Audit of Science Investment and Funding Programs (Innovation & Science Development)
Final Report

Professor Mandy Thomas, Ms Meredith Nolan, Mr Alex Cody and Dr Geoff Garrett AO

This audit and strategic analysis of the Science Investment and Funding Programs managed by the Department of Science, Information Technology, Innovation and the Arts (DSITIA) and its predecessors, has been undertaken as part of the government's examination of its science capability and investment following the election in March 2012.

The government is committed to using science and innovation for economic success by ensuring that it has access to the best possible scientific advice and that this is directed toward meeting the future policy challenges of Queensland industries, and contributes to sound decision-making about environmental, economic, industry and social issues.

This audit is the third in a series of audits of the Queensland Government's scientific capability and investment oversighted by the Office of the Queensland Chief Scientist.

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Biography of Professor Mandy Thomas, Lead Author

Mandy Thomas (BA Hons; PhD ANU), has taken up the position of Professor – Strategic Initiatives at QUT.

She has had extensive research management experience including managing the research portfolio at the Australian National University as Pro Vice Chancellor – Research from 2006 to 2012.

She has held academic posts at several Australian universities, as well as working for almost 3 years for the Australian Research Council in Canberra where she ran the Discovery Projects scheme.

Prior to gaining a PhD in the anthropology of contemporary Vietnam she was an ultrasonographer with a background in science, evidence of her broad experience across a range of disciplines.

Report at a glance

The Queensland Government is committed to using science and innovation for economic success by ensuring it has access to the best possible scientific advice and that this is directed toward meeting the future policy challenges of Queensland industries and contributes to sound decision-making about environmental, economic, industry and social issues.

The Queensland Government's strategic investments in science capability over the last decade have left an enduring legacy. Funding provided to science, technology and innovation has significantly impacted upon Queensland's competitiveness in terms of its global reputation for science excellence and its research capability.

An internal audit and strategic analysis of the science investment and funding programs managed by Science Development, Department of Science, Information Technology, Information and the Arts (DSITIA) (and its predecessors) has been undertaken by the Office of the Queensland Chief Scientist as part of the government's examination of its science capabilities following the March 2012 State election.

Key findings of the audit include:

- In the mid 1990s Queensland's public R&D sector was regarded as fragmented, lacking critical mass and not well placed to foster interdisciplinary approaches increasingly needed to address Queensland's social and environmental challenges.
- Since 1998, the Queensland Government has invested $4.9 billion into science, research and development, innovation and education. Of this $4.9 billion, the responsible departments invested $1.28 billion towards science infrastructure ($863 million), operational funding ($192 million), projects and collaborations ($186 million) and skills ($39 million). This investment has leveraged approximately $2.7 billion from external sources, resulting in a leverage to funding ratio of at least 2:1.
- The government's investment has funded 45 pieces of research infrastructure, 248 projects and 318 fellowships/Smithsonian fellows/PhDs.
- 71% of the total funding has been invested in Brisbane universities with 14% supporting regionally based universities and the balance supporting non-university recipients (i.e. independent medical research organisations and State and Federal science agencies).

Audit of Science Investment and Funding Programs – at a glance

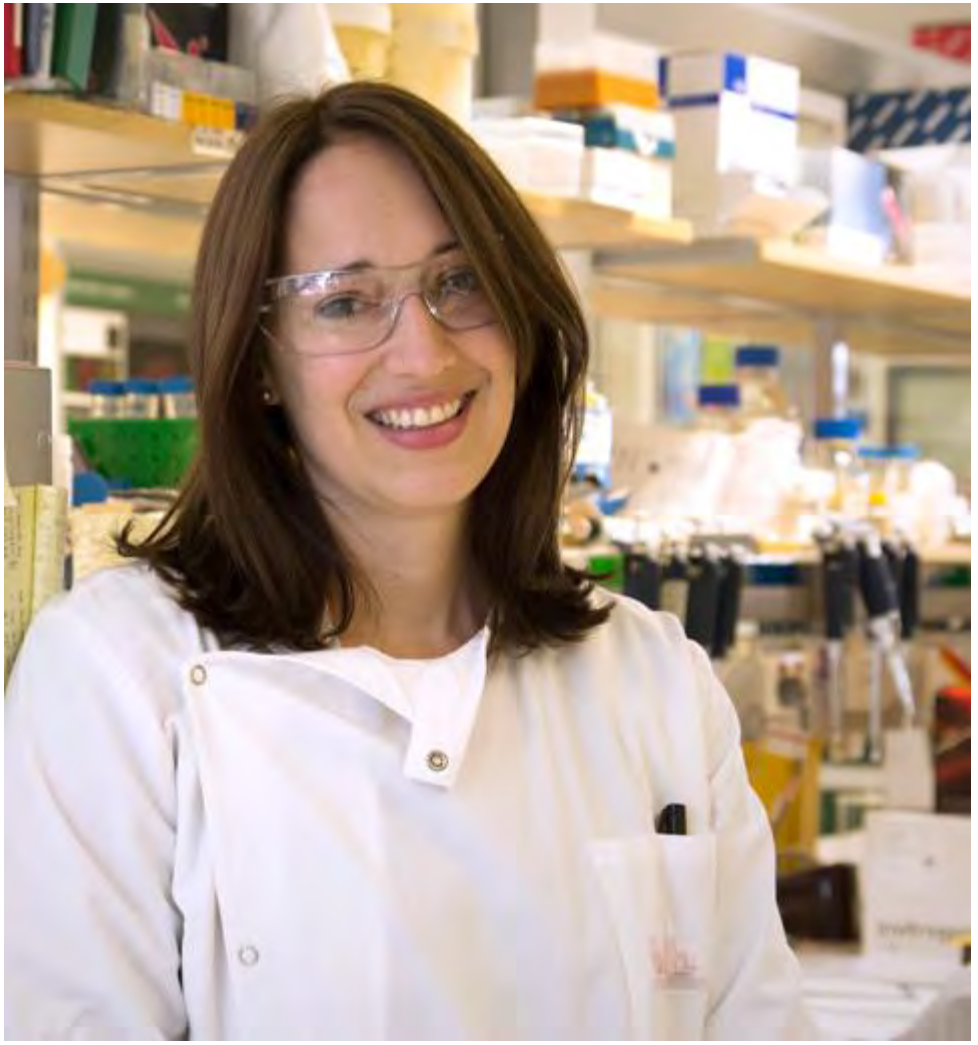
- The cost of administering the science funding programs has been estimated at approximately 1.35% of the program investment.
- The first six years of science investment (1999-2005) saw a large commitment to update existing and introduce new infrastructure which was critical to attracting the best and brightest people to Queensland. Each new piece of infrastructure attracted significant leveraged funding from outside government, including philanthropists, the university sector, Australian Government and industry.
- Operational funding arrangements with universities and independent research organisations were however found to be temporary, piecemeal and expose the government to continuing ad-hoc requests for recurrent funding. There is a risk that operationally-funded research infrastructure (including facilities and equipment) may no longer perform at full capacity if alternative funding cannot be secured.
- The investment in infrastructure has clearly been followed by a significant investment in people. The combined push for people as well as projects has meant that the reputation of science in Queensland has now never been higher. This is recognised not just in the international world rankings of universities but also in the ability to attract talent into Queensland from interstate and around the world.
- In relation to research quality, analysis of Queensland's 2012 Excellence in Research for Australia (ERA) results show that Queensland university researchers are performing above or well above world standard in relation to the four pillar areas as well as health, IT and the environment.
- Whilst academic impact and Queensland's reputation for science as a result of the investment is high, it is still difficult to assess societal impact. Queensland still underperforms in competing for external competitive grant funding.
- Research impact, in contrast to research excellence, is much harder to assess. It often takes many years to become apparent and can be difficult to identify the causality between a research project and a specific impact. Overall, there remains a need to better communicate the linkage between achievements, e.g. medical breakthroughs, now emerging as a result of the significant science investment into infrastructure, projects and skills in the State over the preceding decade.

Audit of Science Investment and Funding Programs – at a glance

- The importance of partnering with the best in science and research is vital given its global nature as well as its increasing scale and complexity. The government investment has supported a range of international agreements with science groups around the world, including collaborative science initiatives with emerging scientific powerhouses, China and India. Continuing to build on Queensland's reputation for scientific and research excellence will become increasingly important in the future.
- A large proportion of the $1.28 billion was invested in the broad R&D priorities of health and well-being and enabling sciences and technologies (many of which also supported the health/biomedical domains), with a fifth in targeted environmental science. This investment has coincided with Queensland having developed notable strengths in health and biomedical research.
- The government is still providing some funds into the science and research system through: commitments to existing grants and loans ($40.8 million in 2012-13, $29.38 million in 2013-14 and $17.64 million in 2014-15); a $4.8 million commitment to the Queensland University of Technology's Centre for Tropical Crops and Biocommodities; approximately $10 million per annum in operational funding commitments to the Institute of Molecular Bioscience (which ceases in 2014); and $42.12 million to establish the Australian Institute of Tropical Health and Medicine with James Cook University.
- From 2015, recipient universities are required to commence infrastructure loan repayments of just on $200 million (over the following 19 years). Noting the original intent of loan repayments was to create a revolving science innovation fund, the Audit recommends investigation into the creation of a revolving/ endowment type fund aimed at creating the basis for a more sustainable source of science funding for Queensland.
- The concept of 'brains to business' and the translation of research into quantifiable economic outcomes remains problematic.
- Whilst the government has entered into proceeds of commercialisation agreements tied to infrastructure loans, returns to the State are yet to eventuate. Initial overly optimistic expectations of returns have been tempered with the realisation, particularly in disciplines such as molecular biology, neuroscience and nanotechnology, that these areas of great complexity have longer commercialisation lead times.
- However, these arrangements - many of which will remain in place over the next 20 years or more - will ensure that the State will share in any large windfall revenues that may eventuate from the exploitation of state-supported research. Additionally, the prospect of commercialisation returns is improving as university commercialisation offices become better at identifying and exploiting new intellectual property with commercial potential.

Key recommendations of the Audit include the necessity for maintaining momentum and building on Queensland's world class research infrastructure, capabilities and attracted and retained talent by:

- supporting talent through a re-focussed fellowships program
- encouraging greater engagement between universities and businesses in order to convert research outputs to practical outcomes
- building an increased emphasis on supporting research in regional Queensland and engagement with Asia
- developing greater engagements with the community as to the benefits of science and encouraging the uptake of science in schools and as a career
- improving review and assessment mechanisms relating to research impact, and
- creating a more stable future funding and investment platform through creation of a revolving science and innovation/endowment type fund.



Dr Irena Vetter, Institute for Molecular Bioscience/ School of Pharmacy, University of Queensland Queensland Young Tall Poppy 2014

Contents

Describe and analyse the science funding and investment through DSITIA Science Development and Innovation programs in relation to the following questions:

1. What is the scope and content of the current science funding and investment program?
2. How does this program align with the government's objectives and priorities?
3. Who are the key clients and stakeholders?
4. What resources and capabilities (systems, funding and staffing) are required by DSITIA to conduct the science funding and investment program?
5. What resources and capabilities (systems, funding and staffing) are required by funding recipients to participate in the program?
6. What are the advantages and disadvantages of the science funding and investment program in terms of its efficiency and effectiveness?
7. What opportunities are there to reduce the administrative burden on funding recipients?
8. Are there any alternative mechanisms available to government to encourage and stimulate the development and maintenance of science research capability and expertise?
9. What are the benefits, costs and risks associated with any alternative mechanisms?
10. What recommendations are proposed for the future provision of science funding and investment programs?

Audit process, timeline and consultation

Audit rationale

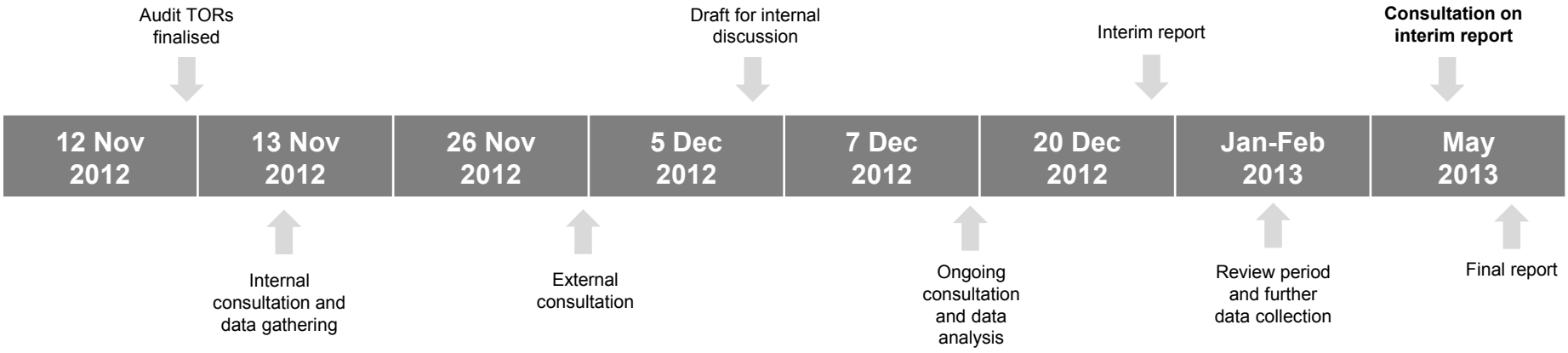
The Queensland Government is committed to using science and innovation for economic success by ensuring that it has access to the best possible scientific advice and that this is directed towards meeting the future policy challenges of Queensland industries and contributes to sound decision-making about environmental, economic, industry and social issues. This internal audit and strategic analysis of the science investment and funding programs managed by Science Development and Innovation (Science Development), DSITIA (and its predecessors) has been undertaken as part of the government's examination of its science capability and investment following the State election in March 2012. This Audit is the third in a series for wider consideration of the State Government investment in scientific services and capability, conducted through the Office of the Queensland Chief Scientist.

Audit process

Following an agreed Terms of Reference, the audit process involved information gathering in relation to Science Development managed science investment and funding programs, consultation with major collaborators, grants assessors, clients and stakeholders, and a process of internal and external review. An external reviewer was appointed to lead the audit. The Queensland Chief Scientist provided process and governance oversight and objective assessment of the audit.

Consultation process

Consultation occurred through face to face meetings and telephone interviews. Interviews were conducted with senior staff from eight Queensland universities, leading research organisations, grant assessors, grant recipients (and some unsuccessful applicants), Queensland Government agencies, and industry. A detailed consultation list is provided at Appendix 1 (page 70).



Uplift in Queensland's science and research capability

- STEM related employment substantially increased – 117,600 (1996-97) to 245,500 (2012)
- GERD intensity increased from 1.2% to 1.5% of GSP
- BERD intensity increased from 0.5% to 1.0% of GSP
- Between 1997 and 2011, the number of publications with Queensland authors grew by 218%, compared to 167% for Australia as a whole
- Queensland's top 3 subject areas for publications were in the broad realms of biology - 'Medicine', 'Agricultural & Biological Sciences' and 'Biochemistry, Genetics and Molecular Biology'
- Queensland universities by and large assessed as being at, above or well above world standard (2012 ERA analysis)
- China now (2012) constitutes 8% of our total publication collaborations compared to 5% in 2002.
- The number of Queensland/China co-authored publications has grown nearly 6.5 fold in the past decade (compared to a 2.5 fold increase in total Qld publications).
- 44 new research infrastructures

Introduction

Over more than a decade the Queensland Government has made strategic investments in science capability that have left an enduring legacy. Funding provided to science, technology and innovation by the State Government has significantly impacted upon the State's competitiveness in terms of its global reputation for science excellence, its research capability and, in all likelihood, its industries. The evidence points to an extraordinary uplift in the number of researchers who are now working in Queensland across a range of institutions. Due to these investments, over the last decade there has been a remarkable transformation of Queensland into a highly attractive intellectual hub that has attracted creative minds and led to heightened levels of industry engagement with research in universities.

