, 34%) and is consistent with previous years (Figure 6). DAF has strong partnerships with industry and research bodies in order to facilitate the growth and sustainable development of the agriculture, fishing and forestry industries. One of the services DAF provides is world-class research, development and extension so it is not unexpected that DAF is one of the top investors in R&D for the Queensland Government.

The second largest spend is by the Department of Health ($26.5 million, 15%). The Department of Health is responsible for managing the public health system in Queensland and this includes working with other state and national agencies. In Queensland the Hospital and Health Services (HHS) are an independent statutory agency responsible for their own strategic plans and are contracted by the department to provide health services. As such the research provided by these agencies is important in supporting the department and in 2014-15 the HHS provided an additional $22.3 million (12%) in R&D investment.

Investment by DSITI's Science Development unit has seen a 46% decrease this year from $38.7 million in 2013–14 to $21 million in 2014–15. As occurred in previous years, this decrease is primarily due to reduced infrastructure commitments. In contrast in 2014-15, over $7 million in government support was awarded to 25 Accelerate recipients in areas such as agriculture, Great Barrier Reef protection, improving health management and biofuels. An additional $10.3 million was leveraged from Queensland universities and other project partners as part of this program. Funding for similar initiatives will continue under the Advance Queensland initiative in future years. This program will deliver ongoing commitment to partnerships and fellowships and additional programs to further Queensland's capacity in the research space.

Figure 6: Queensland Government monies ($180 million) (not including leverage) expended by departments on R&D for 2014–15*



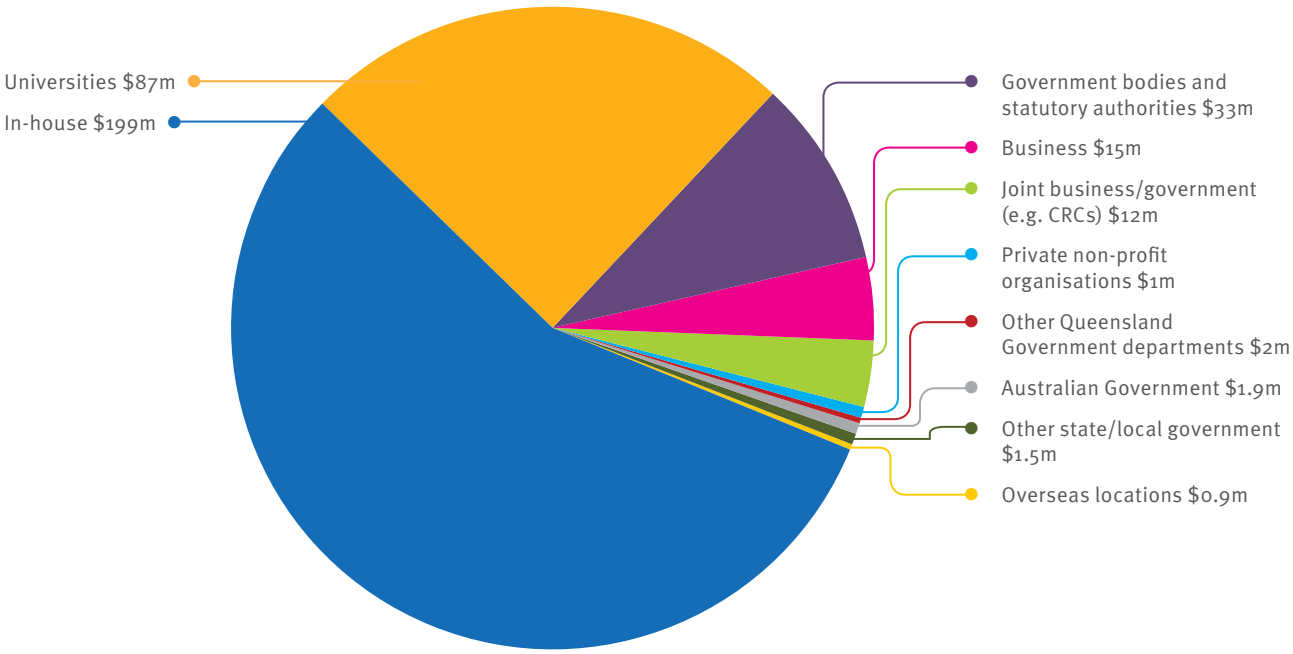
* R&D expenditure was attributed to the Queensland Government agency funding the R&D. In some instances, this differed from the department reporting the R&D expenditure. As such, values here may differ from the values reported by individual Queensland Government agencies to the OQCS.

5. Funding locations: in-house and external

A large part of the Queensland Government's commitment to research is performed on site in departments and in-purpose built facilities and field stations, just to name a few. In-house research has provided a strong contribution to Queensland and in 2014–15, $201 million was spent on research performed in-house and across Queensland Government departments (Figure 7). Of the $201 million, $199 was spent by departments on their own research in-house. The additional $2 million was used to fund research in other Queensland Government departments.

In-house research funding can come from multiple sources and in 2014–15 $103 million (51%) came from the Queensland Government and an additional $98 million (49%) was leveraged from external sources. The Australian Government is a large contributor towards this externally funded R&D performed in-house ($35 million, 18%). This is followed by funding obtained from businesses (8%), joint business/government organisations (7%) and from private non-profit organisations (6%).

Figure 7: Total R&D expenditure ($354 million) by location that performed the research, 2014–15



In 2014–15 externally performed research was responsible for 44% of total research ($153 million). Percentage wise this is the lowest spend on external research since 2007–08 although similar percentages occurred in 2008–09 and 2009-10. Universities are the major location of research outside of the government with $87 million (25%) going towards this set of organisations. Over half of this money ($39 million) was provided by the Science Development unit of DSITI, and includes Accelerate funding and capital funding.

The next largest spend by location is with government bodies and statutory authorities and as expected a large proportion of this $33 million spend (almost $19 million) was spent at QIMR Berghofer and provided by the Department of Health. Additionally, the Department of Natural Resources and Mines provided almost $7 million to the Office of Groundwater Impact Assessment, an independent entity established under the Water Act 2000 and funded through an industry levy.

In 2014–15, for every dollar invested by the Queensland Government an additional $0.96 was secured from other sources, including the Australian Government, universities and businesses.

6. What is the focus of our R&D?

6.1 Our Queensland science and research priorities

In October 2013 the Queensland Chief Scientist released the Queensland Science and Research Priorities, an overarching framework to guide Queensland Government R&D investments, and help ensure any future investments provide value for money and are well aligned with Queensland Government objectives. The priorities are focussed on well-defined areas, use our competitive advantages, and reflect identified needs and activities the government considers important. The priorities are seen as a 'living document' and updated versions are published periodically.

In March 2015 the Queensland Chief Scientist reviewed the Queensland Science and Research Priorities to ensure they are focussed on well-defined areas, use our competitive advantages, and reflect identified needs and activities the government considers important. The Revised Queensland Science and Research Priorities published in June 2015 include services innovation and the role of science and technology therein.

The Revised Queensland Science and Research Priorities:

- Delivering productivity growth and jobs for Queensland by developing **enhanced production technologies, tools and practices** particularly in the **agricultural, mining, advanced manufacturing** and supporting sectors including engineering services
- Growing our **knowledge intensive services** through **science, research and innovation**
- **Protecting our biodiversity** and heritage, marine and terrestrial, with particular focus on the **Great Barrier Reef**
- Natural advantage **cleaner, and renewable energy technologies** development (e.g. gas, solar, biofuels)
- Ensuring the **sustainability of our physical** and especially our **digital infrastructure** critical for research and—correspondingly—strategically leveraging national programs (including making use of 'big data')
- **Building resilience and managing climate risk**, through the design and development of construction technologies for extreme weather event resistance (floods, cyclones, droughts), **particularly in tropical environments**
- Supporting the **translation of health and biotechnology** research where Queensland has a particular interest of specific expertise, such as vaccine/drug development, age-related and tropical diseases, and skin cancer
- Improving **health** data management and **services delivery** (including telemedicine)

- Ensuring **sustainable water use** and delivering **quality water and water security** in a variable climate and in a resources-intensive economy
- **Digitally-enabled technologies**, e.g. the development and application of advanced modelling, visualisation, sensing and simulation technologies, tools and practices, including robotics.

The complete reviewed set of priorities and supporting documentation is available on the OQCS website.

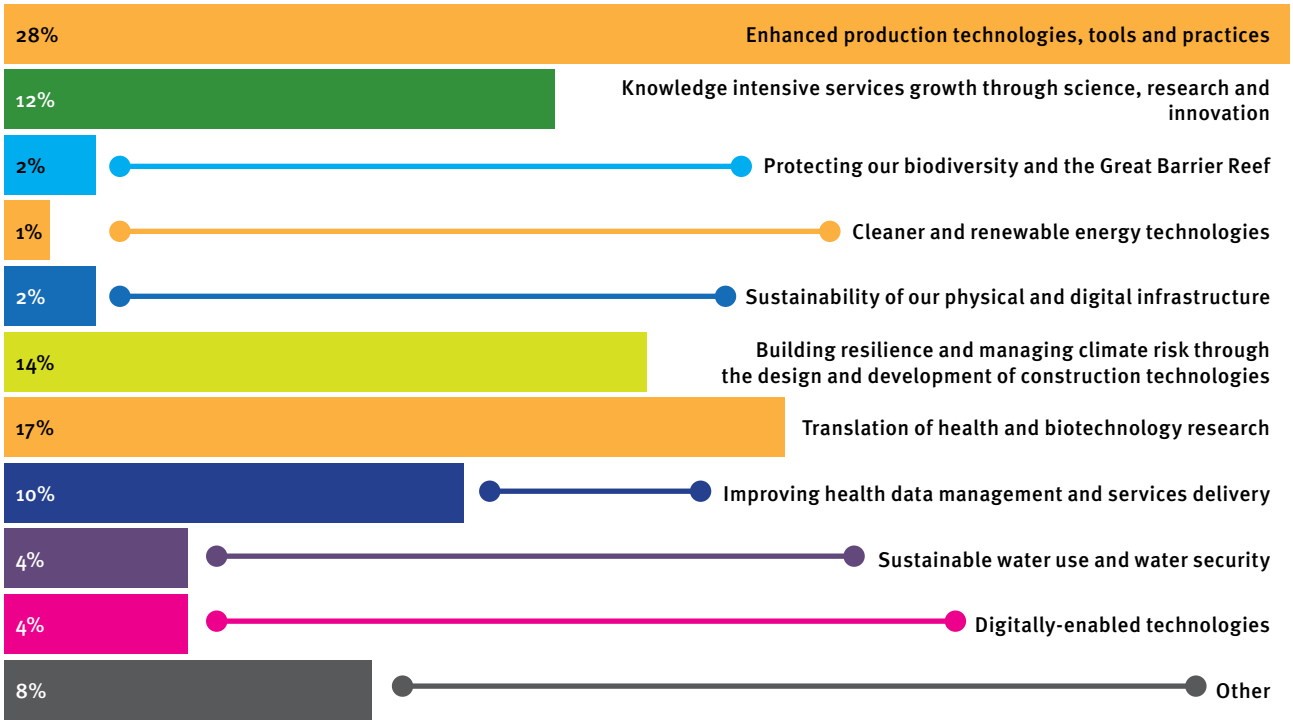
The priorities listed above have been used to categorise the R&D performed in 2014–15 (Figure 8). In cases, where an R&D project is relevant to two or more priorities, its expenditure is apportioned between the relevant objectives so that the proportion of funds invested in each priority could be estimated. As there have been modifications to the priorities from the 2013–14 report, a complete comparison is not available.

The single largest spend on research has been in the 'Delivering productivity growth and jobs for Queensland by developing enhanced production technologies, tools and practices particularly in the agricultural, mining, advanced manufacturing and supporting sectors including engineering services' with over $100 million (28%) invested in this area with the majority of funding coming from DAF.

The second highest priority spend was in 'Supporting the translation of health and biotechnology research where Queensland has a particular interest of specific expertise, such as vaccine/drug development, age-related and tropical diseases, and skin cancer' with 17% ($61 million) of total spend in this area. The third highest spend was in the 'Building resilience and managing climate risk, through the design and development of construction technologies for extreme weather event resistance (floods, cyclones, droughts), particularly in tropical environments' with 14% ($48 million) of total spend.

In 2014–15 a small number of projects were not aligned to the priorities (8%). A large proportion of this spend includes a variety of social good research projects. Also, government departments have their own strategies and priority areas to support, and funding goes towards these goals as well.

Figure 8: Classification of spend according to the 2014–15 Queensland Science and Research Priorities*

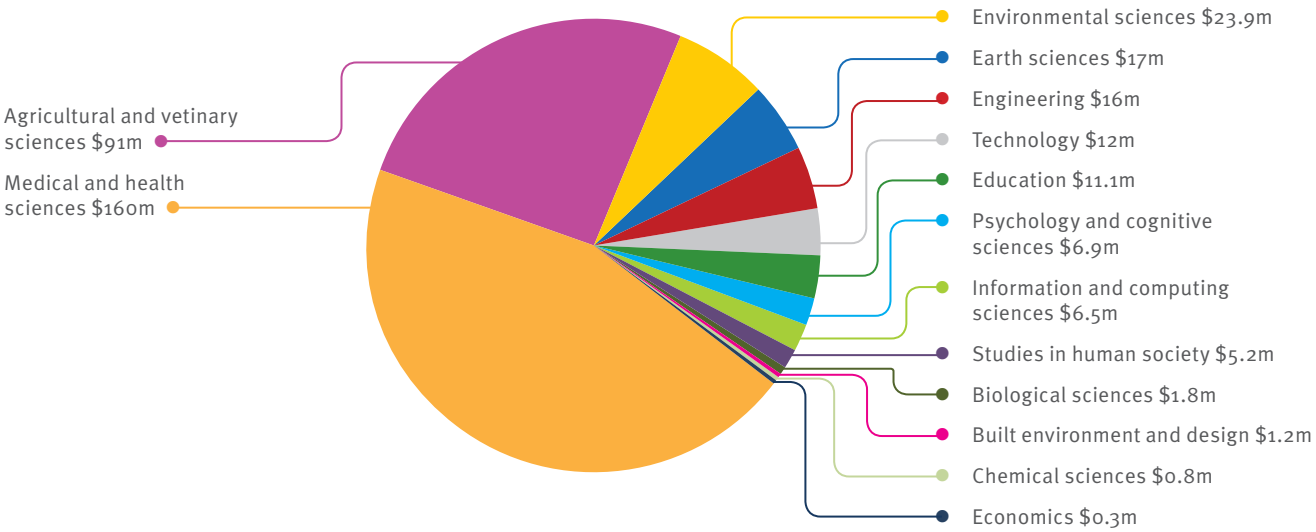


* The Queensland Science and Research Priorities are available on the OQCS website.

6.2 Queensland research areas

Significant investment (from 1998–2011) in capital, people and projects has laid a strong foundation for research groups working in health research in Queensland. The Queensland Government spent 45% ($160 million) of total R&D funds on medical and health sciences research across government, almost identical to last year's commitment of 46% (Figure 9).

Figure 9: Total R&D expenditure by field of research[3] for 2014–15, classified by perspectives or techniques used to perform the research.



Of course a large proportion of this funding, 73% ($117 million) comes from medical and health sciences research. There are a variety of organisations that support and fund research in this area including, the Hospital and Health Services, the Department of Health, QIMR Berghofer Medical Research Institute and Queensland Fire and Emergency Services.

DSITI also provided capital funds to James Cook University (JCU) for the establishment of the Australian Institute of Tropical Health and Medicine ($5 million) in 2014–15. This funding will continue until 2016–17 to establish three facilities at the Townsville, Cairns and Torres Strait (Thursday Island) nodes of the university's campus. These facilities will build on JCU's current capabilities in tropical science and medicine and existing expertise in the Australian Tropical Science and Innovation Precinct, Australian Tropical Forest Institute and the Queensland Tropical Health Alliance.

Other departments supporting research in the medical and health sciences include the Department of Education and Training and their investment in the Cooperative Research Centre for Living with Autism Spectrum Disorders.

A similar investment was made this year in the agricultural and veterinary sciences. In both 2013–14 and 2014–15, 26% of expenditure was dedicated to research in this area.

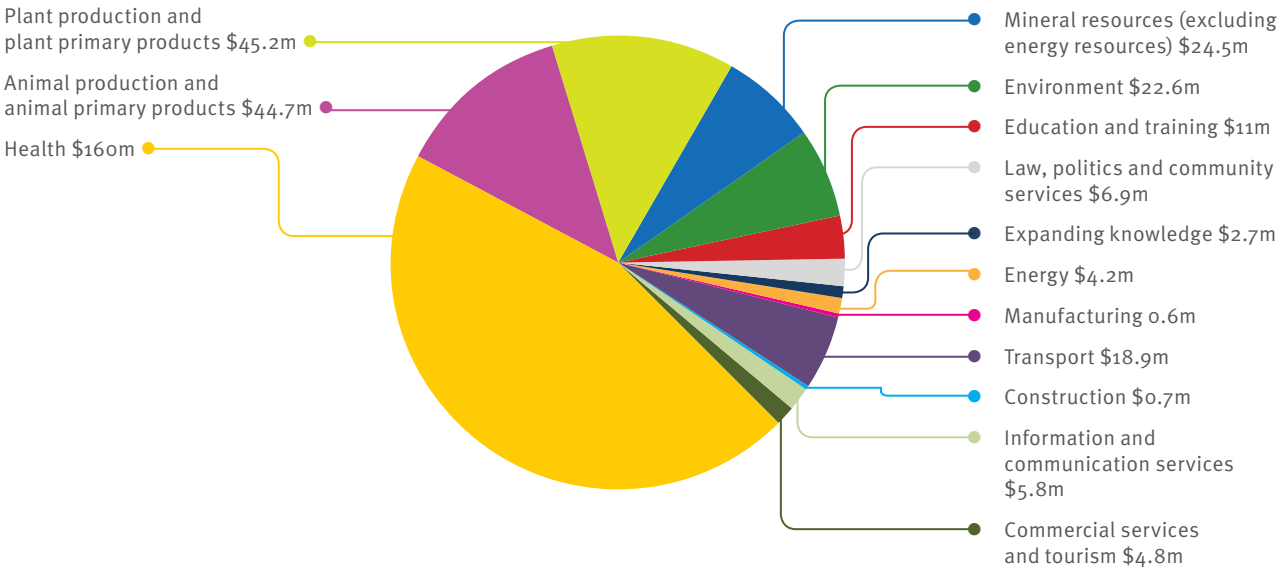
3 In order to compare the 2014–15 research spend with previous years, use of the ABS classifications for Socio-economic Objectives (SEO) and the Fields of Research (FOR) have been used in this report and the two previous reports. Further explanation of the classifications can be found in the glossary. In essence, FOR indicates the 'technical areas used to perform the research' and the SEO classification breaks research down into 'the outcome areas'.

6.3 Queensland research outcomes

An important factor in classifying research spend is not only to determine which areas the research is undertaken in (i.e. the methods used) but also where the research outcomes will be delivered i.e. what is the purpose of the research. Using the socio-economic objective (SEO) we can see that 45% of R&D expenditure is intended for health outcomes, a similar result to last year (Figure 10).

Almost identical spends were seen in plant production and plant primary products, and animal production and animal primary products (13% spend in both). However, animal production and animal primary products had an increased spend of $44.7 million compared to $16.8 million (5%) in 2013–14. Included in this is additional expenditure on projects in the Queensland Governments Accelerate Partnerships program provided by DSITI.

Figure 10: Total R&D expenditure by socio-economic objective for 2014–15, classified by intended outcome of the research



4 The term 'socio-economic objectives' (SEO) refers to an official classification of R&D expenditure that has been developed to capture the area of expected national benefit rather than the immediate objectives of the researcher. It describes the purpose of the research

7. Findings and recommendations

In the 2013–14 Queensland Government R&D Expenditure Report we provided six findings and recommendations. Before a proper assessment can be made on the recommendations some time must elapse. However an update on the progress of these recommendations is an important step in ensuring we are moving forward in the right direction.