The Queensland Government is committed to using science and innovation for economic success by ensuring that it has access to the best possible scientific advice and that this is directed toward meeting the future policy challenges of Queensland industries and contributes to sound decision-making about environmental, economic, industry and social issues. This internal audit and strategic analysis of the science investment and funding programs managed by Science Development and Innovation (Science Development), DSITIA (and its predecessors) has been undertaken as part of the government's examination of its science capability and investment following the election in March 2012.

Conduct of the audit

Following an agreed Terms of Reference, the audit process involved information gathering in relation to Science Development managed science investment and funding programs, consultation with major collaborators, grants assessors, clients and stakeholders, and a process of internal and external review. An external reviewer was appointed to conduct the audit. The Queensland Chief Scientist provided process and governance oversight and objective assessment of the audit.

Consultation occurred through face to face meetings and telephone interviews. Interviews were conducted with senior staff from eight Queensland universities, leading research organisations, grant assessors, grant recipients including unsuccessful applicants, Queensland Government agencies, and industry.

Key points

Since 1998, the Queensland Government has invested $4.9 billion into science, research and development, innovation and education.

Of this $4.9 billion, Science Development has invested $1.28 billion towards external science infrastructure ($863 million), projects ($186 million), operational funding ($192 million) and skills ($39 million).

This investment has leveraged at least $2.71 billion from external sources, resulting in a leverage to funding ratio of at least 2:1.

Scope of the investment

The need for particular aspects of science funding has changed over time. Until now the Queensland Government has primarily provided funding for key infrastructure, projects and fellowships, top-up funding for PhD scholars, and operational funding to certain institutes. The first years of the investment in science in the state saw a large commitment to update existing and introduce new infrastructure which was critical to attracting the best and brightest people to Queensland. Each new piece of infrastructure attracted significant funding from outside government, including philanthropists, the university sector, federal government and industry. In addition, the Queensland Government has been required to provide co-investment in order to secure Australian Government funding to support research infrastructure. This large and sustained investment in research infrastructure underpinned the transformation of science in the state.

How has Queensland been positioned as a result of this investment?

In the mid 1990s Queensland's public R&D sector was regarded as fragmented, lacking critical mass and not well placed to foster interdisciplinary approaches increasingly needed to address Queensland's social and environmental challenges. Science funding in Queensland has been pivotal in developing the state's human resources and know-how. Evidence also indicates that the investment has been significantly expanded through leveraging which has meant that substantial additional funding has flowed into Queensland from these initiatives. It has also led to highly informed policy development, a heightened awareness of the risks in managing emergencies, as well as new products and solutions which have led to more highly valued forms of employment.

The investment in infrastructure has clearly been followed by a significant investment in people. The combined push for people as well as projects has meant that the reputation of science in Queensland has now never been higher. This is recognised not just in the international world rankings of universities but also in the ability to attract talent into Queensland from interstate and around the world.

In terms of prevailing R&D priorities for Queensland, the highest investment was made in the Enabling Sciences and Technologies R&D priority (33% of total investment) – of which a substantial component (approximately 65%) was in the biological sciences field, followed by Health and Wellbeing (22%), an Environmentally Sustainable Queensland (21%) and Smart Industries (21%). The remaining 3% investment was towards Tropical Opportunities and Safeguarding Queensland.

Analysis of the funding indicates 71% of the total funding has been invested in Brisbane universities with 14% supporting regionally based universities and the balance supporting non-university recipients (i.e. independent medical research organisations and state and federal science agencies).

The importance of partnering with the best in science and research is vital given its global nature as well as its increasing scale and complexity. The Government investment has supported a range of international agreements with science groups around the world, including collaborative science initiatives with emerging scientific powerhouses, China and India. Continuing to build on Queensland's reputation for scientific and research excellence will become increasingly important in the future.

One of the original key objectives of the Smart State initially was to help facilitate diversification to knowledge industries. The focus on a four pillar economy introduced subsequent to the completion of Smart State funding rounds is likely to shift future investment. Nonetheless, there has been some significant investment and new infrastructure for agriculture and resources (refer pages 24 and 36). For example, the Health and Food Sciences Precinct at Coopers Plains, the Queensland Crop Development Facility at Redlands and the Centre for Advanced Animal Science at Gatton.

Now that many talented individuals have made Queensland home and the infrastructure is there to support the diverse areas of their research, there is a need to further develop the products of that research by encouraging greater engagement between universities and businesses in order to convert research outputs to practical outcomes. This should be the focus within the four pillars and more broadly within the priorities of the new government and beyond.

In relation to research quality, analysis of Queensland's 2012 Excellence in Research for Australia (ERA) results shows that Queensland university researchers are performing above or well above world standard in relation to the four pillar areas as well as in health, IT and environmental research. However, Queensland still underperforms relative to our proportion of National GDP, for example, or on a per capita basis, in competing for external competitive grant funding (refer Appendix 6, page 87).

In addition, operational funding arrangements with universities and independent research organisations are temporary, piecemeal and expose the government to continuing ad-hoc requests for recurrent funding. There is a risk that operationally funded research infrastructure (including facilities and equipment) may no longer perform at full capacity if alternative funding cannot be secured.

Key clients and stakeholders

Science investment stakeholders and clients of the Innovation and Science Development Group in DSITIA include universities, research organisations, R&D intensive industry and businesses, philanthropic organisations, and local, state, federal and international governments. A detailed listing of stakeholders is provided at Appendix 11 (pages 97-98). Key stakeholder views as to the science investment business model are provided at page 50.

Key Issues - maintaining momentum and funding translation

Delivering a science skills and fellowships round in 2012-13 provides a modest funds injection into research organisations and protects important research talent. Funds were allocated for this purpose in the *Smart State: Investing for the Future* implementation plan, however were returned to the Consolidated Fund as savings in the last state budget.

Departmental and recipient resources, and contracting arrangements for allocated grants

Following a recent restructuring and staff reduction within the Innovation and Science Development Group, the previous Science Investment and Funding (Science Development) and Commercial Evaluation Services (Innovation) teams were merged into a single Contract and Investment Management (CIM) team, comprising thirteen staff. CIM has responsibility for science investment programs within the scope of this audit (refer pages 22 and 44), in addition to innovation funding programs which are outside the scope of this audit. Core functions include managing government investment assistance, via contract and administration management; providing agreement and legal management advice and recommendations; reporting outcomes of science and innovation investments against milestones and key performance indicators; identifying promotional opportunities resulting from the science and innovation investments; and negotiating and finalising new agreements.

The cost of administering the science funding programs has been estimated at approximately $11 million for the period 2002-03 to 2012-13. Adjusting the $1.28 billion science investment for one-off infrastructure projects managed by others (to approximately $812.88 million), this equates to approximately 1.35% of the science program funding.

Reporting requirements for approved funding recipients focus on the provision of six monthly reports detailing progress against research milestones, submission of financial statements and final reports at the projects conclusion. Infrastructure loan recipients are required to submit annual reports and participate in annual review committee meetings to discuss progress, future research agendas and issues. This process is being streamlined from 2013, with individual committee meetings for each facility being replaced with one annual meeting per university, where all funded facilities will be discussed from a portfolio perspective.

Opportunities to reduce administrative burdens

Views expressed during consultation were that the requirements of recipients were not particularly onerous, and were certainly less complex than international grant applications. Some interviewees commented that a 'one-size fits all' approach to contractual arrangements between funding recipients and the Queensland Government meant that it could be time consuming to tailor contracts to individual needs.

The establishment of a web enabled grants system and database was raised as a way to improve efficiencies in administering science investment and funding programs, including: improved, streamlined application, assessment and processing procedures; significant reduction in manual, paper based processing; and the ability to access and manage program and investment data in a holistic and coordinated way.

Limited interim funding

The government is currently still providing some funds into the science and research system through:

- commitments to existing grants and loans ($40.8 million in 2012-13; $29.38 million in 2013-14 and $17.65 million in 2014-15)
- $42.12 million commitment to establish the Australian Institute of Tropical Health and Medicine (AITHM) with James Cook University (a combination of capital and operational funding)
- a $4.85 million commitment to QUT's Centre for Tropical Crops and Biocommodities for the development of new varieties of chickpeas and other pulses that are more drought tolerant and disease resistant
- operational funding commitments of $10 million per year to the Institute of Molecular Bioscience at UQ which ceases in 2014 (final payment in January 2014)
- $1 million over 4 years (2012-16) co-contribution to the Queensland Consortium funding for the Australian Synchrotron.

In 2013-14 funding flows from the Queensland Government, principally to the university sector in Queensland which have averaged in excess of $50 million per year (of competitive funding) for the past 11 years, will begin to drop significantly so that by 2016-17 the government's current planned funding commitment is exhausted, to zero. Since the universities use Queensland Government funds to leverage Australian Government and other funding sources the total reduction in operating funds for the universities is likely to be at least twice this amount. Job losses, including of some critical talents, are therefore likely.

Refocusing of funding?

Notwithstanding, the State's serious fiscal challenges, the continued funding of research excellence is considered essential into the future otherwise there is a real danger of losing hard-won capacity. Given the State's current fiscal environment, the range of any new science funding should be highly targeted to maximise the benefits, such as toward a targeted fellowships program, with no further funding allocated to PhD top-up scholarships and in the short term, Premier's Fellowships. It is important to note however the significant negative effects of not investing, which would begin with a decline as talent moves interstate or overseas. To prevent this occurring some funding, even if at a reduced level, is required over the next few years to sustain Queensland's excellence in research.

It is also worth noting that although skills funding was available to all Queensland researchers, initially many Queensland Government researchers thought that they were not eligible to apply for State grants. Only 1 of 82 research fellowship grants has been awarded to a Queensland Government researcher (a BSES researcher in 2004). Even in recent years when the eligibility of Queensland Government researchers was clarified, few fellowships applications were received from Queensland Government researchers. For example, only 3 of 155 fellowships applications were received from Queensland Government researchers in the 2011-12 funding round. This represents a lost opportunity for State scientists to secure funding to undertake specific research projects.

Endowment fund?

The original intent of loan repayments against infrastructure loans under the Smart State Research Facilities Fund and Innovation Building Fund programs, was to create a Revolving Science Innovation Fund, funded by these repayments. An urgent investigation into the creation and operation of such an endowment fund is strongly recommended.

Operational funding

The current funding model supporting university research creates a funding gap for operational funding. The Queensland Government is regularly requested to assist Queensland universities in meeting this gap, which has become more acute as university budgets have felt the effects of reduced numbers of international fee paying students and cuts in Commonwealth funding.

This report demonstrates that across all the key areas of government funding of science, there has been a large and sustained impact on scientific research in the state. At the same time, the Queensland Government is facing funding shortfalls for the foreseeable future and the Australian Government funding is also likely to contract. It is clear that any future science funding has to incorporate this fiscal reality.

Key Recommendations

In order to maintain the momentum of science development in the State this report recommends the following be examined closely in the government's forward R&D investment planning:

- The continuation of new science funding, within State Budget constraints and with a focus on achieving tangible societal outcomes aligned with the government's priorities.
- This funding would be allocated to a more focused Fellowship program with an emphasis on the engagement of early and mid career researchers in research with business, an increase in funding to regions in Queensland and building a capacity for Queenslanders from across the economy to work with Asia.
- The use of science infrastructure loan repayments to support the State's science investment in the future. This would establish a revolving science investment fund as an endowment, but noting sufficient funds would not be generated until the 2020s. Negotiated reduction for early payment may be a viable option.
- Any funding that becomes available due to anticipated claims not eventuating under current contracts (e.g. due to projects finishing early), could also contribute to a new science funding allocation.
- In order to increase the wider recognition of the capability that has developed in Queensland, more effort is required in demonstrating to the community the benefits of scientific research. This would be through increased outreach by funded fellows, greater engagement through public events, art and media.
- Development of mechanisms and a much greater emphasis on improving university – industry collaboration for faster translation of research.
- A review of the outcomes and impact of the science funding programs needs to be implemented every three to five years, in order to assess the schemes in terms of measurable outcomes for the state.

A refocusing of the investment in science in the state will ensure that Queensland businesses and universities not only remain competitive but expand their global reach, that the regions flourish, and that Queensland is the site of choice for excellence in science. *(Detailed recommendations are provided at pages 65-68.)*

Need for scientific knowledge

Around the globe it is now recognised and demonstrated that new scientific knowledge is a key to long term economic growth. The reasons for this are that scientific knowledge drives technology and innovation and in the process highly skilled jobs are created. In the latest survey of global competitiveness talent-driven innovation was seen to be the most important element of a nation's competitive advantage [1].

Clearly for Queensland to remain internationally competitive in terms of its industries, and in attracting bright minds to the State, what is needed is an innovative economy, and this will be founded in the quality and availability of scientific research.

The $1.28 billion investment, managed by DSITIA (and its predecessors), was part of a broader long-term economic growth strategy to create knowledge intensive industries within Queensland and improve the productivity and sustainability of existing industries.

Queensland's science capability in the 1990s

The task facing the Queensland Government at the time of investing in the late 1990s and early 2000s was the need to increase Queensland's capacity to generate and utilise new knowledge. A significant portion of Queensland's public research and development infrastructure was out-dated, and Commonwealth infrastructure funding was regarded as insufficient to address this situation. The Queensland public research and development sector was regarded as fragmented, lacking critical mass, and not well placed to foster the interdisciplinary approaches increasingly needed to address Queensland's social and environmental challenges. There was also an element of 'lock-in' due to the fact that, with dated infrastructure, it was difficult to attract Commonwealth research funding into Queensland, which in turn led to a lack of 'block' funding (which usually followed competitive research funding) that might have been used to improve infrastructure. Direct Commonwealth R&D expenditure in Queensland (e.g. through agencies like the Commonwealth Scientific and Industrial Research Organisation (CSIRO)) was below the national average in relative terms.

The business R&D base in Queensland was also relatively small by national standards. For example, in 1994-95 Queensland's BERD to GSP ratio (0.3%) was less than half the national figure at that time (0.7%).

Systematic investment by the Queensland Government

A sustained and systematic investment in research was considered necessary to build scientific scale and capability, through a focus on new infrastructure and attraction of talented researchers. Creative individuals and innovative organisations with high quality scientific capability within Queensland contribute to improvements in the government discharging its own functions such as providing health care, education and environmental management. The generation of new knowledge has the potential to improve products, processes and services beyond the lab as well as provide the necessary ability to adapt discoveries from around the world to Queensland's unique circumstances.

[1] *'2013 Global Manufacturing Competitiveness Survey', Deloitte, 2012.*

Way forward

A more focussed approach

This report examines the investment to date and - out of this - argues for a more focussed program to lift Queensland to the next level, the aim being to benefit Queensland and Queenslanders, bringing from this, economic wins and improving the quality of life for all Queenslanders. It will be argued that the next stage of science funding is critical to enabling the further expansion of the economy by nurturing future industries and in harnessing opportunities for a stronger Queensland.

Partner with the best

The importance of partnering with the best in science and research is vital given its global nature as well as its increasing scale and complexity. The Queensland Government funding of collaborative research has been complemented by established formal relationships with other national governments. Continuing to nurture linkages with world-class players ('partnering with the best') is very important. Queensland is a small player on the world science, research and innovation scene – which is a highly competitive business. Queensland will only grow and succeed through active partnering, and intense focus.

Continuing to build on Queensland's reputation for scientific and research excellence will become increasingly important in the future. But, in addition, more work needs to be done in the setting up of joint ventures, in developing strategic alliances between researchers and businesses and in creating the positive conditions needed to incubate new ideas in a business setting.

Secure alternative sources of funding for ongoing operation of research institutes

The major funder of research and development in Australia is the Australian Government. However, no additional government funding was announced to support research infrastructure capital in the 2012-13 Federal Budget. There is a risk that operationally funded research infrastructure (including facilities and equipment) may no longer perform at full capacity if alternate funding cannot be secured. $499 million was also cut from the Australian Government's Sustainable Research Excellence program which will impact directly on the finances of university research institutes set up with previous Queensland Government support.