Recommendation One was that the '**Queensland Government efforts should increase opportunities to collaborate and gain additional partners in projects** (noting that this may not always include leveraging additional funding) … ' To build on this successful model the design of the recently announced Advance Queensland initiative should stipulate a matched funding requirement for grant recipients. This will encourage greater commitment from external sources who will need to put 'skin in the game'. This will provide an opportunity for skills development, job creation and strong university/government/industry collaborations to develop and foster.

This is linked with **Recommendation Two**, which states that it is '**important that we optimise the use of infrastructure we have already invested in and developed**'. A good example of this is the joint collaborative research agreement between Queensland University of Technology's Institute of Health and Biomedical Innovation and the QIMR Berghofer Medical Research Institute, which enables QUT to have access to specialist health and medical laboratories and facilities at the QIMR Berghofer building.

Over the past year, the Advance Queensland initiative has provided and is providing opportunities for Queensland universities and businesses to link with the Queensland Government and each other, and promote the use of research and problem-solving skills to assist business growth. A particular focus of the Advance Queensland Knowledge Transfer Partnerships is to link small-to-medium enterprises (SMEs) with graduate students who can work in their company on projects to help develop their products or services.

Additionally, the Advance Queensland Innovation Partnerships will provide grants of up to $1.5 million to Queensland research organisations to undertake collaborative research projects with industry or SMEs.

The Queensland Government has also secured three major flagship partnerships that will help put the spotlight on Queensland and deliver the ultimate goal of turning ideas into jobs:

- The Johnson & Johnson Innovation Partnering Office at QUT will facilitate access to the vast resources and expertise across Johnson & Johnson's scientific research, investor and commercial business sectors to help build, nurture and accelerate the local life science ecosystem. Under this partnership, the Advanced Queensland Johnson & Johnson Innovation Quick Fire Challenge was launched and is focussed on developing innovative product development ideas.

- The Queensland Emory Drug Discovery Initiative, a collaborative project between The University of Queensland and Emory University in Atlanta, USA, will take Queensland researchers' ideas for potential cures for diseases and develop these into new drugs.
- The Siemens Innovation and Translation Centre at the Translational Research Institute is a world leader in the field of MRI scanning technology.

The three partnerships listed above are strong examples of collaborative partnerships and fully utilising the infrastructure we have.

Recommendation Three stated that departments should '**continue to align their research activities with the Queensland Science and Research Priorities and the Australian Government's Science and Research Priorities and … to increase their capacity to optimise research outcomes and leverage further funding**'.

In June 2015 the Queensland Chief Scientist reviewed Queensland's Science and Research Priorities to ensure they are focussed on well-defined areas, use our competitive advantages, and reflect identified needs and activities the government considers important. To deliver on this recommendation the priorities are utilised throughout many of the Advance Queensland Funding programs.

> 'Investment in these targeted areas of science and research will build a foundation for Queensland to develop as a global innovation hub and gateway into markets in the Asia Pacific and beyond[5].'

Australian Government incentives for research that are done in partnership with industry will provide opportunities for universities, government and industry to leverage additional funding whilst focusing on Australia's and Queensland's needs.

Also, Queensland Government departments reflect regularly on their own strategies and priorities providing greater focus and alignment with government, community and industry needs. As they continue to review their own priorities so will the Queensland Chief Scientist reflect and review the Queensland Science and Research Priorities.

Recommendation Four focussed on the **Department of Health and the Hospital and Health Services (HHS)**. It stated that a close relationship between the two entities is needed and suggested that while the **HHSs needed autonomy they must not lose sight of department priorities**. It was also suggested that an **overarching strategy would provide assurance on the expenditure being allocated to this core area and integrity of data, as data collection** would occur through a core agency. A **key R&D strategy** would also ensure alignment of R&D funding to priority areas and provide a way to maximise collaboration and to leverage further returns.

5. Excerpt taken from Advance Queensland Innovation Partnerships.

Over the past year the Department of Health has been planning for Queensland Health research strategies to provide overarching leadership and coordination of research. The focus has been on activities and accountability needed to ensure that the return on state investment in research is maximised and that it is well targeted to address Queensland's health priorities.

In 2015 the Department of Health's Health and Medical Research Unit was involved in a series of meetings to discuss the collection of R&D data for the Queensland Chief Scientist. This process involved all HHSs in Queensland and provided a stronger and more consistent set of data for OQCS. Further discussions were held with some HHSs on the process going forward and the commitment to research including the collection and sharing of data is being strengthened.

Recommendation Five stated that there '**... should be complete compatibility between the projects and funding details listed in the annual reports and the expenditure collection** ... It is also essential that Queensland Government **departments communicate the good research funded and performed** ... ensure that entities provided with government **funding acknowledge appropriately** and routinely the commitment provided by the government in support of their research.'

Over the last 15 years significant investment has gone to the science and research space and provided a strong foundation from which we can address future challenges. We have developed a global reputation for our science and research and the world knows about our world class institutes and universities. But the research performed in and with the Queensland Government is not so well communicated.

The Queensland Chief Scientist acts as an ambassador for Queensland science, fostering cooperation and collaboration amongst the government, research, industry and community sectors. As an advocate for science communication, he works to raise Queensland's profile as a smart region characterised by world class research and investment opportunities, and engages the community in better understanding the importance of science, research and innovation in the state's future economic, social and environmental wellbeing.

To this end, Dr Garrett, the Queensland Chief Scientist, is leading the development of a state-wide *Science Engagement and Communication Strategy* (will be available on the OQCS website) which aims to significantly increase awareness of the great science taking place in Queensland by leveraging and streamlining an array of Queensland science communication, education, engagement and outreach activities. The strategy also aims to support new collaborative activities developed by government, academia and industry. It will harness the talent and enthusiasm of the many scientists and researchers across the state.

The Office of the Queensland Chief Scientist also runs the annual Science in Parliament program—the longest-running science communication program for state Members of Parliament (MPs), bringing together scientists, industry and MPs to discuss the impact of science and research on Queensland's future.

The Advance Queensland website also showcases many of the great research outcomes being delivered across Queensland.

This report is also a communication tool that can be used to highlight the extensive research that occurs in government and with our partners. As such, we have re-designed this report to act as a summary document and included research highlights to showcase the research funded by government departments, HHSs, and other government bodies and statutory authorities. We have also presented just a few examples of significant research in this document and further examples of research are available on the OQCS website. We encourage you to take a look.

Recommendation Six found that the 'two primary areas of focus—the **agricultural sector** and **the treatment and prevention of age-related and Queensland dominant diseases remain a focus for Queensland Government funding** and should be **incorporated in the Revised Queensland Science and Research Priorities** and **departments should be using the priorities … in addition to their own priorities**, to target R&D investment'.

In June 2015 the Queensland Science and Research priorities were revised through extensive consultation across government, the university and research sectors, and with industry. They are published on the Office of the Queensland Chief Scientist's website. Although the two priority areas listed above have been revised, the core research areas—'agriculture' and 'age-related and Queensland dominant diseases' are still a focus for this government.

In the revised priorities the focus has shifted to:

> 'Delivering productivity growth and jobs for Queensland by developing **enhanced production technologies, tools and practices** particularly in the **agricultural, mining, advanced manufacturing** and supporting sectors including **engineering services**.'

and

> 'Supporting the **translation of health and biotechnology** research where Queensland has a particular interest or specific expertise, such as vaccine/drug development, age-related and tropical diseases, and skin cancer'.

It is apparent from this collection that these priorities remain a strong focus of government research. As stated earlier, the Queensland Science and Research Priorities are throughout many of the Advance Queensland funding programs, as are the Queensland Government's Investment Decision Rules (R.E.D.S.) on the OQCS website. Utilising these priorities and the investment decision rules, departments can better target their investments in R&D.

Research in use

The Queensland Chief Scientist acts as an ambassador for Queensland science, fostering cooperation and collaboration amongst the government, research, industry and community sectors. As an advocate for science communication, he works to raise Queensland's profile as a smart region characterised by world class research and investment opportunities, and engages the community in better understanding the importance of science, research and innovation in the state's future economic, social and environmental wellbeing. Following are only three examples of collaborative research being performed in Queensland with many more available on the OQCS website.

Science of Learning Research Centre

In 2013 the University of Queensland was part of a consortium awarded $16 million over four years from the Australian Research Council and industry partners for a Science of Learning Research Centre. The Science of Learning Centre is a collaboration between two of Australia's leading research institutes, the Australian Council for Education Research (ACER) and the Queensland Brain Institute (QBI).

The objectives of the Science of Learning Research Centre are to identify research and understand effective teaching and learning practices in the light of current knowledge about basic learning processes and factors that influence successful human learning.

The centre brings together research from several disciplines, including neuroscience, psychology, and education. Research in each of these disciplines contributes to a deeper understanding of learning processes and to a better understanding of ways to support successful school learning. The Centre also employs state-of-the-art brain imaging technology and modelling techniques to synthesise the results across the disciplines. These different but complementary research activities are essential to investigating and understanding the complexities of classroom learning. Further information is available on the Science of Learning Research Centre website.

World-first immunotherapy clinical trials

In September 2015 QIMR Berghofer Medical Research Institute began world-first immunotherapy clinical trials at the Wesley-St Andrew's Research Institute targeting the malignant brain cancer glioblastoma multiforme (GBM)—one of the deadliest and most difficult to treat cancers. This is just one example where QIMR Berghofer researchers' skills in harnessing the immune system are being translated to the clinic.

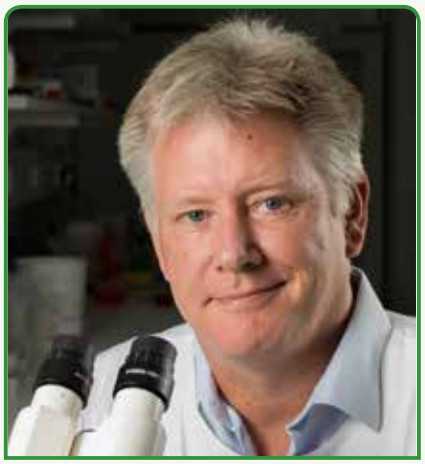
Immunotherapy is emerging as one of the most powerful strategies to treat cancers, especially melanoma—of vital importance given Queensland has the unenviable record as the melanoma capital of the world. But other cancers, including lung cancer, breast cancer, head and neck cancer, brain cancer and leukaemia, are also being targeted.