Aim for research impact for societal benefit

While, to date, Queensland Government investment has focussed primarily on building research excellence and capacity, and to some extent driving towards its commercialisation outcomes, a shift in emphasis towards impact is now arguably required - 'impact' implying the engagement of Queensland's research capacity to achieve greater uptake of the new knowledge needed to enhance economic, social, and environmental wellbeing in Queensland. The recognition and celebration of the impact of scientific research will have a flow-on effect for wider engagement, including attracting more young people into scientific and other high value careers. A greater emphasis on impact will be congruent with policy development at the national level. The Commonwealth is currently examining options to implement performance-based funding relating to impact, to complement existing schemes that reward academic excellence.

This report firstly identifies information about current funding and investment opportunities, summarising the outcomes for the State. It then examines the views of key clients and outlines the resources and capabilities that have been acquired; we then explore the advantages and disadvantages of the model to date. We follow with an investigation into possible alternative mechanisms for the future of science funding in the State. Conclusions are then drawn on the ways in which the funding could potentially be refocused in order for maximum advantage to be accrued.

The 2014 National Youth Science Forum visits the Education Lab at the QIMR Berghofer Medical Research Institute

Introduction: Funding overview (1998 – 2012) - overview of investment profile

Key Points

Between 1998-2011 the Queensland Government committed almost $4.9 billion into science, research and development, innovation and education.

There were three programs of investment:

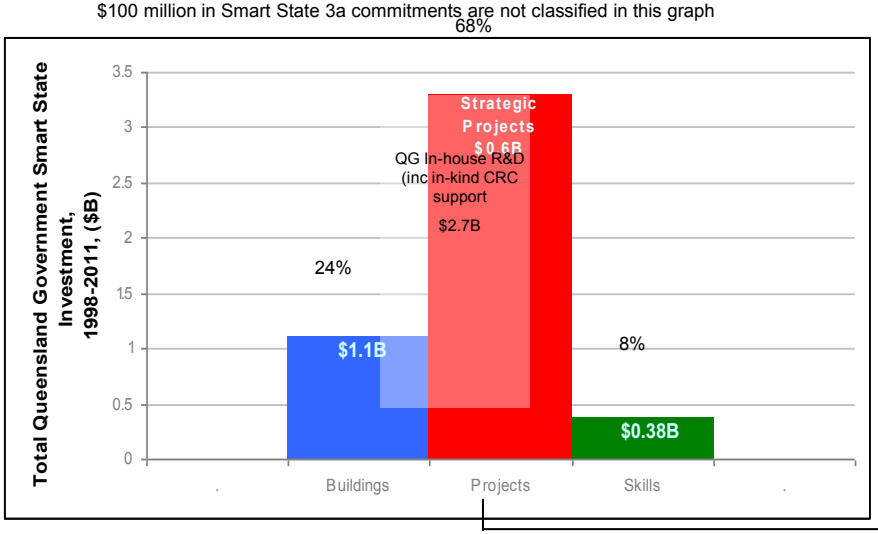
- Queensland Government in-house R&D - $2.7 billion (55%)
- Smart State External Grant Funding - $1.9 billion (39%)
- Education - $0.33 billion (6%)

Queensland Government In-house R&D (including in-kind CRC support) was a major component of the Smart State investment, comprising $2.7 billion (55%) of the $4.9 billion.

Of the $1.9 billion investment in external entities, DSITIA administered a $1.28 billion science investment. The remaining $0.62 billion includes investments made to external parties by non DSITIA science agencies such as Queensland Health, Natural Resources and Mines and DSITIA Innovation. A small component of the total investment supported the construction of Smart State Academies and other education initiatives.

Total Queensland Government Smart State Investment (Total: $4.9B)

$100 million in Smart State 3a commitments are not classified in this graph



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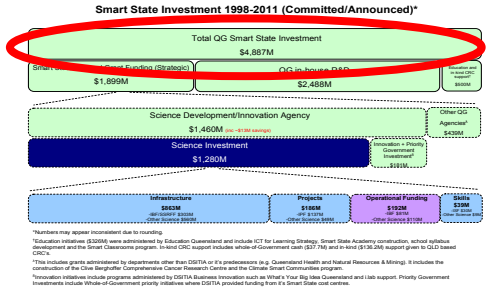
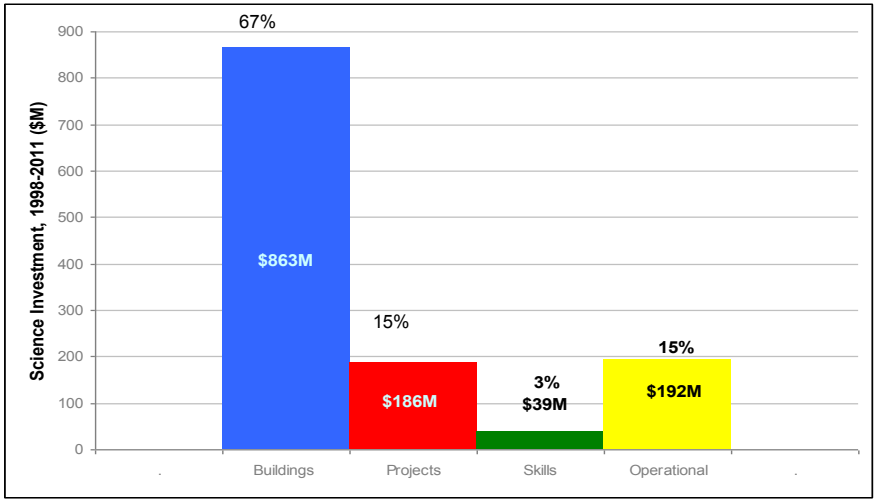


Operational Funding was classified under Projects in the $4.9 billion breakdown.

Total Science Investment (Total: $1,280M)



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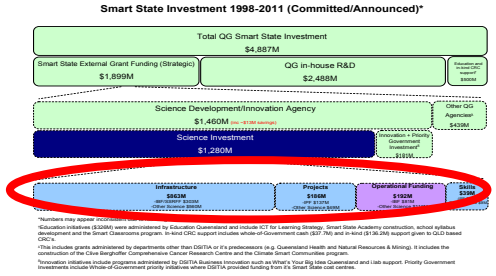
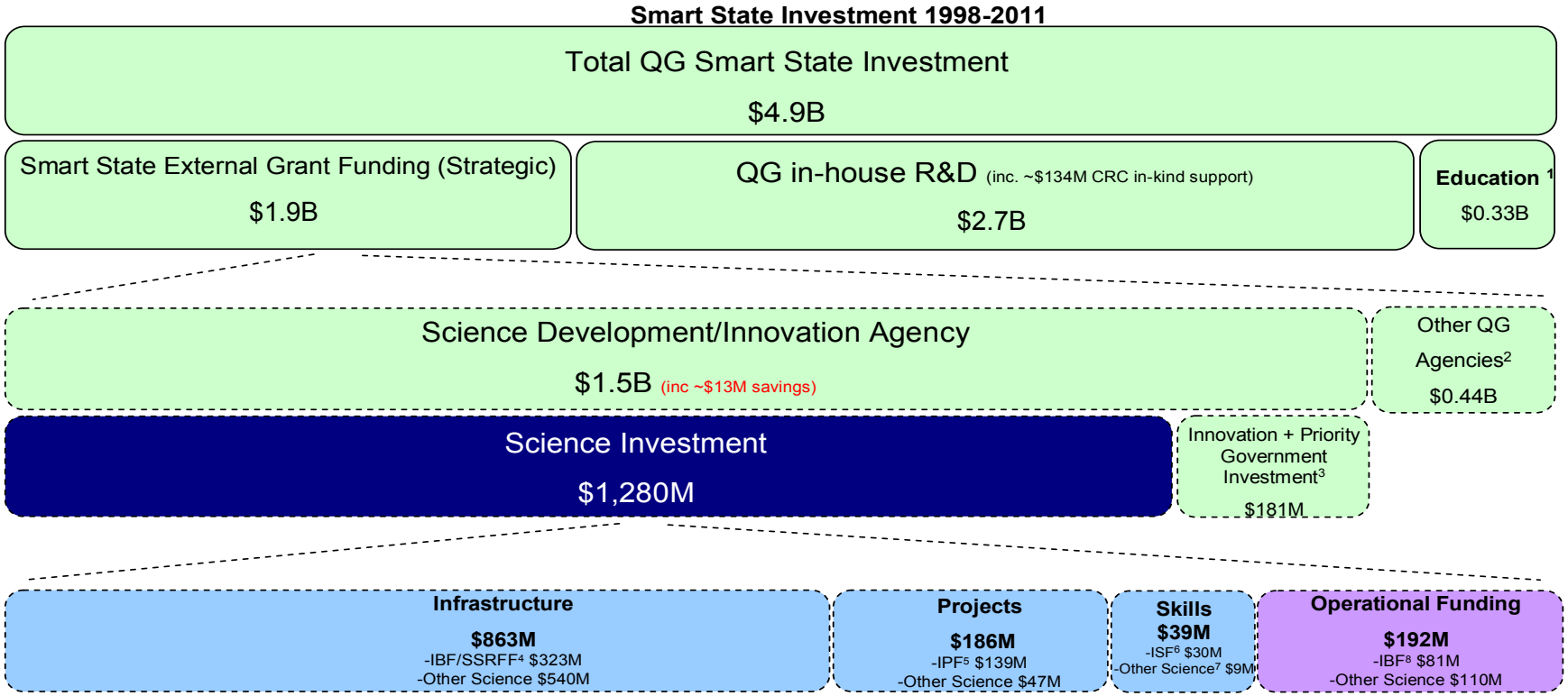


Smart State Investment 1998-2011



[1]Education initiatives ($326M) were administered by Education Queensland and include ICT for Learning Strategy, Smart State Academy construction, school syllabus development and the Smart Classrooms program

[2]This includes grants administered by departments other than DSITIA or its predecessors (e.g. Queensland Health and Natural Resources & Mining). It includes the construction of the Clive Berghoffer Comprehensive Cancer Research Centre and the Climate Smart Communities program.

[3]Innovation initiatives include programs administered by DSITIA Business Innovation such as What's Your Big Idea Queensland and i.lab support. Priority Government Investments include Whole-of-Government priority initiatives where DSITIA provided funding from it's Smart State cost centres.

[4] Innovation Building Fund (IBF) and Smart State Research Facilities Fund (SSRFF). $298.8M of the $323M administered through IBF/SSRFF was via competitive funding rounds in the form of loans. The remaining $24.5M of $303M was given as grant infrastructure funding not requiring repayment, Institute for Glycomics ($11M); Synchrotron ($2.75M pre 2012/13); Office of Commercialisation USQ ($0.15M); Qld Animal Breeding Facility ($1.7M), Qld Crop Development Facility - DPI ($3M), Molecular and Clinical Pathology Research Laboratory ($3M), Translational Research Institute equity ($0.5M)

[5] Innovation Project Fund (IPF)

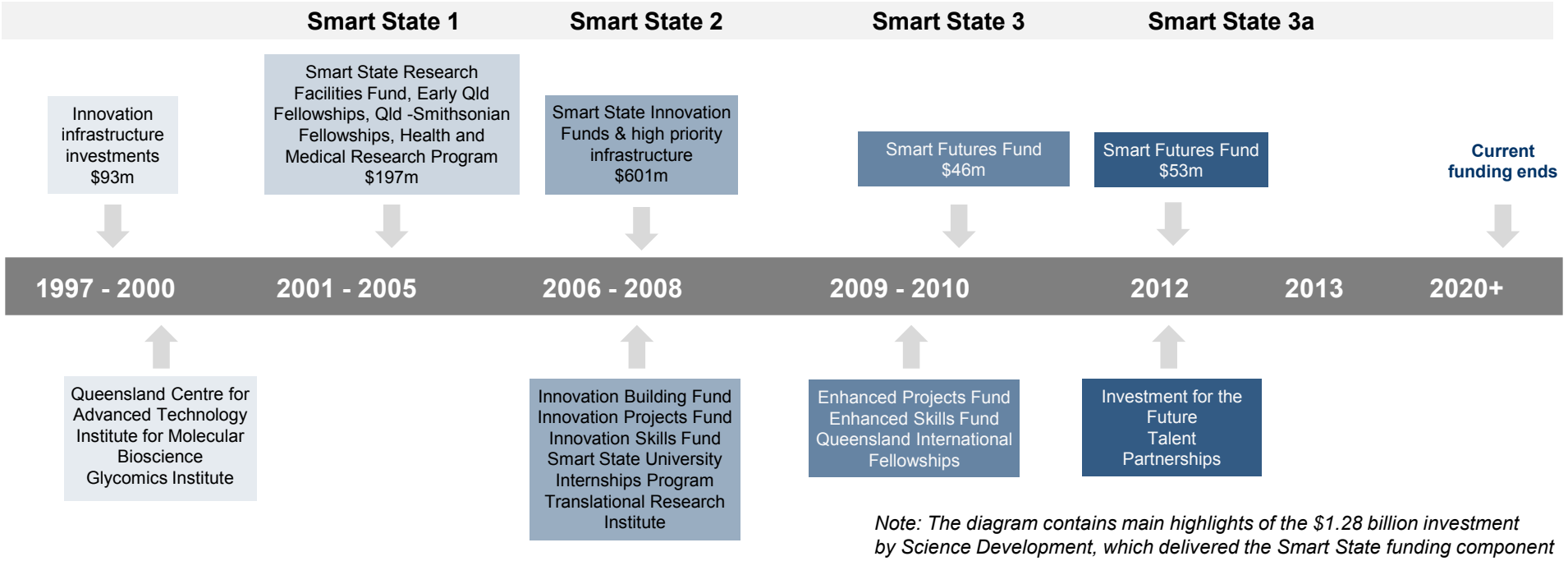
[6] Innovation Skills Fund (ISF)

h as Queensland Smithsonian Fellowships, Queensland China Climate Change, Smart State Health and Medical Research Fund fellowships and Bachelor of Biotechnology Innovation degree.

[8] $81M of operational support was administered outside of competitive funding rounds through the Innovation Building Fund (IBF) budget with an additional $110M in operational funding was

What is the scope and context of the current science funding and investment program?

Queensland Government Science Investment Timeline: Infrastructure - Operational - Projects - Skills



Note: The diagram contains main highlights of the $1.28 billion investment by Science Development, which delivered the Smart State funding component

Key points

The Smart State Strategy has been one of the most highly valued, durable and best known initiatives across the country for supporting scientific excellence. Since 1998, the Smart State Strategy has aimed to raise productivity in Queensland by:

- ensuring that new ideas are created and circulated – through investing in research infrastructure and skills
- ensuring that ideas can be successfully applied – through investing in commercialisation support and emerging industries
- complementing these investments by ensuring appropriate skills exist in the labour market – through education, skills and training initiatives.

The next stage was envisaged to focus on building science with economic return, with better commercialisation of Smart State outcomes as a priority for the state.

Science Investment and Funding Programs in Scope – Timeline chronology

Science Investment Highlights of the $1.28 billion

	Infrastructure Highlights (Not showing $47.3m in infrastructure funding)	Projects Highlights (Not showing $47.5m in projects funding)	Skills Highlights (Not showing $3.1m in skills funding)	Operational Highlights (Not showing $2.4m in operational funding)
Pre-2000 Highlights				
pre-2000	Innovation infrastructure investments - $93.3m			Institute for Molecular Bioscience (IMB) (1999-2009) - $77.5m
Smart State 1 Highlights				
2001 **2002** **2003** **2004** **2005**	Smart State Research Facilities Fund – $170m + $20m (Qld Brain Institute)		Queensland-Smithsonian Fellowships Program - $0.7 million Fellowships Program - $1.5 million Smart State Health and Medical Research Program -$5.15 million (inc $0.67m operational funding)	Queensland Cyber Infrastructure Foundation (2004-09) - $6m
Smart State 2 Highlights				
2006 **2007** **2008**	Innovation Building Fund - $133.3m* High priority infrastructure projects - $399.5m *(National Collaborative Research Infrastructure Strategy, Translational Research Institute, Smart State Medical Research Centre, Knowledge Based Research and Business)*	Innovation Projects Fund - $58.5m *(Grants supporting collaborative national and international research: Research Industry Partnerships Program, National International Research Alliances Program, Partnerships Alliances Facilitation Program)*	Innovation Skills Fund - $10.16m *(Grants supporting research talent via scholarships, fellowships and internships: Premier's Fellowships, PhD Scholarships, Fellowships, Internships, Queensland International Fellowships)*	• Queensland Brain Institute (2007-12) - $25m • Queensland Cyber Infrastructure Foundation (2007-11) - $8.5m • NICTA QLD Research Laboratory (2007-12) - $10.1m • E-Health Research Centre (2007-12) - $5m
Smart State 3 Highlights				
2009 **2010**		Enhanced Projects Fund - $36.44m *(Grants supporting collaborative national and international research: Research Industry Partnerships Program, National International Research Alliances Program, Partnerships Alliances Facilitation Program)*	Enhanced Skills Fund - $9.3m *(Grants supporting research talent via scholarships, fellowships and internships: Premier's Fellowships, PhD Scholarships, Fellowships, Queensland International Fellowships)*	Biopharmaceuticals Australia (2008-2011) - $7.1m IMB (2009-14) - $50m
Smart State 3a Highlights				
2012		Partnerships - $43.74m *(Grants supporting collaborative national and international research: Research Partnerships Program, Co-Investment Fund)*	Talent - $9.268m *(Grants supporting research talent via scholarships, fellowships and internships: Premier's Fellowships, PhD Scholarships. Fellowships, Queensland International Fellowships)*	

Explanatory notes: ** This commitment includes operational funding and one off infrastructure outside the competitive funding rounds. Summary of the programs at Appendix 2, pages 71-74.*

Overview of the infrastructure investment

$298.76 million, in the form of loans, has been provided to recipients through the Smart State Research Facilities Fund, the Innovation Building Fund, and a one-off loan to the University of Queensland through the Smart State Building Fund, towards the establishment of 36 science research institutes and facilities.

These 30 year interest free loan agreements were negotiated on a case-by-case basis with each recipient. A suite of agreements make up the loan between each recipient and the State of Queensland - a Head Agreement; a Loan Agreement; and a Proceeds of Commercialisation Agreement.

In addition, separate to the funding rounds and on a case by case basis, the Queensland Government:

- Invested in a further nine strategic investments for new university infrastructure and renewal of state and federal facilities, including the Institute for Molecular Bioscience, Sustainable Minerals Institute, Institute for Glycomics, Queensland Centre for Advanced Technologies, Ecosciences Precinct, Health and Food Sciences Precinct, Translational Research Institute/ BioPharmaceuticals Australia, Queensland Institute of Medical Research (QIMR) Central, and most recently the Australian Institute of Tropical Health and Medicine
- Co-invested in the Commonwealth Government's National Collaborative Research Infrastructure Strategy (NCRIS).

	Listed Infrastructure	Unlisted infrastructure	Total
IBF/SSRFF	320.4	2.9*	**323.3**
Specials	428.47	111.63**	**540.1**
			863.4

**Unlisted IBF infrastructure includes contributions to the Office of Commercialisation ($0.15 million) and funds towards Australian Synchrotron ($2.75 million) (excludes +$1million synchrotron operational funding).*

***Unlisted special infrastructure includes contributions to many research infrastructure including Process Engineering and Light Metals Centre ($4 million), Pharmacy Australia CoE ($3.4 million), Bundaberg Turtle Interpretive Centre ($4.4 million) and Centre for Native Floriculture ($2 million).*

Case Study: Ecosciences Precinct and Health and Food Sciences Precinct

$290 million of the investment in renewal of the Queensland Government research infrastructure contributed to the establishment of the Ecosciences Precinct at the Boggo Road Urban Village, Dutton Park and the Health and Food Sciences Precinct at the Queensland Health Forensic and Scientific Services campus, Coopers Plains. This investment leveraged $87.9 million of Commonwealth funding through the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

This investment was driven by the need of the Queensland Government and CSIRO to upgrade aging and fragmented research centres across 12 sites in South East Queensland to meet contemporary standards and create critical mass, avoid duplication of expensive infrastructure, enhance R&D quality and output and maximise collaboration.

Science at the Ecosciences Precinct focuses on climate change, protecting Queensland's natural resources and environment, and developing ways to grow Queensland's farming, forestry and marine industries so they are competitive and sustainable. The Precinct's facilities enable it to support a wide range of sciences, including chemistry, microbiology, entomology and other disciplines. The Precinct co-locates a critical mass of around 1,000 scientists from the CSIRO, the Queensland Government's Department of Science, IT, Innovation and the Arts, Department of Agriculture, Fisheries and Forestry (DAFF), Department of Natural Resources and Mines, Department of Environment and Heritage Protection, and the Queensland Alliance for Agriculture and Food Innovation (QAAFI).

The Health and Food Sciences Precinct, Coopers Plains established animal biosecurity research and diagnostic testing facilities, food science, animal nutrition, biochemical analysis and consumer and sensory laboratories, and a state of the art Food Pilot Plant facility designed to service the needs of the Queensland and Australian food industries. The plant and associated food technology, sensory and consumer science facilities are available to conduct scientific research and trial new products or processes. This Precinct co-locates around 190 CSIRO, DAFF and QAAFI scientists, alongside around 550 staff located on the Queensland Health Forensic and Scientific Services campus.

Ecosciences Precinct , Dutton Park

Health and Food Sciences Precinct, Coopers Plains

Government Investment in Science: Analysis of the Science Investment – Operational Funding

Operational funding by the Queensland Government

Two biomedical research institutes - the Institute for Molecular Bioscience ($127.5 million over 15 years, expiring 2014) and the Queensland Brain Institute ($25 million over 5 years) – received operational funding to support their establishment. This start-up funding was intended to progress these institutes to a level at which each institute could attract funding from the Commonwealth Government required to sustain its on-going operations. Both have established themselves as excellent research institutes.

Of the balance of operational funding support provided by the Queensland Government (refer Appendix 3, page 76) $24.6 million has supported ICT research related initiatives. Due to fiscal constraints, the Queensland Government did not continue funding of National ICT Australia (NICTA), previously funded at $10.05 million over four years (2007-08 to 2011-12). Note: The Queensland Government committed an additional $1.65 million of transitional funding to NICTA (2011-12 to 2013-14) as a one-off, funded under the Co-Investment Fund.

There was an approved allocation of $4.7 million over four years (to 2006-07) for the establishment of the Smart State Health and Medical Research Fund (SSMRF), which included establishment of the $2 million Operational Support Program (OSP). SSHMRF-OSP provides operational funding support to independent medical research institutes at a rate of up to 25 cents per dollar of competitive grant income attracted by the recipient institute. Approximately $668,000 of the $2 million OSP allocation was for operational funding (captured in skills funding) and $1.48 million allocated to skills. Remaining funds were administered by Queensland Health after it was transferred responsibility for the SSMRF-OSP in 2008.

The Queensland Institute of Medical Research (QIMR) and BSES Limited have also historically been allocated operational funding from departmental budgets (Queensland Health and Department of Agriculture, Fisheries and Forestry respectively).

Risks associated with operational funding

The current funding model supporting university research creates a funding gap for operational funding. The Queensland Government is regularly requested to assist Queensland universities in meeting this gap, which has become more acute as university budgets have felt the effects of reduced numbers of international fee paying students and commonwealth funding cuts.

The Australian Government, through its Mid-Year Economic and Fiscal Outlook (MYEFO) for the 2012-13 financial year, announced cuts to the university sector totalling around $1 billion over 2012-13 to 2015-16 including $499 million from the Sustainable Research Excellence (SRE) program. The loss of SRE funding will impact directly on the finances of university research institutes set up with the support of the previous Queensland Government. Further, on 13 April 2013 the Australian Government announced savings in the higher education sector that will contribute to the funding of school education reforms. The $2.3 billion of announced savings will include a $900 million efficiency dividend for university funding – a direct reduction in universities' fiscal capacity to support research and teaching.

Finally, operational funding arrangements are temporary, piecemeal and expose the government to continuing ad-hoc requests for recurrent funding. There is a risk that operationally funded research infrastructure (including facilities and equipment) may no longer perform at full capacity if alternate funding cannot be secured.

Investment in Projects and Collaborations (2005-06 to present)

To complement the infrastructure investment and operational funding, approximately $139 million over seven years was invested through the Innovation Projects Fund in projects to advance new areas of research, encourage collaboration and promote leading technologies in established and emerging industries. An additional $47 million was administered by DSITIA's predecessors in the form of one-off grants to support strategic needs. Examples of one-off projects include CRC support ($19 million cash) Queensland Clinical Trials Network ($5 million), Renewable Energy Program ($4 million), Biobus ($2 million), Queensland Life Sciences Industry ($2 million), Science on Saturday ($1 million), and many smaller grants supporting science and science-based innovation.

Key points

Although 1:1 matching funding was a requirement for competitive programs, the funding leveraged significantly exceeded the minimum requirements.

Partnerships were created with 36 industry partners and 53 international organisations.

Overview of competitive project funding

Program	No. awarded	$ awarded	$ leveraged ($m)	Leverage to funding ratio
National and International Research Alliances Program (2005-06 to 2009-10)	50	$73.2m	$221m	3.0 : 1
Research Industry Partnerships Program (2005-06 to 2009-10)	28	$19.1m	$33.6m	1.8 : 1
Partnerships Alliances Facilitation Program (2005-06 to 2009-10)	25	$1.86m	$4.66m	2.5 : 1
Co-Investment Fund (2011-12 to present)	18	$28.3m	$65.73 m	2.3:1
Research Partnerships Program (2011-12 to present)	18	$14.9m	$24.03m	1.6 : 1
Queensland - Chinese Academy of Sciences Biotechnology Projects Fund & Researcher International Visit Program (2008-2012)	5	$1.3m	$4m	3.1:1
Indo - Queensland Biotechnology Projects Fund (2008-2013)	3	$0.729m	$2.3m	3.2:1
Total Competitive Projects	147	$139.4m	$349.0m	2.5:1
One-off Projects (non-competitive, case by case)	**101**	**$46.8m**	**N/A**	**N/A**
Total Projects (Competitive and one-off)	**248**	**$186.2m**	**N/A**	**N/A**

How is Queensland positioned as a result of its science investments?

International Collaborations

Key points

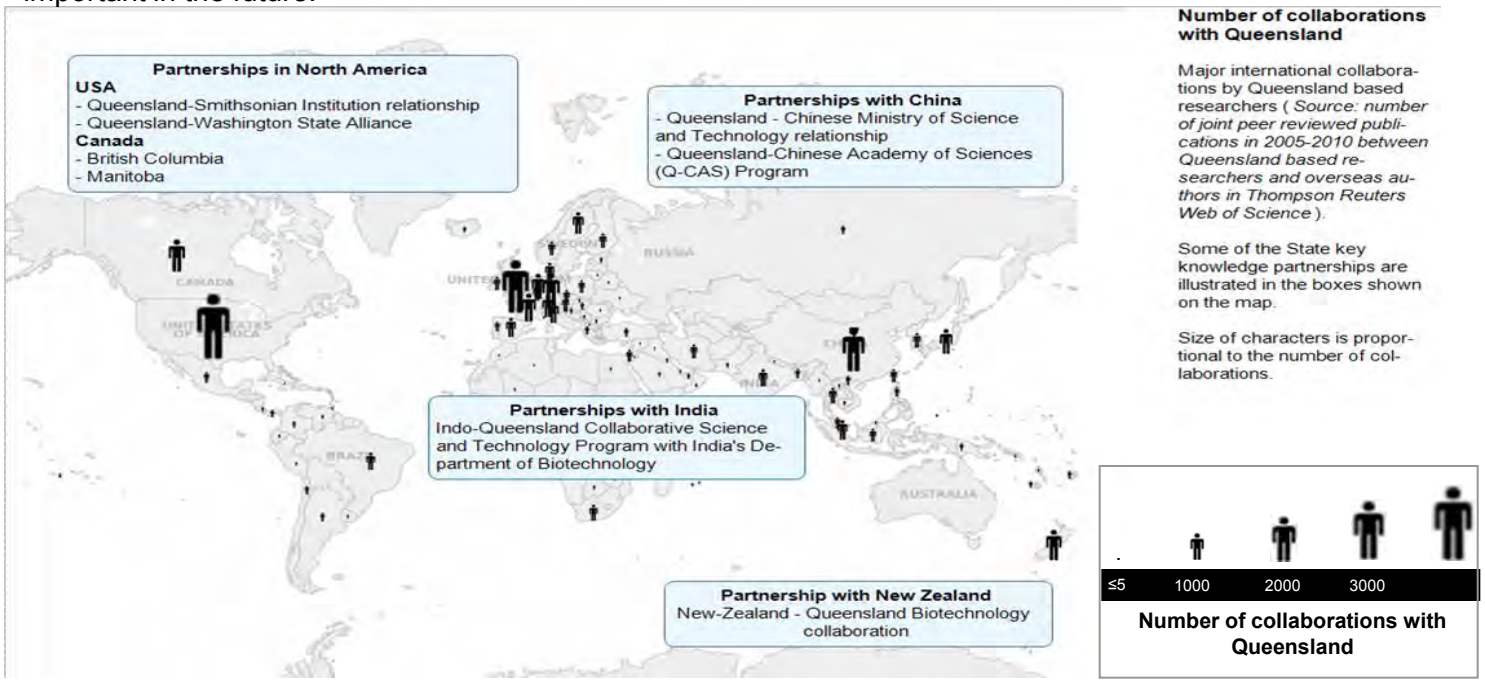
State government support through funding programs as well as Memoranda of Understanding and Statements of Intent have contributed to:

- Strong academic-industry links (e.g. Boeing, Pfizer, Syngenta, Dow)
- Strong region to region links (e.g. Washington State, China, Chinese Academy of Sciences, Queensland-Smithsonian relationship)
- Strong collaborative funding links (e.g. Bill and Melinda Gates Foundation, Merchant Foundation, Mason Foundation, James S McDonnell Foundation)

Primarily through the investments in projects, the importance of partnering with the best in science and research has been vital given its global nature as well as its increasing scale and complexity. The Queensland Government has supported a range of international agreements with science groups around the world, including collaborative science initiatives with emerging scientific powerhouses China and India. Continuing to build on Queensland's reputation for scientific and research excellence will become increasingly important in the future.

Advantage

Continuing to nurture linkages with world-best players ('partnering with the best') is important. Queensland is a small player on the world science, research and innovation scene – which is a highly competitive business. We will only grow and succeed through active partnering, and intense focus.



How is Queensland positioned as a result of its science investments?

International Collaborations – A Case Study

Science Development currently manage a number of international alliances, with funding programs to date focussed on three key alliances – Smithsonian (United States of America), China and India.

Queensland-Smithsonian Fellowships Program (2001 – current)

Investment by the Queensland Government of just over $700,000 has leveraged nearly five times the original investment by Queensland home institutions and Smithsonian host institutions resulting in a total value of over $3 million for the program. Highly regarded by the local and international research community, the program has proved to be a cost effective means of linking to international knowledge, expertise, resources and networks in a broad range of fields, particularly life sciences, education and ecosciences.

Queensland-Chinese Academy of Sciences (CAS) Program (2010 – current)

Queensland is the only sub-national government in the world to have a jointly funded collaborative research program with the CAS. Investment by the Queensland Government of nearly $1.3 million has leveraged over three times the original investment by Queensland home and Chinese host institutions resulting in a total value of nearly $4 million for the program.

Biotechnology projects have delivered significant progress, including the preclinical trial of a new class of drugs, the establishment of the first joint Australia-China neuroscience laboratory and subsequent discoveries that will assist the development of new therapeutics for the treatment of ubiquitous neurological diseases such as dementia, and investigations of plant and insect biodiversity that may assist in detecting the effects of projected climate change.

CAS is now the single largest international science research collaborator with Queensland based on joint publications. The program accelerates access to Chinese scientific expertise, resources and networks in areas aligned with the Queensland Government's strategic priorities, and are an important opportunity to position Queensland as a key knowledge partner with China, the world's second largest producer of scientific knowledge.