Coordinator of the Immunology Department at QIMR Berghofer, Professor Mark Smyth, said more than 100 patients had participated or were currently participating in the Institute's clinical trials of immunotherapy. 'The early results are showing that immunotherapy is effective in training the body to fight cancer,' Professor Smyth said.

'It is also improving patients' quality of life by avoiding the debilitating side effects of chemotherapy and radiation therapy.'

QIMR Berghofer Centre for Immunotherapy and Vaccine Development Coordinator, Professor Rajiv Khanna, said the technology QIMR Berghofer had developed was unique. QIMR Berghofer researchers use a sample of a patient's blood to grow killer T-cells (a type of white blood cell) in a specialised laboratory. Scientists then effectively train the killer T-cells to recognise virus or cancer cells, before re-infusing the killer T-cells into the patient to attack the cancer.

'We have research teams that are leading the world in immunotherapy and through our domestic and international collaborations, I see QIMR Berghofer's work benefiting not only Queenslanders and Australians, but the whole world,' Professor Khanna said.



Professor Mark Smyth

Professor Rajiv Khanna

Professor Frank Gannon

Recognition of this leadership position came in 2015 in the form of two major agreements with international companies that will support and expand this research in QIMR Berghofer.

QIMR Berghofer Director and CEO, Professor Frank Gannon, said that the world-class research is matched and made possible by the Institute's manufacturing facility, Q-Gen Cell Therapeutics, which received certification in 2015 for the production of the cellular therapies.

'This approval has allowed Q-Gen Cell Therapeutics to prepare the T-cell therapies needed to provide immunotherapy to patients with Nasopharyngeal carcinoma and Glioblastoma, and is a facility that is available to other researchers in Queensland or elsewhere', Professor Gannon said. 'This is another example of QIMR Berghofer's commitment to getting our laboratory discoveries through clinical trials and to the hospital bedside.'

Making chemotherapy safer for cancer patients

Associate Professor Ingrid Winkler

Each year more than one-third of cancer patients who receive chemotherapy in Australia suffer from an infection during, or soon after, receiving treatment as a consequence of the immune-suppression linked to chemotherapy.

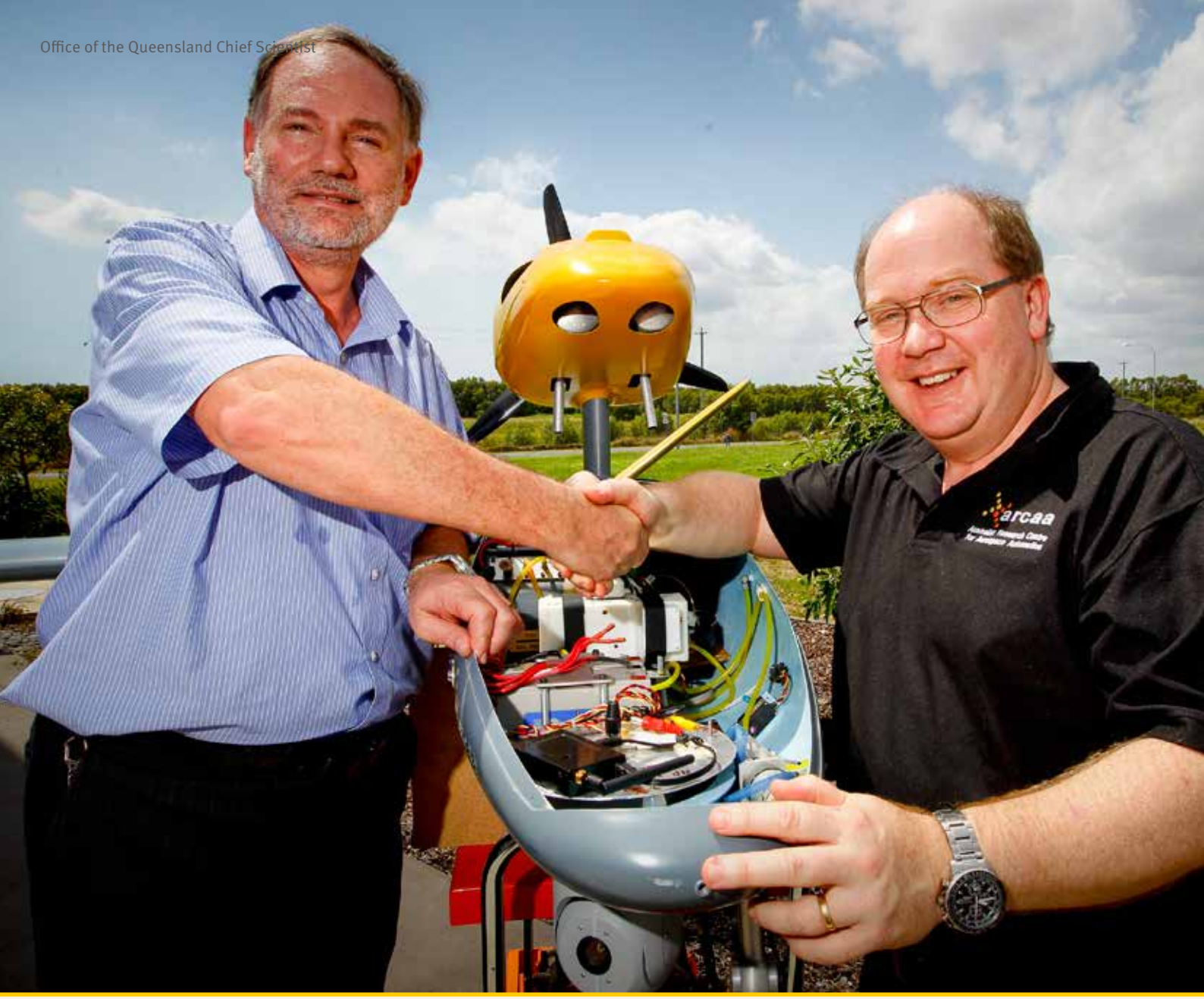
Mater Research Institute—University of Queensland (MRI–UQ) researcher Associate Professor Ingrid Winkler was awarded a $360,000 Smart Futures Fellowship from the Queensland Government to undertake research into the complications of chemotherapy. The funding was provided over three years 2010–13, and was matched by MRI.

The complications of chemotherapy mainly derive from damage to the stem cells in the bone marrow that regenerate blood and immune systems, leaving patients susceptible to infections.

Dr Winkler has identified a factor (E-selectin) in the bone marrow that contributes to these complications. She found that when E-selectin is blocked after chemotherapy—by administering an antagonist—normal stem cells were protected resulting in faster immune recovery. In mice, this translated to less overall chemotherapy induced side-effects and a greatly increased overall survival following multiple rounds of chemotherapy.

To bring these benefits the patients, Dr Winkler has partnered with a USA biotech company, who plan to start clinical trials to help alleviate the side-effects of chemotherapy in patients.

The research has the potential to help cancer patients recover faster from their chemotherapy, and to greatly reduce the health costs of cancer treatment. In the USA it is estimated that almost half the cost of a cancer treatment is in supporting patients through cancer therapy side-effects. Cancer patients represent about 1.4% of the population, however about 10% of the total health costs. An estimated 1700 Queensland hospitalisations each year may be preventable if the complications associated with chemotherapy can be better managed.



Professor Duncan Campbell welcomes Adjunct Professor Brendan Williams from Boeing to Project ResQu

Creating a more RESilient QUeensland—Unmanned Aircraft for Emergency Response and Biosecurity

Project ResQu, a $7 million two-year project funded by the Queensland Government, QUT, CSIRO, Boeing Research and Technology—Australia, and Insitu Pacific Ltd grew out of a vision to build a resilient Queensland through the application and growth of a burgeoning unmanned aircraft industry. Queensland has established national and global leadership in a growing aerospace and unmanned aircraft industry which has been further advanced through the relationships and outcomes from Project ResQu.

Through strategic investment, the Queensland Government has established a concentration of research and industry capability in Queensland with a strong culture of collaboration on problems of national and international significance. In 2014, Queensland was home to more than 30% of the Australian Unmanned Aircraft industry. Project ResQu built upon this existing research and industry base, with the aim of focusing these capabilities on accelerating the sensible utilisation of unmanned aircraft for civilian operations. Further information is available on the Australian Research Centre for Aerospace Automation website.

Glossary

Research and development (R&D)
This report uses the *Frascati Manual*[6] definition—the internationally recognised standard in this area as determined by the Organisation for Economic Cooperation and Development (OECD):

> '... creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications.'

This includes basic, strategic and applied research and experimental development, along with administration and indirect activities which support R&D and are treated as overheads.

This does not include:

- science activities such as routine monitoring and data collection
- quality control
- testing and standardisation
- scientific and technical services
- market research
- operations research or statistical analyses
- policy-related studies
- routine computer programming
- extension or commercialisation of R&D.

R&D expenditure
Money expended (excluding GST) in the indicated financial year.

Capital expenditure
Expenditure that is spent on R&D facilities, such as the acquisition of land and buildings.

Current expenditure
Expenditure for labour costs, project materials, grants for fellowships, administration and other overheads, and the costs of indirect services (for example, library materials).

Leveraged funds
Cash contributions from external organisations towards R&D projects funded or performed by the Queensland Government. This only includes direct contributions (the expenditure forming part of an R&D contract or agreement). This does not include in-kind support (for example, use of internal databases or staff time not directly attributed to the project). Where the Queensland

6 Frascati Manual 2002: Proposed Standard Practice for Surveys on Research and Experimental Development, OECD, Paris, 2002, available on the OECD website.

Government does not hold the financial records for amounts spent by external organisations on a project in 2014–15, leveraged funds are calculated pro rata (based on the overall commitment by organisations to the project and the Queensland Government's expenditure on the project in that year).