Queensland-Ministry of Science and Technology, India (2008 – current)

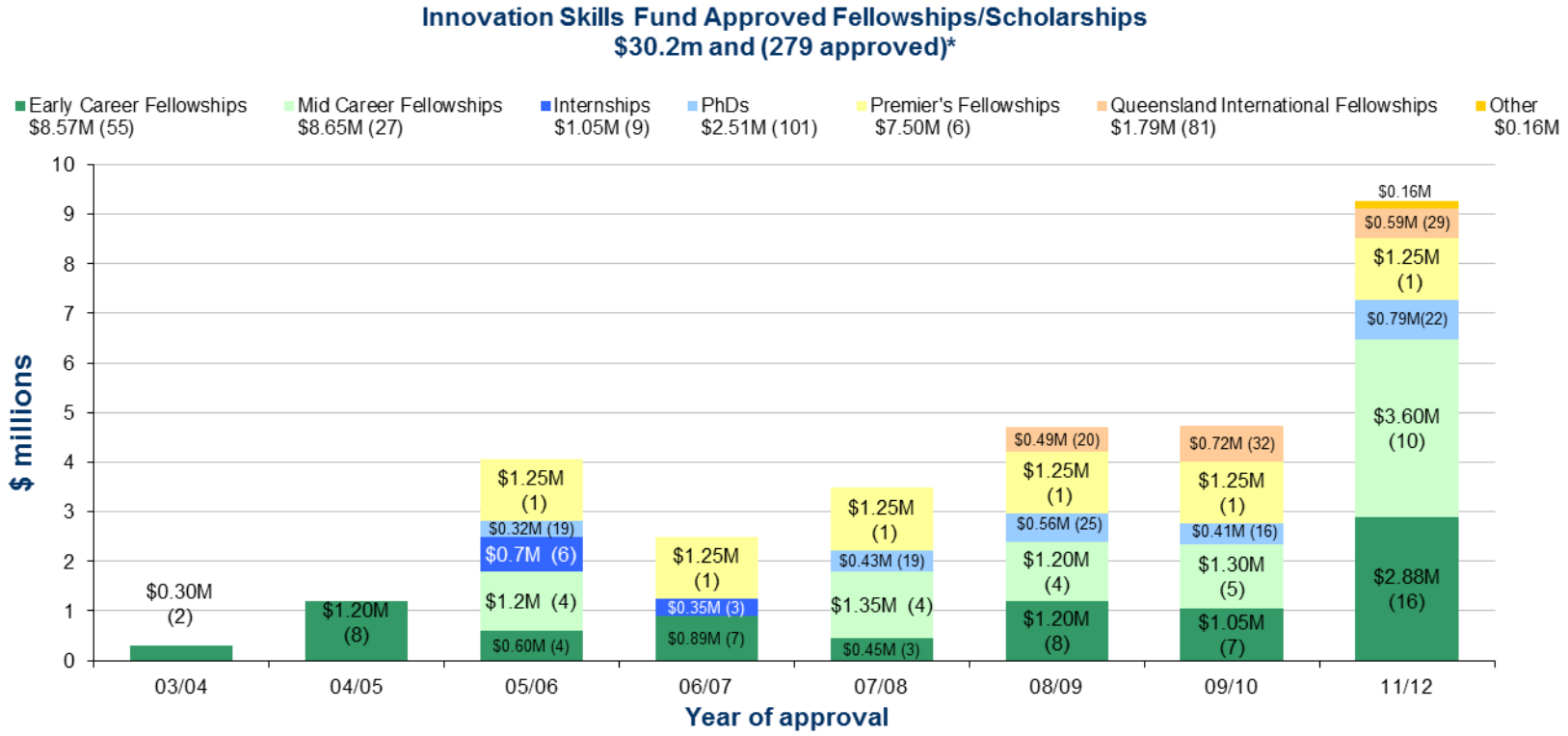
The Indo-Queensland Collaborative Science and Technology Program (IQSTP) has supported 3 Indo-Queensland biotechnology projects and 2 early career fellowships recipients. The program accelerated access to Indian scientific expertise, resources and networks in areas aligned with the Queensland Government's strategic priorities, and were an important opportunity to position Queensland as a key knowledge partner with India. To date, outcomes have been achieved particularly in research on pharmaceutical care for metabolic syndrome.

The Queensland Government investment of $729,000 has leveraged over three times the original investment by Queensland home and Indian host institutions resulting in a total value of nearly $2.3 million for the program. Whilst the pilot round of joint projects demonstrated strong interest in building links with India in biotechnology, the State's current fiscal position has precluded funding a second round of joint projects at this time.

Investment in skills and talent (2003-04 to 2011-12)

Attracting and retaining talent followed the investment in infrastructure, with an increased investment over the years in supporting research talent with the greatest investment in early and mid-career fellowships. A small, internationally focussed program to encourage international collaborations and researcher mobility has been highly regarded by the Queensland research community and international partners.

Grant durations: Early Career Fellowships: 3 years | Mid Career Fellowships: 3 years | Internships: 3 years (university discretion over how funding is dispersed to interns) | PhDs: 3 years | Premier's Fellowships: 5 years | Queensland International Fellowships: 9 months
Note: Other ($0.16m) incorporates Inspiring Australia and the one-off Rod Walker Memorial Fund



*Figures are for commitments made, not cash flow. Payments are generally made in equal instalments during the out years following grant approval.
*Table excludes international programs run by others within the Innovation and Science Development Group, DSITIA i.e. Smithsonian programs ($700k - 39 fellowships).
*$8.9m in additional skills funding was administered through programs outside of the Innovation Skills Fund. Please see annotation on page 78.

Queensland Government Science Investment and Funding Commitments

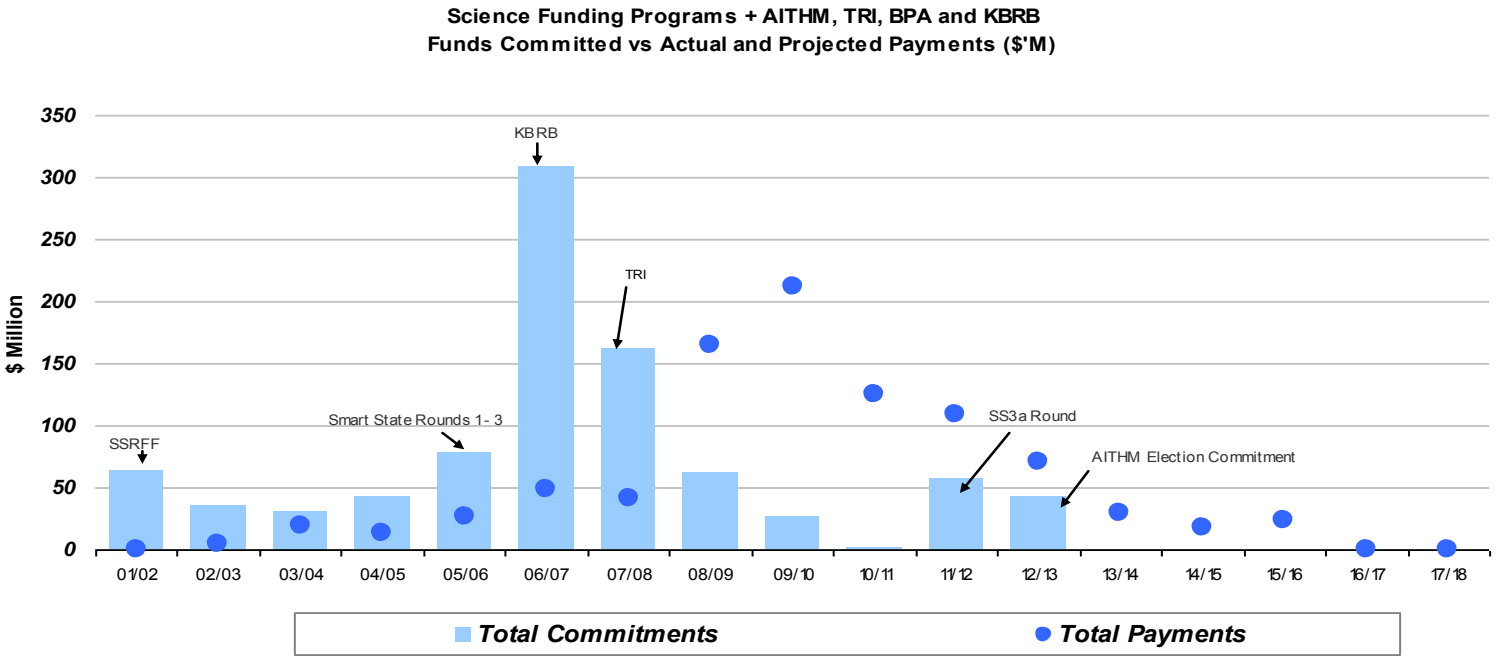
Key points

Significant investment was committed up to 2008-09 with less funds committed from 2009-10 onwards. Committed funds are generally paid over a three year period as project milestones are achieved. Cash flow to the science research sector has therefore been consistent over many years.

There is however a significant decrease in cash flow to the sector from 2013-14 due to previously funded projects concluding and also the lack of newly committed funds since 2009.

This lack of funding will impact on key areas such as securing competitive funding, for example: with the Commonwealth; progressing research with benefits for Queenslanders; and retaining quality researchers in Queensland.

Science Investment and Funding Program Commitments against Actual and Projected Payments 2001-2018
(Total Commitment: $470m IBF/SSRFF/IPF/ISF + $42m AITHM + $100m TRI* + $10.9 BPA + $290 KBRB = $912.9m)
*Note: Only 46.47m of $100m TRI Commitment was administered from DSITIA



Note: AITHM: Australian Institute of Tropical Health and Medicine (new commitment)
TRI: Translational Research Institute
BPA: BioPharmaceuticals Australia
KBRB: Knowledge Based Research and Business (includes Ecosciences Precinct and Health and Food Sciences Precinct)
IBF: Innovation Building Fund
SSRFF: Smart State Research Facilities Fund
IPF: Innovation Projects Fund
ISF: Innovation Skills Fund
Note: The above graph represents a mix of infrastructure, projects and skills funding payments, both actual and projected. Details of forward funding commitments allocated by these components are provided in Appendix 7 (pages 88-90).

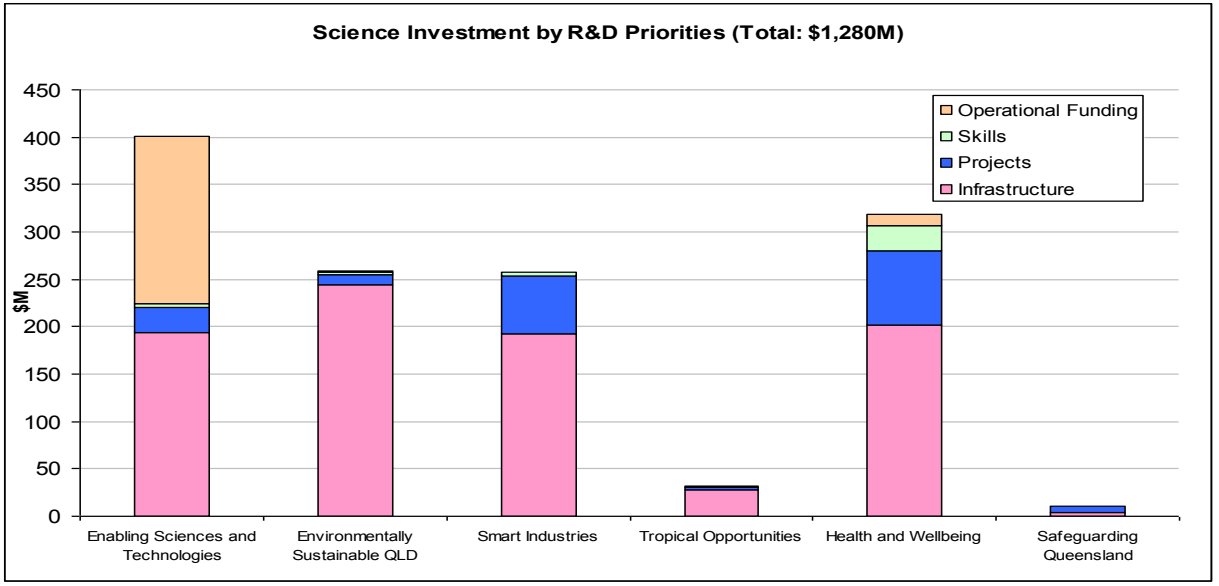
Over the past 15 years, Queensland Governments invested in significantly raising Queensland's research capacity in order to position Queensland in areas of technological opportunity linked to Queensland's existing or emerging competitive advantages.

Queensland R&D Priorities

Since 2004 the Queensland Government's investment in R&D has been allocated over the following six priorities developed by the Office of the Queensland Chief Scientist, and outlined in the *Queensland research and development investment strategy 2010-2020*:

1. Enabling Sciences and Technologies
2. Environmentally sustainable Queensland
3. Health and Wellbeing
4. Safeguarding Queensland
5. Smart Industries
6. Tropical Opportunities

As per the figures to follow, overall, the largest quantum of research investment in external agencies has been in the R&D priority of the Enabling Sciences and Technologies (33% of total investment) with, as previously noted, a strong (65%) focus on biological sciences. This is followed by Health and wellbeing (22%), an Environmentally sustainable Queensland (21%) and Smart Industries (21%). The remaining 3% investment was within the R&D priorities of tropical opportunities and safeguarding Queensland.



Allocating additional resources to research support and adopting a more whole-of-Government approach has enabled the Queensland Government to support a range of research across the six R&D priorities lifting and broadening science capacity within Queensland. With the exception of operational funding, the investment supported four of the six R&D priorities broadly at a similar level.

The spread of investment to some extent reflects the range of applications received with fewer applications in the areas of Tropical Opportunities and Safeguarding Queensland and that these types of research activities are undertaken by government departments, e.g. Biosecurity Queensland. It should be noted that classification of the data gave a strong preference to inclusion of health and medical research within the Health and Wellbeing priority.

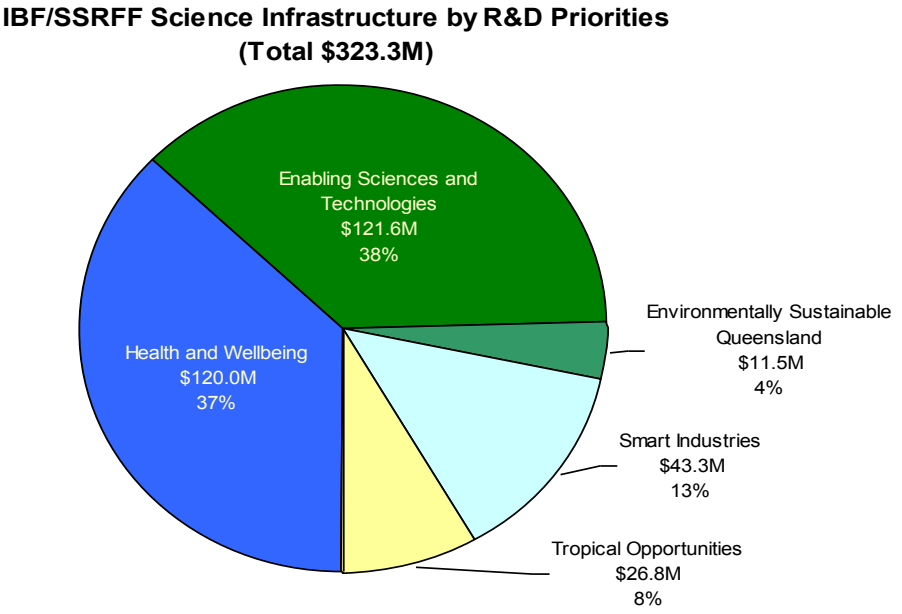
The majority of skills funding supported the Health and Wellbeing priority. Enabling Sciences and Technologies were the recipients of most of the operational funding (with a strong biomedical component as previously mentioned).

Infrastructure – Operational – Projects

Infrastructure funding breakdown R&D Priorities (Competitive funding only)

The greatest share of infrastructure funding was expended against the Enabling Sciences and Technologies R&D priority at $121.6 million, followed by Health and Wellbeing ($120.0 million), Smart Industries ($43.3 million), Tropical Opportunities ($26.8 million) and Environmentally Sustainable Queensland ($11.5 million).

Graph notes: *(1) Enabling sciences and technologies includes QBI and AIBN (2) Health & Wellbeing includes Institute of Health & Biomedical Innovation and WRI Health & Med Res. Ins. (3) Smart Industries includes Queensland Crop Development Facility and CoE Engineered Fibre Composites (4) Environmentally Sustainable QLD includes Smart Water Res. Facility and Lizard Island Res. Station (5) Tropical Opportunities includes ATSIP and ATFI. Excludes one off special projects conducted outside of competitive funding rounds i.e. Innovation Building Fund and Smart State Research Facilities Fund.*



Project funding breakdown against the Queensland R&D Priorities (Competitive funding only)

The greatest share of projects funding was expended against the health and well-being R&D priority at $62.5 million, followed by smart industries ($40.9 million), enabling sciences and technologies ($16.4 million), environmentally sustainable Queensland ($9.8 million), safeguarding Queensland ($5.3 million) and tropical opportunities ($2.4 million).

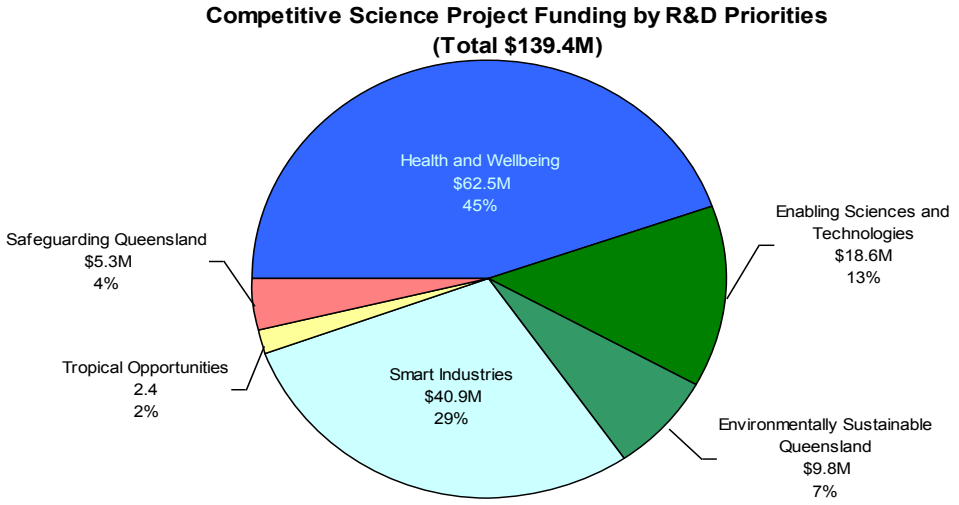
Of 147 competitive project funding recipients, 127 are research organisations (86%) and 20 are industry organisations (14%). Queensland Government departments represent 6% ($8.2 million) of project recipients.

The latest round of projects funding (Research Partnerships Program and Co-Investment Fund) was significantly oversubscribed - 137 funding applications were received, seeking funding of $148 million. A total of 36 projects were awarded funding of $43.7 million.

Graph notes:

Figures include: *Research Partnerships Program, Co-Investment Fund, National and International Research Alliances Program, Research Industry Partnerships Program, Queensland-Chinese Academy of Sciences Biotechnology Projects Fund and international visits, Indo-Queensland Biotechnology Projects Fund, Partnerships Alliances Facilitation Program.*

Figures exclude: *one off special projects conducted outside competitive funding rounds and international programs run by others within the Innovation and Science Development Group, DSITIA i.e. Queensland-Smithsonian program.*

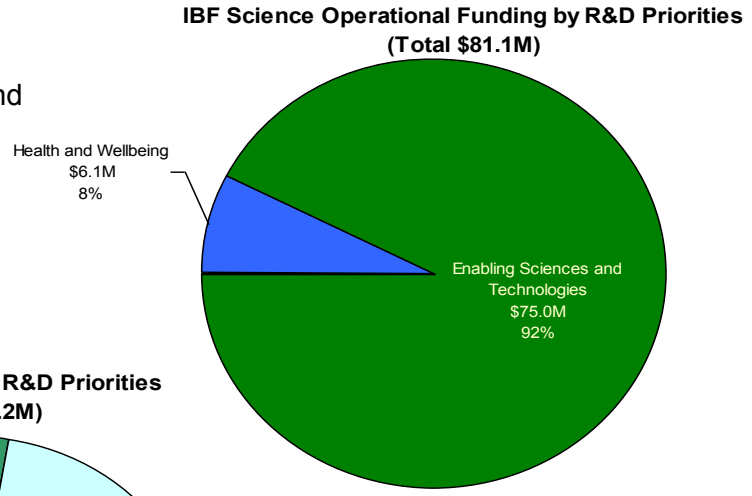


Operational – Skills

Operational funding breakdown R&D Priorities

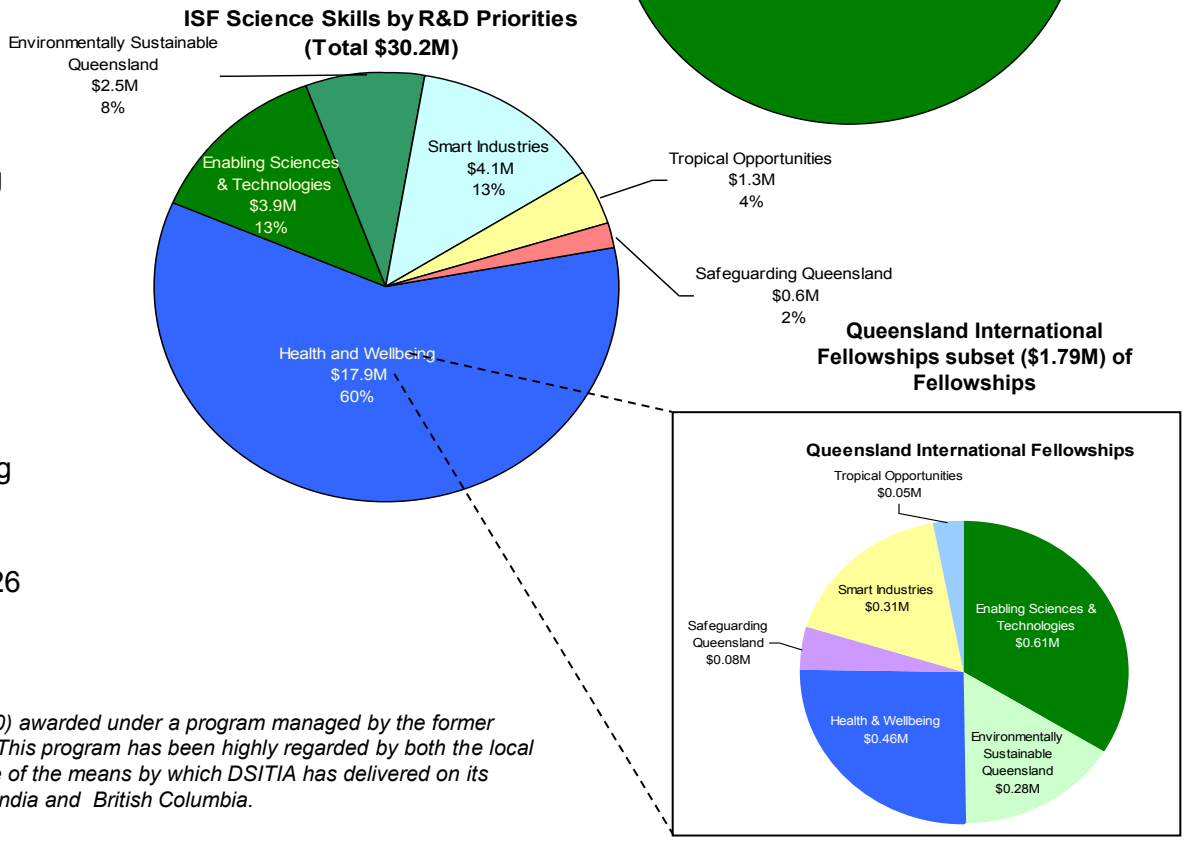
- The greatest share of operational funding was expended against the Enabling Sciences and Technologies R&D priority at $75 million, followed by Health and Wellbeing ($6.1 million).

Graph note: *Excludes one off special projects administered outside of the Innovation Building Fund. One off specials not shown include the Institute for Molecular Bioscience (1999-2009), Queensland Cyber Infrastructure Foundation (2007-2011) and National ICT Australia QLD (2007-2012)*



Skills funding breakdown against R&D Priorities

- Under the Fellowships programs, which supported Premiers, international and early-mid career fellowships, and PhD top-ups, the greatest share of expenditure was allocated against the Health and Well-being R&D priority ($17.9 million). The next greatest was against Smart Industries ($4.1 million).
- Under the Queensland International Fellowships, Enabling Sciences and Technologies and Health and Well-being received the largest allocation of funds ($0.61 million and $0.46 million respectively), followed by Smart Industries ($0.31 million) Environmentally Sustainable Queensland ($0.28 million).
- Under the Premier's Fellowships, aimed at world leading scientists, four fellowships ($5 million) were in Health, with the remaining two ($1.25 million per fellowship) in Enabling Sciences and Technologies, and Environmentally Sustainable Queensland.
- Health featured strongly in PhD scholarships funding ($1.26 million) followed by Smart Industries ($365,500) and Enabling Sciences and Technologies ($365,000).



Note: *These figure exclude 39 Queensland-Smithsonian Fellowships ($700,000) awarded under a program managed by the former International Collaborations team, now part of Science Development, DSITIA. This program has been highly regarded by both the local and international research community. International fellowships have been one of the means by which DSITIA has delivered on its commitments under various international alliance agreements e.g. with China, India and British Columbia.*

Alignment with the Four Pillars: agriculture, resources, construction and tourism

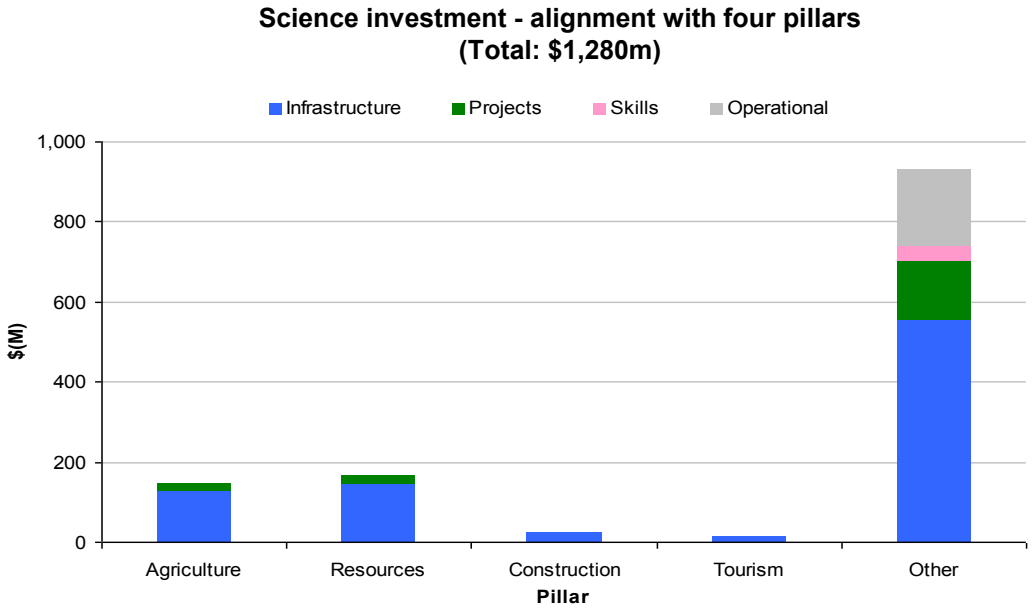
Queensland's four pillars

In reassessing this past investment in terms of the new Queensland Government's four pillars of agriculture, resources (including energy), construction and tourism, resources has received the greatest combined share of investment in research infrastructure, projects and skills. This may however be an underestimation, as a number of 'environment' projects relate to the agriculture and resource pillars. There is an opportunity to target pillar activities with future investments where appropriate.

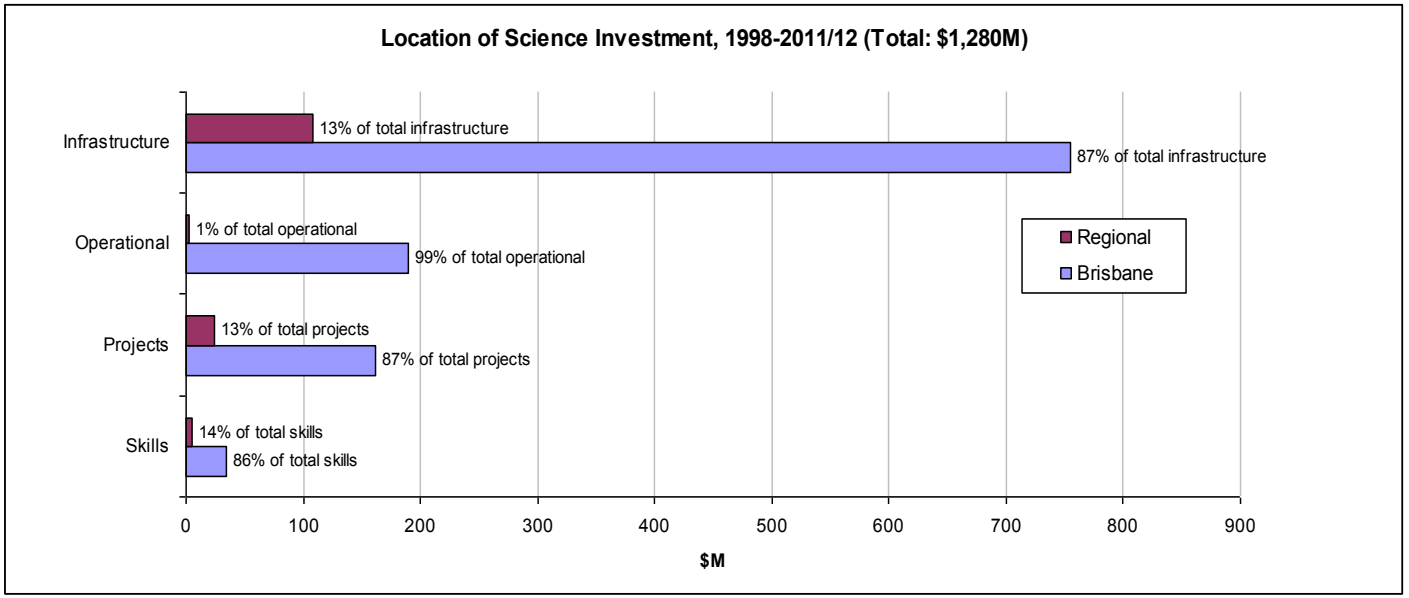
Approximately one quarter of the state government's funding over the 1998-2011 period was invested in areas that align with the four pillars:

- Agriculture: $146.54 million
- Resources: $167.26 million
- Construction: $24.67 million
- Tourism: $13.95 million

The remaining $927.89 million has been committed to other areas, such as health and medical, enabling technologies and environmental science.