Queensland Government R&D funding

Money provided from departmental budgets and spent on R&D.

Total Queensland Government R&D expenditure

Includes both Queensland Government funding and leveraged funds.

Socio-economic objective (SEO)

The SEO classification allows R&D activity to be categorised according to the intended purpose or outcome of the research rather than the processes or techniques used in order to achieve this objective. For example, a project developing information technology systems engineering for telemedicine would be aligned with the Health SEO as it provides health outcomes. The codes for this classification are listed in Appendix B.

Fields of research (FOR)

The FOR classification allows R&D activity to be categorised according to the field of research and the methodology used in the R&D. For example, a project developing an artificial material for use in joint replacements would be aligned with engineering as it utilises engineering-based techniques, rather than the health outcome it would provide for. It is important to note that direct comparison between the two classification systems is not possible. The codes for this classification are listed in Appendix B

Appendix A: Department research highlights

Each year we ask departments, government bodies and statutory authorities and hospital and health services to identify R&D that is carried out or funded by their organisation. The research highlights listed below are taken from departmental annual reports and also provided by the organisations.

Cairns Hospital and Health Service

- Successful in obtaining a grant of $175,000 from Australian Primary Health Care Research Institute (APHCRI) for analysing sub-acute and primary health care interfaces—research in the elderly (ASPIRE) study. The study examined care transitions of older people who present to the Cairns Hospital emergency department (ED), transfer to acute and sub-acute care, and return home.

  The purpose of the study is to ensure appropriate use of resources, reduce avoidable hospital admissions and optimise outcomes for the increasing number of older people who present to ED. The outcome was a suite of policy recommendations forwarded to APHCRI in Canberra and local recommendations for better coordinated services for older people. A key recommendation was the trial of an in-patient care navigator role which has been established and is being evaluated. The final report has been uploaded to the APHCRI website.

Department of Agriculture and Fisheries

- Evaluations on the returns from investing in agricultural Research, Development and Extension (RD&E) consistently demonstrate that for every $1 invested, returns of up to $10 can be expected over the course of 25 years.
- $54.9 million (12%) from grants and contributions (including income received for research and development projects from external funding bodies).
- The department's investment in RD&E includes $14.77 million in partnerships with the university sector and Sugar Research Australia (an industry-owned research and development corporation).
- Queensland's tomato industry is valued at an estimated $273 million. In 2014–15, a DAF tomato breeding project produced more than 100 new parent lines, a number of which will be selected for commercial release. The new varieties are resistant to a variety of diseases, including fusarium wilt, powdery mildew, root-knot nematode, tomato yellow leaf curl virus and tomato spotted wilt virus.

Powdery mildew is one of the two most damaging diseases of tomatoes in eastern Australia and causes production losses estimated at $20-$25 million annually. Tomato yellow leaf curl virus is the other disease of major concern and impacts large areas of the Bundaberg and Bowen regions, with serious implications for producers. The new lines are expected to be available in the near future.

- Reinvigorating Indigenous plantation forestry: the collaborative Australian Centre for International Agricultural Research sandalwood project, involving the department and the University of the Sunshine Coast, developed germplasm for sandalwood and whitewood. The project captured a diverse range of Cape York Peninsula sandalwood germplasm and successfully established grafted clonal seed orchards in Bamaga and at the Walkamin Research Station. A genetic improvement and testing program is now in place. Endemic sandalwood species were commercially harvested in the Cape York Peninsula from 1860 to around 1940, when the industry collapsed due to over-harvesting. If domesticated, this species could underpin development of Indigenous and plantation-scale forestry activities in the region.
- Reef water quality protection plan: the department continues to play a major role in improving the health of the Great Barrier Reef. In 2014–15, DAF committed $4.32 million in funding to lead and support actions of the Reef water quality protection plan 2013, a key component of the Reef 2050 long-term sustainability plan.

Department of Communities, Child Safety and Disability Services

- The department has partnered with Griffith University to explore levels of parent satisfaction and ratings of service transactions within statutory child protection services. Systematically assessing parents' opinions about services is consistent with the principle of turning users into active agents of the intervention and promoting their autonomy. Such research may help to reduce power asymmetry that exists between workers and child welfare clients and may assist to provide client-centred and family-focussed casework practice. Parental input is helpful in assessing program efficacy, designing service improvement strategies and enhancing professional practice, which in turn may increase parental engagement.

Department of Education and Training

- Science of Learning Research Centre: committed $200,000 of in-kind support over four years and leveraged an additional $12 million cash from the Australian Government and other industry partners to deliver a special research centre, led by The University of Queensland. The centre brings together researchers in education, neuroscience and

cognitive psychology, who work together with teachers to understand the learning process. This Centre is establishing new criteria to assess the impact of different types of learning and strategies to inform teaching practices of benefit to all Australians.

- Autism CRC: committed $400,000 in cash and an additional $340,000 in-kind support over eight years, while leveraging a further $31 million from the Australian Government and $4.4 million from other essential participants. The Autism CRC will enhance the potential of individuals with autism spectrum disorder (ASD) to achieve valued life outcomes, improve the quality of life of people with ASD and their families, and improve the cost efficiency of diagnosing and supporting people with conditions on the autism spectrum in Australia through an end-user driven, cooperative, public-private research centre.
- Exceptional Teachers in Disadvantaged Schools Initiative: committed $150,000 and an additional $91,000 in-kind support over three years, and leveraged a further $384,000 from the Australian Government to ensure that the best trained teachers are placed in the schools that need them most. This longitudinal study will provide evidence of how quality teaching is enacted in low socioeconomic status (SES) school environments, and enable new learnings to be applied to the preparation and professional development of the Australian teaching workforce.

Department of Health

- Dr John Fraser has been awarded a Health Research Fellowship of $750,000 over five years by the Health and Medical Research Unit within the division of Clinical Excellence. Dr Fraser's research aims to increase the understanding of how artificial heart and lung devices affect the body's own clotting and inflammation systems.
- Dr Shelley Wilkinson has been awarded a Health Research Fellowship of $414,000 by the Health and Medical Research Unit within the division of Clinical Excellence. Dr Shelley Wilkinson's research aims to improve mothers' and babies' health through translating evidence-based maternity programs into practice.
- Dr Clint Douglas has been awarded a one-year Nursing and Midwifery Research Fellowship of $15,000 by the Health and Medical Research Unit within the division of Clinical Excellence. Dr Douglas's research aims to create a pain identification tool in residential aged care facilities.
- Professor Robyn McDermott has been awarded a Senior Clinical Research Fellowship of $4.25 million over five years by the Health and Medical Research Unit within the division of Clinical Excellence. Professor McDermott's research aims to develop a Chronic Disease Prevention and Care Centre serving the rural and remote communities of Far North Queensland.

Department of National Parks, Sport and Recreation

- Queensland Parks and Wildlife Service in partnership with the University of California (Conservation Metrics team) is investigating the efficacy of automated acoustic surveys as a technique for improving our ability to accurately and efficiently detect trends in seabird populations over a timeframe that may allow intervention should the trend be one of decline.

  The pilot study commenced in 2013 and compared data from traditional seabird surveys for wedge-tailed shearwaters *Ardenna pacifica* and black noddies *Anous minutus* to automated acoustic surveys in the Capricornia Cays, Queensland, an internationally recognised important bird area (IBA). Wedge-tailed shearwater (WTS) acoustic activity rates were significantly correlated with burrow densities at multiple stages of the breeding season. Black noddy (BN) acoustic activity was also correlated with nest counts but only for part of the breeding season. Chick calls were detected and quantified for both species—highlighting the possibility for determining if a species produced young in a given breeding season and chick densities.

  Based on data collected from the primary study site, statistical power was estimated (based on data collected from the primary study site—NW Island). The results indicated that the acoustic survey design had a high power to detect trends in WTS even with low survey effort. A larger survey design is required to detect the same trends for BN. The data from the pilot has shown that measures of acoustic activity at breeding colonies can provide data with lower impact than traditional survey techniques. Further work will be undertaken to explore how the acoustic monitoring program might be designed to monitor these species across multiple sites over the long-term.
- The department's Queensland Academy of Sport Centre of Excellence for Applied Sport Science Research (QAS CoE) facilitated the establishment of a new research project that is assessing if a high volume, performance focussed swimming program will elicit meaningful, therapeutic change in people with cerebral palsy? The project is applying Talent Identification/Talent Development methods from elite sport to identify untrained people with Cerebral Palsy, with moderate-to-severe impairments, but with physical and psychological attributes known to be advantageous in competitive swimming. Over the next three years the project will bring together research partners (and financial contributions) from the QAS CoE ($86,000), The University of Queensland ($77,000), Australian Paralympic Committee ($5000), Swimming Australia ($2,500), and the Motor Accident Insurance Commission ($78,000).

- The Queensland Academy of Sport's Centre of Excellence for Applied Sport Science Research supported an innovative sport criminology research project in partnership with Griffith University, Queensland University of Technology and The University of the Sunshine Coast. The 12 month project was funded by the QAS CoE ($9995) and the Griffith Criminology Institute (GCI) ($2500) to provide:
  - greater insight into the labyrinth of networks that support sophisticated and deliberate doping-related activities in sport
  - recommendations and strategies to assist sport to be proactive in early identification of doping-related behaviours exhibited by athletes, coaches and support staff.

  The research found networks are crucial in the elite sports doping industry, and suggest targeting doping networks as well as individual athletes to disrupt elite sporting drug rings in the future. The findings of the research will be published in the European Journal of Criminology early in 2016 and the lead researcher from Griffith University was invited to present the findings at the prestigious 71st Annual Meeting of the American Society of Criminology in Washington DC in November 2015.

Department of Natural Resources and Mines

- Expended over $20 million in a wide variety of research and development projects within the Department of Natural Resources and Mines in 2014–15.
- Further development of software and hardware to enable online access to large geological and geographical datasets for the minerals and energy resources sector through the Integrated Information Initiative.
- The department also developed the free Queensland Globe for G20 mobile app, and the free Queensland Resources smartphone and tablet app to showcase our world-class resources and help attract global investment in Queensland's mining and petroleum sectors.
- More than $1.0 million was provided to support the mining industry with specialised mining safety research, consulting and investigation services at the Safety in Mines Testing and Research Station (SIMTARS).
- Commencement of the second round of the Industry Priorities Initiative under the Future Resources Program which provided funding of $3.64 million toward five further innovative geoscience projects nominated by industry as research priorities.
- Collection of over $4.5 million worth of new pre-competitive geophysical data and geological assessments in the Mount Isa region to both attract new exploration investment and support existing exploration activity.

- Invested $6.24 million in a range of further research projects undertaken by the Geological Survey of Queensland to improve understanding of the geology and geological resources of Queensland.
- Commencement of Round 8 of the popular and successful Collaborative Drilling Grants initiative which resulted in contracts being signed with sixteen successful applicants who will potentially share up to $1.43 million in grant funding.
- Reef Projects: major research projects ($2.55 million) aimed at improving the quality of water entering the Great Barrier Reef lagoon. This includes projects under the Paddock to Reef program.
- Murray-Darling Basin (MDB) projects: science projects to improve knowledge and guide the sustainable allocation of water, and understand the associated threats to the environment from water resources development. This work will assist Queensland in reviewing Water Resource plans across the Queensland MDB and also meet our commitments to have these plans accredited under the Murray-Darling Basin Plan.
- The Murray-Darling Basin Authority's (MDBA) Basin Plan Monitoring and Evaluation program aims to measure, track and report basin environmental outcomes. The MDB Fish Survey sits within this program and involves monitoring fish in the MDB to evaluate the effects of the Murray-Darling Basin Plan on fisheries productivity.
- Committed $143,000 of in-kind support along with in-kind contributions from Department of Agriculture, Fisheries and Forestry, Australian National University and Griffith University together with $300,000 from SEQWater to leverage $477,000 from Australian Research Council (ARC). The project is aging and genetic testing of the Australian Lungfish to determine suitable environmental conditions for spawning so that this threatened species can be provided for when managing water infrastructure in the future.

Department of Science, Information Technology and Innovation —Science Delivery

- Climate data provided through the Open Data portal is being used to help sugarcane producers plan their irrigation requirements—when to apply and how much—so that their irrigation efficiency is maximised, irrigation inputs are minimised and productivity is increased. The IrrigWeb application was developed by SQR Software Pty Ltd for AgriTech Solutions, and uses the free climate data provided by the Queensland Government SILO database.

- Species data provided through the Open Data portal is being used by government, business, academia and the general public. This data is also redistributed via the Atlas of Living Australia, a major national partnership of Australian museums, herbaria, the CSIRO, a range of government agencies and other entities with biological collections. Data is sourced from all levels of government and other third parties and managed in the WildNet database within the department's Science Division.
- Much of Science Division's spatial, monitoring and modelled data is available through the Queensland Open Data portal supporting government, business, academia and the general public. The Queensland Open Data is a whole-of-government initiative that each department contributes to and funds.
- Movement of turtles and dugong along the Queensland coast is now better understood following the production of short movies which track animal movement using telemetry data. The movies will assist the Department of Environment and Heritage Protection in protecting vulnerable species and developing science-based policies.
- The FORAGE system is based on 30 years of seasonal forecasting, pasture growth modelling science and satellite technology to provide decision support tools specifically for grazing land management for the whole of Queensland. Graziers and land managers can easily access property-scale information to support sustainable grazing land management decisions through the FORAGE system, available on the Queensland Government's Long Paddock website. FORAGE is supported by the best available science and helps landholders to identify priority areas and adjust the management of grazing animals to restore pasture and soil condition as required.
- SEAtide is a probabilistic storm tide forecast model for the Queensland coast that was develop to enhance the existing deterministic storm tide forecasting capabilities and emergency response. SEAtide has increased the capability of the State Disaster Coordination Centre (SDCC) to respond to storm tide threats by providing probabilistic storm tide information at a finer resolution for the warning areas.

Department of Science, Information Technology and Innovation —Science Development

- Awarded $7.23 million in government support to 25 Accelerate Queensland recipients in the areas such as agriculture, Great Barrier Reef protection, improving health management and biofuels. The recipients leveraged an additional $10.29 million from Queensland universities and other project partners.

- A new three-year partnership with the Smithsonian Institution in Washington to support Queensland researchers and teachers to undertake research at the world famous US institution. The government will invest $360,000 to support Queensland-Smithsonian and Queensland-Cooper Hewitt fellowships programs. This is the only agreement of its type between the Smithsonian Institution and an Australian state government.
- From 2013–14 to 2016–17, funding of $46,332,000 awarded to James Cook University toward the construction of the Australian Institute of Tropical Health and Medicine (AITHM). Three facilities will be established at the Townsville, Cairns and Torres Strait (Thursday Island) nodes of the James Cook University campus. These facilities will build on JCU's current capabilities in tropical science and medicine and existing expertise in the Australian Tropical and Innovation Precinct, Australian Tropical Forest Institute and the Queensland Tropical Health Alliance.
- Established a Queensland node of the Commonwealth Research Data Storage Infrastructure (RDSI) and National eResearch Collaborative Tools and Resources (NeCTAR), providing critical infrastructure for very large-scale research data and computer cloud resources to Queensland research.
- Funding of $9.9 million was awarded to The University of Queensland for the operation of the Clem Jones Centre for Ageing Dementia Research for the development of:
  - novel therapeutic approaches to prevent and treat dementia
  - new and improved diagnostic tests and tools to ensure dementia is detected as early and accurately as possible
  - lifestyle strategies for maintaining a healthy brain
  - novel research tools and methods for study of dementia.
- Queensland-Pfizer Drugs for Diabetes and Cardiovascular Drug Discovery: funding of $2.2 million awarded to The University of Queensland under the Co-Investment Program. This project leveraged a new R&D partnership between the Australian Government, The University of Queensland, and the world's largest research-based pharmaceutical company Pfizer to develop new treatments for diabetes and cardiovascular diseases. The project was completed successfully in September 2014.
- Assistant Professor Christian Hamilton-Craig from Metro North Hospital and Health Service, Prince Charles Hospital Service District was awarded funding of $198,000 under the Smart Futures Fellowship Program for work on 'Novel cardiac imaging to improve outcomes in patients with coronary heart disease'. This project aimed to evaluate new, non-invasive

methods for quickly and accurately diagnosing and evaluating coronary heart disease in order to reduce ED waiting times and better manage the demand for hospital services.

The outcome was new methods of defining and treating cardiac illness that led to a change in treatment protocols, better and more rapidly informing clinical decisions at lower cost and less risk, thereby significantly improving patient care and systems management. The project was completed in November 2015.

- Funding of $2.2 million awarded to Queensland University of Technology under the Co-Investment Program for Project ResQu. This project focussed on unmanned aircraft (UA), safety studies were undertaken and automated safety technologies developed to enable the timely approval of UA for disaster recovery. UA also routinely delivering benefits through surveys for biosecurity and resource management.

  UA can fly for extended periods of time and in conditions considered too dangerous for piloted aircrafts making them better suited to the continuous mapping of floodwaters and fire-fronts, assessing damage to infrastructure and locating disaster survivors. The project was completed successfully in February 2015.

Department of Transport and Main Roads

- The Department of Transport and Main Road (TRM) committed $200,000 towards the Smart Transport Research Centre (STRC) in 2014–15. A key focus of R&D during this period, was the extension of capabilities around the Model Free Network/Jellyfish application, which has the potential to support the department's transport modelling activities. This research led to a trial application project, given its demonstrated potential to improve data management.
- TMR invested $5000 towards the Long Term Pavement Performance Study (Stage 3) for Transport System Asset Management, an ongoing project which commenced in 2011. The study helped to fill the knowledge gaps in pavement structural capacity and used this structural data to improve the health of TMR's road infrastructure network. The project is an alliance between TMR, Logan City Council, Gold Coast City Council, Redland City Council and Griffith University. The research is being conducted at Griffith University's Gold Coast campus.
- Committed $50,000 towards the King George Square bus station Step-Hear system trial. TMR collaborated with Guide Dogs Queensland to implement this 'talking signs' system, which made a difference to the independence, mobility and navigation of passenger with a vision impairment at bus stations.

- Invested $21,000 towards technology for the development of new go card products that specifically cater to passengers travelling for business conferences and tourism purposes. These new products support Queensland Government initiatives and sales increase travel days on Queensland transport.
- Committed $3.68 million towards the Emergency Vehicle Priority (EVP) project, enhancing the safety of frontline officers and the community by providing a green traffic signal light for emergency response vehicles to pass through. In 2015, the EVP project won an Intelligent Transport System (ITS) Australia National Industry Awards in the local government category.
- TMR invested $80,000 to design, develop and deliver the Queensland Registration Check mobile app to help customers quickly and easily check the registration details of a car, truck, motorcycle or trailer. The project was conducted in-house by TMR.
- Committed $121,024 to the Australasian New Car Assessment Program (ANCAP). This program provides consumers with transparent advice and information on the level of occupant and pedestrian protection provided by different vehicle models in the most common types of crashes, as well as their ability—through technology—to avoid a crash. Since 1993, ANCAP has published crash test results for over 500 passenger and light commercial vehicles sold in Australia and New Zealand. The Australian Government, all states and territories, and motoring organisations are members of ANCAP.
- Since 1990, the Monash University Accident Research Centre (MUARC) has conducted research to examine issues relating to vehicle safety in both Australia and New Zealand through the analysis of large databases on real crash outcomes, the registered vehicle fleet, roadworthiness inspections and detailed injury outcomes from insurance claims. In 2014–15, TMR committed $22,667 towards MUARC.
- TMR committed $4.2 million to the Australian Roads Research Board (ARRB) in 2014-15 to investigate and research opportunities for the application of new and innovative technologies, which have the potential to provide improved value for TMR and government. This work demonstrated improvements in:
  - the value achieved from total road expenditure
  - technical capability
  - technology transfer and learning
  - cost effectiveness of project outputs.