Allocation of the science investment by location



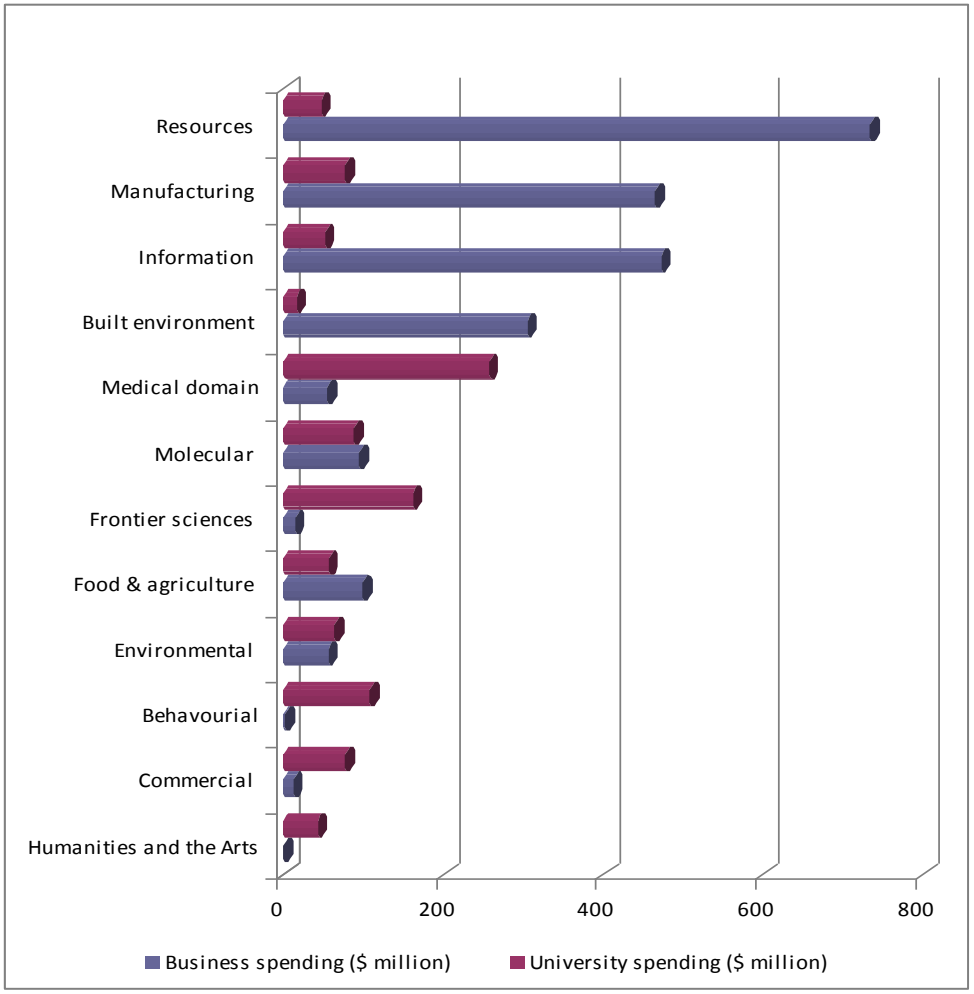
- Approximately 89% of DSITIA's total science spend was invested in recipients within Brisbane and its immediate suburbs particularly the Brisbane-based universities (comprising Griffith University, Queensland University of Technology, The University of Queensland and the Australian Catholic University).
- The remaining 11% supported recipients in regional Queensland particularly the regionally based universities (comprising Bond University, Central Queensland University, James Cook University, University of Southern Queensland and University of the Sunshine Coast).
- The university sector received 52% ($665 million of $1.28 billion) of the science investment with the remaining 48% going to non-university recipients, such as research organisations (e.g. QIMR, CSIRO) and industry (e.g. Xstrata Technology, Australian Aerospace, Magnetica and Alchemia). The University of Queensland has received the largest share of university funding with 65% ($424 million of $665 million) of the university share towards infrastructure projects and buildings. Queensland University of Technology received 15% of this funding and Griffith University received 10%.
- The Queensland Government's $42.12 million election commitment to develop the Australian Institute of Tropical Health and Medicine (AITHM) with James Cook University, announced in 2012, is not included in the above graph. If AITHM is included, the proportion of funds invested in regional infrastructure would increase from 13% of total infrastructure to 18%. Likewise, regional operational funding would increase from 1% to 5%.

Queensland business and university spending

Comparing Queensland business and university R&D spend

- The Health of Queensland Science report (2013) identifies the different R&D spending priorities of Queensland business and the university sector.
- Of Queensland business R&D expenditure ($2.3 billion), 32% was spent in resources, 20% in Information/ICT and Manufacturing respectively, 13% in Built Environment, and 4% in Food and Agriculture.
- Comparatively, Queensland University sector R&D expenditure ($1.06 billion) followed the following profile: 32% in Molecular/Medical, 15% in Frontier Sciences, 6% in Environmental and 5% in Food and Agriculture.
- When compared to other States and Territories, R&D in higher education in Queensland has a relatively lower emphasis on pure basic research and a greater emphasis on applied research, consistent with the government's emphasis on 'practical and applied scientific and technology capability'.
- While business expenditure on R&D in the State has increased substantially over the past two decades it (as a percentage of GSP/GDP) remains well below the Australian average and most OECD nations.

Queensland business and university spending ($) in broad research domains



Note: 2008-09 – latest available data. Derived from ABS 8111 and ABS 8104. Industry values are estimates. Source: Dr T Barlow (2011) Australian Research: Strategies for Turbulent Times.

Special Initiatives (Election Commitments)

NB: Funding for these initiatives is not included in the $1.28 billion, as this funding commenced post the 2012 State election

Science and Innovation for Economic Success

This election commitment is to rebuild our State's practical and applied scientific and technology capability, including by partnerships with Queensland's universities, to provide practical research that boosts the four pillars of our economy – agriculture, mining, construction and tourism. Responsibility - Minister for Science, Information Technology, Innovation and the Arts.

Science and Innovation for Economic Success

This election commitment is to put the Chief Scientist properly in charge of science policy, and enables the State's applied science efforts to be directed towards meeting our economic challenges. Responsibility - Minister for Science, Information Technology, Innovation and the Arts.

Australian Institute for Tropical Health and Medicine (AITHM)

A special election commitment provides $42.12 million to establish the Australian Institute for Tropical Health and Medicine (AITHM). Building on substantial prior investment in tropical science, the establishment of the AITHM in conjunction with James Cook University will provide strategic investment to enhance the delivery of research capability, training opportunities and increased surveillance capacity in North Queensland in the field of tropical health and medicine. Responsibility - Minister for Science, Information Technology, Innovation and the Arts

Current actions in progress to deliver against these commitments include:

- A Science and Innovation Action Plan (March 2013)
- A 'Health of Queensland Science' Review Report (April 2013)
- A series of audits of Government Departments' prevailing science activities, including this report, DSITIA Science Delivery and Department of Agriculture, Fisheries and Forestry (DAFF) completed. Department of Transport and Main Roads (DTMR) commences May 2013, followed by Department of Environment and Heritage Protection (DEHP) and Department of Natural Resources and Mines (DNRM)
- A Government R&D Expenditure Report 2011-12 (February 2013)

Innovation and Science Development's science investment stakeholders and clients include universities, research organisations, R&D intensive industry and businesses, philanthropic organisations, and local, state, federal and international governments. Key messages and stakeholder views are provided on the following pages, with a list of clients and stakeholders provided at Appendix 11 (pages 97-98).

Client stakeholder views and key messages

A range of interviews were conducted with people working in government, researchers, academic leaders and industry representatives about the scope and current science funding and investment area. The interviews were focused upon whether the funding achieved the government's objectives and priorities; whether the funding and investment program was efficient and effective; and what alternative mechanisms were available to government to encourage and stimulate the development of science research capability and expertise.

A summary of the key outcomes of the interviews with clients indicates the following:

- **Science funding in the state has been visionary, and much has been achieved**

There was overwhelming support for the science funding in the State, from industry, government and researchers. This comment from one of the respondents is in response to the question of the impact of the State's funding of science - ***"the State has done a fantastic job in building capacity across a range of scientific research and this has been very good for Queensland's reputation and is critical to maintain."***

Not only have the Queensland universities lifted their performance considerably over the last decade but Queensland is now seen as the site of some of the best scientific researchers in the country.

Clearly the State has benefitted not only directly in terms of its universities which have all been boosted as a result of the Smart State funding, but importantly in terms of the flow-on effect to other businesses associated with the building of infrastructure and capacity in science.

- **Better communication of results is needed**

It was clear from many of the respondents that the communication of the outcomes of the research needs to be significantly improved. As one respondent said, ***"funding programs and successes are one of the best kept secrets and there has been a missed opportunity to exploit the branding to its maximum potential."*** While there were numerous suggestions about how this might occur it was generally felt that not all researchers were the best at speaking about their research even though as one respondent noted, ***"all the programs need more time spent on promotion of work."***

Suggestions ranged from researchers going to schools to speak about their research, to an annual event where researchers could present their work 'in a three minute format' such as the 'Three-Minute Thesis'*.

**The Three Minute Thesis is a research communication competition developed by The University of Queensland. The exercise develops academic, presentation, and research communication skills and supports the development of research students' capacity to effectively explain their research in three minutes in a language appropriate to an intelligent but non-specialist audience.*

Ultimately when considering the serious decline in the number of students studying science at university level, it was agreed that science teaching in the State urgently needs to be boosted. Fewer students are studying science in the later years of high school and this is no doubt related to the lack of recent advanced knowledge of science of many of the teachers in the system. The funding of teachers to upgrade their qualifications, as the excellent 'Science Sparks' initiative was achieving, was seen as something which would lift the engagement of school students in science and was seen to have a very much larger and longer term benefit when compared with any of the alternatives (such as the presentation of research to schools by academics).

All the universities in the State have benefited from the State's investment but clearly the Brisbane universities have had the more exceptional outcomes. Interviews indicated that regional areas could be better supported, specifically in their areas of expertise. This was not a suggestion to fund the regions in all fields, but to focus on their areas of expertise. For example, while the State will invest a large amount of money in infrastructure in the tropical health area at James Cook University, this would problematic if the university could not then attract staff to work in the field. As one respondent stated, ***"Population is growing in regional Queensland and there are not enough researchers there. There are more regional universities than in any other State which is geographically very widespread, so we definitely need a regional focus when funding science."***

- **Regions need to be supported**

At the same time, it was recommended that the Brisbane universities should be working with regional universities collaboratively where this would be useful. An example of the type of program which could be funded in the State is the Collaborative Research Networks (CRN) scheme which was a one-off funding scheme to provide resources to different types of universities to work together for mutual benefit. Queensland universities are currently recipients of 27% of the CRN funding awarded by the Federal Government. Clearly if this program were to continue the State could build on this significant investment.

- **Asia needs to be an emphasis**

The issue of whether or not Asia should be a focus of some of the science investment in the State was pursued by a number of respondents. Clearly the State's key economic partners are Asian countries, and in addition there are a growing number of Asian students choosing a higher education pathway in Queensland. At the same time there has not been a concerted effort on the part of universities to lift the amount of research undertaken in Asia or the number of students studying Asian studies, or Asian languages. As one respondent commented, ***"many universities do not have an emphasis on Asia commensurate with its importance globally. This needs government leadership."***

It was generally felt that, in terms of research fellowships, there was a need to emphasise research collaboration with Asian partners as an incentive to attract more researchers to reach beyond their traditional partners.

Confusion over what benefits flow to the state

There was some confusion about who has benefitted from some of the funding through the Smart State schemes – the State or the nation. It was generally agreed that the schemes need to be much more targeted to the State's needs. As one respondent stated, ***"a percentage of funding should be targeted to priority areas for the State (e.g. food production, energy)".*** One example that was used of the funding not having been targeted to the State's needs was PhD top-up funding which went to the best PhD students regardless of what they were working on. It was thus seen as not having been very strategically focussed. It was often commented that it was ***'both excellence and impact that needs to be funded'.*** The focus on the impact of the funding should be greater in the future. It was generally felt that a focus of funding on the four pillars was also necessary within any of the schemes, and a greater emphasis on meeting regional Queensland's needs.

Industry needs to be better targeted and engaged

Much of the commentary on business and researcher links in Queensland has been focused on ways that these relations could be improved. ***"Industry needs to tell government what their needs are."*** Time and again both business and researchers commented that links between business and universities need to be improved. The potential to effect a change on the economy through this mechanism was highlighted in many discussions. For example, ***"Queensland could be an energy superpower. We need to turbocharge industrial innovation in that area, by getting researchers to work with business."***

While respondents suggested that researchers need to spend time in business for true engagement to occur, there was a reluctance on the part of many researchers to do this, given the emphasis on research excellence and not impact in most of the measures of academic success. As the federal government is considering more of a focus on impact and not just research excellence into the future the signs are that there will be much more interest in impact measures, and this in turn could change researcher behaviour.

The suggestion that there be more researchers engaged in business needs to be also complemented by more entrepreneurs in academia. It is this two way flow of ideas between universities and businesses that clearly needs to be supported if real change is to occur.

Risk that if the funding changed then State risks a brain drain

There was a key concern of many researchers and people working in industry that a sharp reduction of funding would inevitably translate into the movement of people out of Queensland. The comment by many individuals was that they understood the government's priorities but that if funding was substantially cut then expertise would disappear and ***"we will lose talent to other States and overseas."*** In order for this not to occur it is strongly recommended that funding needs to continue, even if in a reduced form, over the coming period.

Summary

The question was raised with interviewees regarding how the existing science funding and investment program assists the government's objective of science and innovation for economic success in relation to the four pillars and in meeting economic, environmental and social policy challenges. It was recommended that some reframing of funding, if and when this is available, be focused on the four pillars. Likewise there was a strong recommendation that a proper review and accounting system be incorporated into the process so that every 3 to 5 years the whole scheme be assessed in terms of measurable outcomes.

In sum, the interviews supported the view that funding to date has been well spent, but what is needed is a reframing of the areas in which it is spent so that it is now more targeted to support the State's priorities. It is clear that promotion and outreach to the community needs to be lifted and a greater emphasis on industry engagement needs to be incorporated into any plan for future funding.

Further comments, in particular the views of key stakeholders as to the strengths and weaknesses of the science investment business model, are discussed under TOR 6 at pages 48-50.

Terms of Reference 4: Resources and capabilities required by DSITIA to conduct the program

Key Points

- A restructure of DSITIA's Innovation and Science Development Group occurred following staff reductions of 56 FTEs following budgetary measures.
- This resulted in a merging of the previous Science Investment and Funding (Science Development) and Commercial Evaluation Services (Innovation) teams into a single Contract and Investment Management (CIM) team.
- CIM has responsibility for innovation funding programs (outside the scope of this audit) in addition to the science and investment programs previously managed by Science Development.

Resources and Staffing Prior to 2012 Restructure - Historical program management resources

- Prior to restructure in 2012, the Science Investment and Funding team had 12 staff, 6 of which were Queensland Government base funded positions, and 6 which historically were funded through a small proportion of the Smart State funding allocation.
- The cost of administering the science funding programs (including independent grant assessors) has been estimated at approximately $11 million for the period 2002-03 to 2012-13. Adjusting the $1.28 billion science investment for one-off infrastructure projects managed by others (to approximately $812.88 million), this equates to approximately 1.35% of the science program funding.

External expertise

- Specials funding was previously used to engage the services of independent science experts (for grant application assessment) and the services of the former Commercial Evaluation and Management group (for specific contract management services).
- High calibre external grant assessors provide probity and wide ranging expertise to ensure a professional and transparent competitive merit based selection process.
- Functions of the Commercial Evaluation and Management Group in Innovation and Business Development, DSITIA, were merged with the former Science Investment and Funding team in November 2012. All contract management responsibilities for science funding programs and corresponding investments now rest with the newly-formed Contract and Investment Management team, within Innovation and Science Development, DSITIA.
- This new team also has responsibility for administering innovation funding programs, including What's Your Big Idea and the Business and Industry Transformation Incentives.

Core functions required of the Contract Investment and Management team (CIM)

- Manage the government investment provided through science and innovation programs
- Provide administrative and contract management services
- Provide agreement/legal management advice and recommendations, including agreement negotiation, execution and variations.
- Report outcomes of science and innovation investments against milestones and Key Performance Indicators
- Identify promotional opportunities resulting from the science and innovation investments.

Utilising in-house expertise

The expertise and skills within the CIM team should be utilised to ensure all investment programs and funding recipients are administered and managed within the Innovation and Science Development Group by the one team. For example, funding programs and recipients linked to key international agreements such as with the Smithsonian Institute or Chinese Academy of Sciences.