As a result, the National Asset Centre of Excellence (NACoE) was established in Queensland. With multi-year committed funding, the Centre will invest in a strategically focussed program of work which will help to retain expertise in the state. It will also collaborate with the private sector to foster innovation in TMR works.

- Committed $165,000 to Sustainable Built Environment projects, this investment has helped TMR to:
  - review current technology and process innovation in active traffic management, efficient lighting technologies and renewable energy technologies to inform current and future TMR projects
  - enhance sustainability reporting, reporting tools and low carbon readiness
  - examine the New Generation Rollingstock Project across its infrastructure lifecycle from planning through design, construction, maintenance and rehabilitation/recycling.
  - understand Building Information Modelling (BIM) touchpoints to establish future formatting, benchmarking, and inform principal audits and actions
  - participate in developing national BIM guidelines, which have direct benefit to TMR by directing/assisting stakeholders to deliver infrastructure projects.

Metro North Hospital and Health Service

- The Perinatal Research Centre is undertaking clinical trials to establish the best way to manage seizures in newborn babies. The Prem Baby Triple P Parenting Study is now half way to completion. This research project, funded by the National Health and Medical Research Council (NHMRC) and led by Professor Colditz, will determine whether this parenting intervention improves outcomes for preterm babies. Other ongoing clinical trials which utilise state-of-the-art methods and techniques include:
  - predicting motor outcomes in preterm babies using MRI
  - establishing the effects of massage in very preterm babies
  - optimising adaptation of the cardiovascular system to extrauterine life in very preterm baby
  - determining the effects of different feeding regimens on development in preterm babies.

These studies will have major impacts on defining best practice in clinical care to ensure best outcomes for babies and their families.

- Intensive Care research resulted in approximately 80 published research articles, numerous successful grant applications and academic success for a number of Metro North Hospital and Health Service (MNHHS) researchers. A key focus has been on sepsis and infection in Intensive Care, as well as antibiotics.

A major piece of completed work in the past year has been the BLING II (Beta-Lactam Infusion Group) Study, which was an NHMRC-funded study. Continued collaboration between The University of Queensland, The George Institute, QIMR and a host of local, national and international partners marked a turning point in the development of the Intensive Care Unit research team at the Royal Brisbane Women's Hospital (RBWH).

- NHMRC's cardiology research program focuses on health service research and evaluation. Much of this research has grown from the efforts of clinicians to improve models of care with interdisciplinary collaboration within RBWH and with other centres nationally and internationally. Research into the evaluation of patients presenting with chest pain is being actively translated into clinical practice throughout Queensland by the Health Innovation Fund supported by the Accelerated Chest pain Risk Evaluation (ACRE) clinical redesign project. This research is informing the evaluation of chest pain across Queensland and internationally.

  Pathways have been developed to investigate families who have suffered a sudden death at a young age, this involved collaboration with clinical genetics, forensic pathology and the Coroner's Office. A Cardiac Catheter Laboratory database with comprehensive mandatory complication tracking is being setup and will inform the Queensland Cardiac Outcomes Registry and the Australian Cardiac Outcomes Registry. NHMRC informed the development of a state-wide heart failure outcomes reporting (HERO) database, which was setup in January 2015. The database will track process and outcome measures of healthcare for all patients referred to heart failure nursing services in Queensland.

  Training echocardiography-naïve nursing staff to assess LV (left ventricle) function is being investigated. This could allow a paradigm shift for echocardiography to affordable population screening and disease monitoring. NHMRC is collaborating with a QUT-based group of researchers to investigate the role of salivary biomarkers in heart failure and cardiovascular disease detection. This may allow non-invasive and cost-effective early disease detection and monitoring in heart failure.

Motor Accident Insurance Commission

- In 2014–15, the Motor Accident Insurance Commission (MAIC) signed a new funding agreement to continue its support of the Centre for National Research on Disability and Rehabilitation Medicine (CONROD). CONROD has developed significant research expertise in the treatment and rehabilitation of injury and disability relating to trauma suffered in a road crash. Funding of approximately $6 million has been approved by MAIC over the next three

years, with an option to extend this funding by an additional two years. This commitment was based on CONROD's strong performance between 2010–14 including:

- leveraging nearly $50 million in additional grant funding during this period
- publication of 285 peer-reviewed journals with over half of these publications of relevance to claimants and the compulsory third party (CTP) scheme
- strong external feedback on its multi-disciplinary approach to its research portfolio covering injury management issues, from acute care to community integration, from a wide range of perspectives including economic, physical, psychological, social and vocational; and on the influence CONROD has on policy and practice decisions
- contribution to Queensland CTP scheme affordability with Queensland having, at the time of funding consideration, the second lowest CTP premiums for the average family car nationally.

Queensland Fire and Emergency Services

- The Australian Government, United States Government, and Queensland Fire and Emergency Services (QFES) provided funding of $658,000 to analyse the exposure of emergency responders to the by-products of fire at chemical, biological and radiological (CBR) incidents, and to generate data for decision support tools. The aim of the project, managed in-house at QFES, is to determine the exposure of firefighters at simulated and actual residential, office and industrial fires. The information will provide a comprehensive picture about the exposure of firefighters undertaking activities within hazardous areas. It will be used to extend and refine guidance regarding the selection of risk control measures and management of fire protective clothing including when it is 'dirty' and cleaning schedules for protective clothing.
- Funding of $1.7 million was provided by the Australian Government, Adelaide University, United States Government and QFES to measure risk-based skin decontamination at CBR and nuclear incidents. The objectives of this project, located at Adelaide University, are to supplement the evidence base for a selected range of chemical agents and refine a risk-based decision support model for skin decontamination in the case of dermal exposures to these agents. The data generated will be incorporated into a Risk Based Decision Support Tool.
- A project budget of $225,000 was funded by the Australian Government, United States Government and QFES to develop a risk-based decision support tool. Co-located at QFES and the Georgia Tech Research Institute (US), the aim of the project is to develop the

knowledge-base and decision frameworks for inclusion into the CBR and nuclear risk assessment tool for managing exposures. In addition, user workshops will be held involving law enforcement and fire agencies drawn from across Australia. The frameworks will be incorporated into the Emergency Response Decision Support Software.

- QFES is working with the Bushfire and Natural Hazards Cooperative Research Centre (BNHCRC) to identify areas that may be at higher risk of bushfire following Tropical Cyclone Marcia, which crossed the Queensland coast on 20 February 2015. A Bushfire Taskforce was established to define the increased level of bushfire risk following damage to local vegetation in QFES Central Region. QFES has provided $40,000 in funding for this project.
- Funding of $145,000 has been provided by QFES to develop a decision support tool (Simulation Analysis Based Risk Evaluation (SABRE)) to support emergency managers to make consistent, justifiable, defensible, repeatable and fully traceable decisions. Stage one of this in-house project will focus on business and data requirements, scoping and planning.
- Funding of $12,000 has been provided by the Department of Natural Resources and Mines, The University of Queensland and QFES to support built environment engineering services, grow knowledge for underground mine safety, and enhance understanding of wayfinding and visibility in smoke environments using camera imaging equipment to inform safe firefighting. This project is being conducted in-house by QFES.
- A project budget of $20,000 has been provided to assess the total energy released from a fire event occurring in a tunnel and allow cross-checking of the codified fire resistance of Brisbane's vehicle tunnels to support built environment engineering services with a specific focus on the then planned Brisbane Bus and Train Tunnel. The project also aims to build knowledge of critical infrastructure fire design and develop alternative tunnel design methodology, which has the potential to significantly impact firefighter response. The Department of Natural Resources and Mines, The University of Queensland and QFES supplied funds for this in-house project.

Queensland Museum

- Queensland Museum Network secured the rights to host the first World Science Festival in the Southern Hemisphere. The inaugural World Science Festival Brisbane was held in March 2016 with more than 120,000 people attending events and activities held in venues across the Cultural Precinct.

- The Cultural Environments Program published five peer-reviewed articles. The Natural Environments Program published a further 136 peer reviewed papers, technical reports and conference abstracts; described more than 120 new species ranging from protozoans to mammals; and received 170 published acknowledgements from peers.
- Chantal Knowles co-edited the volume *Trophies, Relics and Curios? Missionary Heritage from Africa and the Pacific*, the outcome of a collaborative research project with the University of Cambridge and University of East Anglia involving scholars from Africa and the Pacific. David Mewes co-authored the volume *Salute to the Hudswells: The Story of the Colonial Sugar Refining Company's Hudswell Clarke locomotives in Queensland and Fiji*.
- Natural Environments' researchers won 10 new National Taxonomic Research Grants and Bush Blitz Tactical Taxonomy Grants (Australian Biological Resources Study, Department of the Environment), and an Australian Research Council Linkage Grant with a combined value of approximately $370,000.
- The Museum of Tropical Queensland played a major role in the identification of a new species of marine mammal, namely Sousa, the Australian Humpback Dolphin, a major event for marine mammal taxonomy and diversity.
- Curator Dr Brit Asmussen received an AINSIE Research Award from the University of Sydney to carry out 10 radiocarbon dates on bone samples from the Donald Tugby Excavation of Cathedral Cave.
- Senior Curator, Dr Geraldine Mate, co-convened the Australian Archaeological Association —Australasian Society for Historical Archaeology Annual Conference in Cairns and Dr Brit Asmussen contributed to four sessions. More than 300 papers were submitted for the conference, which featured national and international speakers on the theme of archaeology of the tropics.
- Senior Curator Dr Niel Bruce chaired a session at the International Congress on Parasites of Wildlife and 43rd Parasitological Association of South Africa, and co-presented a paper on South African parasites of marine fishes. A field expedition to the northernmost part of South Africa's Indian Ocean coast, Kosi Mouth and Kosi Bay, was the first ever to collect marine isopods from this coast. Ten new species of this significant marine predatory and parasitic group of crustaceans were also discovered from northern Queensland.
- The Cultural Environments Program, in collaboration with the University of Sydney, was awarded an ARC Discovery Grant for Excavating MacGregor: re-connecting a colonial museum collection. The museum holds the largest collection of ethnographic objects

assembled by colonial administrator, Sir William MacGregor, and this project will bring new insights into the collection content and context.

- Queensland Museum researcher, Dr Paul Muir and colleagues, published an article in the journal Science, based on their analysis of present-day global depth distributions of reef-building corals.
- Head of Terrestrial Environments, Dr Robert Raven, completed years of research culminating with the final publication on the taxonomy of the entire family of Ant-Mimicking spiders from the Western Pacific. In his research, Dr Raven described 108 species, of which 77 species and eight genera were new to science.
- In partnership with Queensland XRAY and Siemens, Geosciences staff used high powered CT scanning to uncover new 'dinosaur trackways' from Lark Quarry in western Queensland.
- A 200 million-year-old spider fossil from the Triassic Period was discovered in shale deposits from Dinmore, near Ipswich. This represents the first fossil mygalomorph spider ever described from Australia.
- A new species of fish, well-known to fly fishers as 'sweetlip', and a deepwater species of Sandperch, were discovered using DNA technologies.
- Two new species of rainforest skinks were discovered living in boulder-field associated with rainforests at Cape Melville and the McIlwraith Range in north Queensland.
- Queensland Museum researchers collaborated with other Australian, Singaporean, Japanese and Taiwanese scientists to document and publish a monograph on the native species of Christmas Island and Cocos Keeling Islands.
- A study of the population genetics of 'rock sponges' was conducted, in collaboration with colleagues from the Ludwig–Maximilians–Universität München, Germany, using specimens collected from seamounts in the south-western Pacific.
- Queensland Museum, in collaboration with international researchers, led a pivotal review of the global knowledge of parasites of aquatic wildlife, published in *Trends in Parasitology*.
- Dr Christine Lambkin, Curator of Entomology, was awarded the Peter Doherty Science Education Partnership Award for developing and running the Backyard Explorer project.
- Dr Rob Adlard, Head of Marine Environments and Senior Curator of Parasitology, was elected Fellow of the Australian Society for Parasitology in recognition of his contributions to, and promotion of, the scientific discipline of parasitology.
- The research career of Dr John Hooper, Head of Natural Environments Program, was recognised by publication of the new national science curriculum *Nelson Biology Units 1 & 2* for the Australian Curriculum in June 2015, as a case study entitled, *Sponges and Evolution with 'Sponge Hoops'*: Dr John Hooper.

- Head of Information Management and Information Technology, Kerry Cody, was awarded the Smithsonian Fellowship 2014–15 to work with Smithsonian Institution Archives on building a digital archive framework for improved community access to Queensland's digital objects and information.
- The Queensland Museum discovered and described over 120 new species during 2014–15, ranging from single-celled protozoans to mammals. Over the 153 years of discovery Queensland Museum scientists have described and named more than 4,500 species new to science. The Museum is custodian to a collection of approximately 16 million specimens, living and fossils, rocks and minerals. These biological and geological collections and associated laboratories are located in three campuses (Southbank, Hendra and Townsville), with the collection representing the material evidence of Queensland's natural heritage in time and space.
- The museum commits approximately $0.8 million and leverages approximately $0.3 million from other sources in salary and operational costs to undertake taxonomic and systematics research leading to the discovery of new species.
- In 2014–15 one of the more unusual taxonomic discoveries was a new species of sweetlips fish, named *Plectorhinchus caeruleonothus*. The new species reaches about one metre in length, is widespread on shallow reef flats from Ningaloo Reef, Western Australia, to Cape York, Queensland, and has been a popular target for fly-fishing for decades—and yet it had remained unrecognised as a distinct species until now. It also has an amazing transformation in its coloration between juveniles and adults, and exhibits a unique 'kissing' behaviour between rival males.

  Using its morphological features (bones, fins, scales etc) and mitochondrial DNA barcoding data, the new species was compared to other related sweetlips species from East Africa, the Middle East, east to Japan and south to Australia, and this evidence confirmed it was different from the other species and new to science. The discovery attracted enormous international media attention, possibly because it was a species that had been overlooked for decades, despite its large size and popularity by fly fishers. However, it is more likely that it attracted attention because of the name given to it by Museum scientists, literally meaning 'blue bastard'—*caeruleo* (blue) and *nothus* (bastard)—which the fish has been called due to the difficulty fishers have in catching it using fly-fishing. Excerpt from the QM Board Report, Zootaxa 3985(4): 491–522 (14 Jul. 2015, open access article), and international media (e.g. on The Sydney Morning Herald website).

Queensland Police Service

- Investigate options to improve mainstream media reporting of Islam: The Australia-New Zealand Counter-Terrorism Committee (ANZCTC), located at Griffith University's Nathan campus, provided funding of approximately $840,000 over three financial years (2014–15 to 2016–17) for this project.

  Targeting journalists, editors and journalism students, the project aims to prepare, deliver, assess and then modify various treatment options to improve the quality of mainstream media reporting in Australia on issues relating to Islam. The objective is to minimise the social isolation and conflict experienced by the Muslim community with a view to decreasing the risk of radicalisation.
- Forensic Reasoning Project: with a total budget of $532,000 over five financial years (2011–12 to 2015–16), the aim of this project is to support the claims of fingerprint experts and their ability to provide opinion evidence to Australian Courts. Testing by The University of Queensland produced results that were recognised as world-leading and the Forensic Reasoning Partnership between police forensic experts and psychology academics was the first of its kind.

  The project is funded by an Australian Research Council Linkage Grant ($150,000), Australian Federal Police and National Institute of Forensic Science (combined funding of $150,000), The University of Queensland ($32,000) and the Queensland Police Service ($200,000 in-kind support). The project is located in police headquarters in Brisbane.

QIMR Berghofer Medical Research Institute

- Found a new treatment approach that could offer hope to patients with the aggressive blood cancer, acute myeloid leukaemia (AML).
- Completed a Phase I clinical trial for experimental immunotherapy treatment for aggressive brain cancer.
- Identified a way to prevent bone marrow transplant patients from suffering serious complications.
- Found new markers for melanoma which may allow the disease to be accurately monitored via a routine blood test.
- Determined that sudden 'chromosomal catastrophes' may trigger a third of oesophageal tumours, the fastest rising cancer in Australia.

- Determined more people die from thin melanomas (less than one millimetre) than thick melanomas (greater than four millimetres).
- Used an experimental drug produced from the seeds of a rainforest plant to cure solid cancer tumours in pre-clinical studies.
- Determined that some anti-inflammatory drugs have the potential to prevent squamous cell carcinoma.
- Determined how a single DNA variant increases a woman's risk of developing breast cancer.
- Found that women in rural and remote areas of Australia have a higher risk of dying from ovarian cancer than those in richer, urban areas.
- Discovered a novel family of toxins in the venom of box jellyfish, opening the door for further investigation into the use of the venom in the treatment of cancers.
- Collaborated with the CSIRO on developing a breath test to diagnose malaria.
- Commenced pre-clinical study of a genetic treatment to permanently suppress HIV.
- Developed a unique methodology for conducting clinical trials for the treatment of malaria.
- Developed a method to predict developmental outcomes for pre-term babies.
- Comprehensively mapped the connections in the healthy elderly brain, laying the groundwork for new research into Alzheimer's disease and dementia.
- Identified genes associated with the most common form of glaucoma, the world's leading cause of irreversible blindness.
- Identified five genetic variants that influence the size of structures within the brain.
- Found that hypoglycaemia significantly increases the risk of cardiovascular disease and death in diabetic patients.
- Commenced a two-year trial of a rheumatoid arthritis medication to treat asthma.

Appendix B: Australian Bureau of Statistics classifications

The Socio-Economic Objective (SEO) (1297.0—Australian and New Zealand Standard Research Classification (ANZSRC), 2008)

The ANZSRC SEO classification allows R&D activity to be categorised according to the intended purpose or outcome of the research, rather than the processes or techniques used in order to achieve this objective.

SEO sector and division codes and titles

Sector A: Defence
- 81 Defence

Sector B: Economic Development
- 82 Plant Production and Plant Primary Products
- 83 Animal Production and Animal Primary Products
- 84 Mineral Resources (excl. Energy Resources)
- 85 Energy
- 86 Manufacturing
- 87 Construction
- 88 Transport
- 89 Information and Communication Services
- 90 Commercial Services and Tourism
- 91 Economic Framework

Sector C: Society
- 92 Health
- 93 Education and Training
- 94 Law, Politics and Community Services
- 95 Cultural Understanding

Sector D: Environment
- 96 Environment

Sector E: Expanding Knowledge*
- 97 Expanding Knowledge

The Fields of Research (FOR) classification (1297.0—Australian and New Zealand Standard Research Classification (ANZSRC), 2008)

The ANZSRC FOR allows R&D activity to be categorised according to the methodology used in the R&D, rather than the activity of the unit performing the R&D or the purpose of the R&D.

FOR division codes and titles**

- 01 Mathematical Sciences
- 02 Physical Sciences
- 03 Chemical Sciences
- 04 Earth Sciences
- 05 Environmental Sciences
- 06 Biological Sciences
- 07 Agricultural and Veterinary Sciences
- 08 Information and Computing sciences
- 09 Engineering
- 10 Technology
- 11 Medical and Health Sciences
- 12 Built Environment and Design
- 13 Education
- 14 Economics
- 15 Commerce, Management, Tourism and Services
- 16 Studies in Human Society
- 17 Psychology and Cognitive Sciences
- 18 Law and Legal Studies
- 19 Studies in creative Arts and Writing
- 20 Language, Communication and Culture
- 21 History and Archaeology
- 22 Philosophy and Religious Studies

In the interests of international statistical comparisons, the FOR classification, as far as is practicable, aligns at the two digit division level with the OECD's Fields of Science 2007 classification.

---

* Sector E Expanding Knowledge is for the categorisation of R&D which does not have an identifiable socio-economic objective. This is usually the case for pure basic research or strategic basic research, as defined in the Type of Activity classification. Applied research and experimental development, by definition, have an identified socio-economic objective and therefore should not be categorised.

** In the interest of international statistical comparisons, the FOR classification, as far as is practicable, aligns at the two digit division level with the OECD's Fields of Science 2007 classification.

Visit the Australian Bureau of Statistics website.