Systems (current and suggested for improved efficiencies)

The following systems are utilised in the effective and efficient administration and management of departmental grants awarded:

Grants Administration Database (GAS) maintains details of all grant applicants and recipients across a range of funding programs administered by a number of government agencies (including DSITIA). The database also details funding decisions, agreement milestones and payment details.

Agreement Management System is an in-house database, utilized by only the CIM team, that assists in the management of funding recipients. The system is a case officer and management tool that assists with managing workloads, deliverables, timeframes, and provides functionality like bring-ups and internal management reporting not available through GAS.

A recent review of the DSITIA grant systems recommended a replacement system to GAS and AMS be investigated due to the lack of system maintenance support for the current systems. The recommendation of a replacement grant system also identified the possibility of increasing its functionality to include on-line grant management functions. For example, currently all applications are submitted by applicants in hard copy and application assessment is performed by the suite of independent assessors on the hard copy applications.

Surveys of funding recipients has occurred in the past utilising Survey Monkey. These surveys have primarily focused on the capture of key performance indicator data.

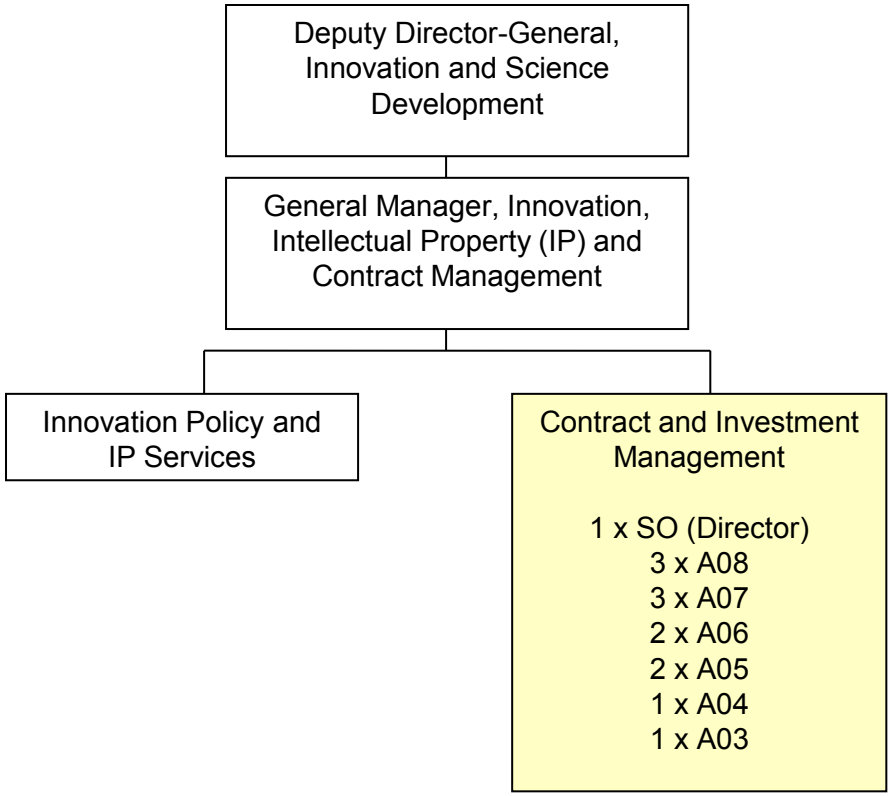
Establishment of a **web enabled grants application system and database** would improve efficiencies in administering science investment and funding programs including:

- Improved, streamlined application, assessment and processing procedures,
- Significant reduction in manual, paper based processing, and
- Ability to access and manage program and investment data in a holistic and coordinated way.

Future staffing and resources

- The current structure is considered sufficient to administer and manage the workload flowing from the legacy programs and funding recipients.
- All positions are now base funded.
- Future requirements however are dependent on the likelihood of new funding programs being approved. If no new funding is provided then the staffing required will progressively decrease in line with the decrease in active funding recipients as the legacy recipients finalise their projects, Likewise, if additional funding is provided then resources are required to establish, administer and manage the outcomes of those programs. The timing of these decisions will dictate whether current expertise is retained or, current expertise is lost and needs to be re-established once new funding is made available.
- Regardless of new funding, legacy recipients will require management until 2017 when their funded projects are due to complete.
- For future competitive funding programs, high calibre external grant assessors would continue to be required in order to provide an independent, transparent and robust assessment process. Individuals engaged to provide these services are compensated with the cost dependent on the number of applications received. Historically the cost has not been significant.
- A graph of funding commitments (2001-2018) showing actual and projected payments under the science investment and funding programs is provided on page 31.
- Graphs illustrating projected payments (2012-2018) by infrastructure, projects and skills funding commitments are provided at Appendix 7 on pages 88-90.

Current CIM Structure and Resourcing Levels



Requirements for recipients

The reporting requirements for approved project and skills recipients, to meet the conditions of the funding agreements are:

- submission of a 6 monthly progress report detailing progress against research milestones (a template report is provided for them to complete),
- submission of a financial statement for the project detailing the funding status to support a payment milestone, and
- submission of a final report at the conclusion of the project.

The requirements for the facilities with respect to the loans provided are as follows:

- submission of Annual Report (these are prepared for general use, not just for DSITIA purposes), and
- holding of annual review committee meetings to discuss progress, future research agenda, and any issues.

Decreasing the administrative burden

From 2013, in recognition that the majority of the funded facilities are now established and operating efficiently, DSITIA:

- moved to suspend requirements for annual review meetings for each facility and now relies on information provided in each facility's annual report, and
- now holds annual strategic meetings with the Queensland universities to monitor governance and identify and resolve common issues and provide a forum for identifying strategic issues, reinforcing linkages and providing opportunities to direct priorities.

Establishment of a **web enabled grants application system and database**, as discussed on page 45 (TOR 4), would improve efficiencies for recipients, enabling electronic submission of applications as opposed to paper based applications. Similarly, greater use of electronic forms e.g. compulsory survey responses, would likewise streamline administrative compliance requirements for funding recipients.

Consultation Point

Views expressed during consultation were that the requirements of recipients were not particularly onerous, and were certainly less complex than international grant applications.

- Some interviewees commented that a 'one size fits all' approach to contractual arrangements between funding recipients and the Queensland Government meant that altering contracts to suit particular individual situations could result in lengthy negotiations to finalise contractual arrangements.
- Establishment of a web enabled grants system and database was raised, as current grants systems do not allow easy extraction of data and the current paper based system also requires significant volumes of hard copy documents to be couriered to grants assessors for all programs.

Principles, Strengths and Weakness of the Science Investment Business Model

Principles of the Investment Business Model

- The Science Investment and Funding Programs have been run on a competitive, merit based process, with some additional special funding towards high priority projects assessed on stand-alone business cases.
- Funds have typically been awarded on the basis of research excellence.
- Investment programs followed a logical progression, with an initial focus on building world class research infrastructure (buildings, plant and equipment), followed by supporting projects and talent.
- A strong emphasis has been placed on co-investment, resulting in Queensland Government funds being used to leverage Commonwealth, philanthropic, industry and research sector funds to achieve greater returns for the State.
- A summary of the programs, including eligibility and objectives is appended (refer Appendix 2, pages 71-74).

Strengths	Weaknesses
✓ Competitive, merit based ✓ Excellence driven ✓ Strong research capability with international reputation (ERA results) ✓ World class research facilities	❑ Research agenda determined by the priorities of other funders or interests of scientists rather than Queensland Government priorities and needs ❑ Ongoing support needed for the ongoing operation of research facilities with ad-hoc support provided in the past ❑ Not enough practical or local impact
✓ Collaborative co-investment model ✓ Leverages state, federal and philanthropic funds ✓ Strong collaborative partnerships with universities and research organisations	❑ Strong dependence on matched funding ❑ Vulnerable to changes in fiscal position of funding bodies ❑ Relatively poor connectivity to Queensland Government scientists
✓ Springboard for early career researchers ✓ Knowledge of State's research capability / strengths ✓ Potential commercialisation returns ✓ Potential to interconnect research communities	❑ Lack of actual commercialisation returns and expectation of blockbusters or high level of economic returns in the future ❑ Limited evaluation capacity ❑ Legacy funding issues / expectations
✓ Links institution's research with industry need ✓ Some connection to global business ✓ Seeded ongoing relationships between Queensland organisations with national and international world leaders	❑ Translation of outcomes to public policy and business; relatively weak linkages to/collaboration with end users (whether in business or government) ❑ Created a reliance on government funding ❑ Funding not linked to specific state priorities / research capability
✓ Experienced and skilled contract management team / capability ✓ Broader whole of government funding perspective	❑ Limited electronic enabled ability to access and manage program and investment data in a holistic and coordinated way

Feedback on Government engagement with the life sciences industry*

"The Department's Smart Futures Funding and other schemes such as NIRAP^ have been vital in providing Fellowships for early and mid-career researchers, developing industry alliances and funding NCRIS facilities and their support staff".

"[DSITIA] interact very well with research organisations and provide a reasonably good level of service. [DSITIA] events are great. 2012 scheduled events including the 'Development Pathway' workshop series are beneficial for early and late career researchers and postgraduate students. The Smart Futures scheme is fantastic and should be run annually. One criticism: where philanthropic money has been raised independently by [our organisation] for large research programs this money has not been matched by the State Government on application. This is disappointing. There are very limited opportunities to attract matching dollars through Federal funding schemes".

**Source: Queensland Life Sciences Industry Report 2012*
^NIRAP: National and International Research Alliances Program

Weaknesses associated with the co-investment aspects of the Science Investment Business Model

National and global funders recognise that regional governments value the opportunity to host leading-edge research, and this is reflected in 'leverage' requirements in their policies. For this reason, state governments face a constant stream of funding requests from universities to match or augment funds on offer from the Commonwealth and global philanthropists like The Atlantic Philanthropies. Experience shows that some of these are excellent opportunities, such that not funding them would risk being of detriment to Queensland's Smart State reputation. In other cases, the benefits to Queensland are less clear, and difficult choices need to be made.

While the co-investment model is potentially advantageous for a State Government, the challenge is to ensure that State funds achieve State objectives, and that the State is not simply subsidising the objectives of other funders. This means being clear on what the State wants for Queensland in return for its funding.

A characteristic of the co-investment model is that it tends to concern micro-level choices. Typically, the government is asked to support a specific centre or institute, and Key Performance Indicators are put in place to ensure that State objectives are met.

A drawback of this approach is that the achievement of the government's overarching policy objectives must be leveraged from a relatively narrow subset of the Queensland research and innovation system. A potential alternative would be to provide support and incentives at a broader level, giving funded entities such as universities greater flexibility to determine how best to deliver on State objectives from across a broad portfolio of activity.

Strengths and Weaknesses of the Science Investment Business Model

Views of key stakeholders

There was overwhelming support for the science funding in the State, from industry, government and researchers. This comment from one of the respondents is in response to the question of the impact of the State's funding of science - ***"the State has done a fantastic job in building capacity across the full range of scientific research and this has been very good for Queensland's reputation and is critical to maintain."***

It was clear from many of the respondents that the communication of the outcomes of the research needs to be significantly improved. As one respondent said, ***"funding programs and successes are one of the best kept secrets and there has been a missed opportunity to exploit the branding to its maximum potential."*** While there were numerous suggestions about how this might occur it was generally felt that not all researchers were the best at speaking about their research even though as one respondent noted, ***"all the programs need more time spent on promotion of work."***

"Population is growing in regional Queensland and there are not enough researchers there. There are more regional universities than in any other State which is geographically very widespread, so we definitely need a regional focus when funding science."

The issue of whether or not Asia should be a focus of some of the science investment in the State was pursued by a number of respondents. As one respondent commented, ***"many universities do not have an emphasis on Asia commensurate with its importance globally. This needs government leadership."***

It was generally agreed that the schemes need to be much more targeted to the State's needs. As one respondent stated, ***"a percentage of funding should be targeted to priority areas for the State (e.g. food production, energy)".*** One example that was used of the funding not having been targeted to the State's needs was PhD top-up funding which went to the best PhD students regardless of what they were working on. It was thus seen as not having been very strategically focussed. It was often commented that it was ***'both excellence and impact'*** that needs to be funded. The focus on the impact of the funding should be greater in the future.

Much of the commentary on business and researcher links in Queensland has been focused on ways that these relations could be improved. ***"Industry needs to tell government what their needs are."*** Time and again both business and researchers commented that links between business and universities need to be improved. The potential to effect a change on the economy through this mechanism was highlighted in many discussions. For example, ***"Queensland could be an energy superpower. We need to turbocharge industrial innovation in that area, by getting researchers to work with business".***

There was a key concern of many researchers and people working in industry that a sharp reduction of funding would inevitably translate into the movement of people out of Queensland. The comment by many individuals was that they understood the government's priorities but that if funding was substantially cut then expertise would disappear and ***"we will lose talent to other States and overseas".***

Infrastructure - what has been achieved as a result of the Science Investment in Infrastructure?

Infrastructure Analysis

The policy objective was to build scientific scale and capability, through a focus on new infrastructure and attraction of talented researchers. In response to increasing calls on State governments to fund new university infrastructure, the Queensland Government established a systematic approach to channel and respond to requests. The program has enabled government to assess proposals against set selection criteria.

Infrastructure funding has supported capability building across the Queensland Government's R&D objectives (refer table on the following page). Indeed, most of the spend has met the capital costs of research buildings and equipment, and significantly has leveraged philanthropic and Commonwealth funding.

Approximately two thirds has supported external research organisations i.e. universities, independent medical research institutes, CSIRO and AIMS. Approximately one third has renewed the Queensland Government's own research infrastructure. $55.675 million of the $863 million investment in infrastructure was co-invested in Commonwealth programs to establish national research infrastructure.

Capabilities, research clusters and science precincts resulting from the infrastructure investment **Categorised by R&D priority*

Enabling Sciences and Technologies
- Drug, vaccine and diagnostic discovery and development
- Biotechnologies, genomics, proteomics and metabolomics
- Neurosciences and imaging
- Digital technologies and e-research
- Nanotechnologies, microtechnologies and advanced materials

Safeguarding Queensland
- Plant, animal and human health biosecurity
- E-security
- Criminology and forensics

Environmentally Sustainable Queensland
- Terrestrial and marine ecosystems
- Climate science, water and soil
- Reef and rainforest research
- Biodiversity and conservation science

Health and Wellbeing
- Cancer and immunology
- Cardiovascular, Diabetes, obesity and other chronic disease
- Dementia and mental illness
- Infectious disease research
- Tropical health and medical research
- Clinical Development and translational research
- Applied Sport Science research

Smart Industries
- Food, nutrition and health sciences
- Horticulture and forestry – plant breeding and propagation
- Animal health, animal production and aquaculture
- Geosystems, mining and minerals processing
- Energy and clean technologies
- Advanced manufacturing, construction and urban design
- Aviation and aerospace research

Tropical Opportunities
- Tropical crops
- Marine ecosystems

What has been achieved as a result of the Science Investment in Infrastructure?

Queensland's Science Precincts and Clustering of Research Capabilities

Location R&D Priority	Brisbane										Regions								Other	State-wide
	St Lucia (UQ & CSIRO)	Kelvin Grove & CBD (QUT, NICTA, Qld Govt Depts, CRCs)	Herston (RBWH, RCH, QIMR & UQ)	Woolloongabba & South Brisbane (PAH & MMRI)	Dutton Park (ESP)	Nathan (GU)	Coopers Plains (DAFF, QAAFI, CSIRO)	Eight Miles Plains (Brisbane Technology Park)	Pinjarra Hills (UQ & CSIRO)	Toowong (WRI & QCTN)	Gold Coast	Sunshine Coast & Bundaberg	Gatton & Toowoomba	Gladstone	Rockhampton	Mackay	Townsville	Cairns	Other Brisbane (QMI & Companies) and Interstate	
Enabling Science and Technologies	•	•																		
Environmentally Sustainable Queensland	•				•	•											•			
Smart Industries	•	•				•	•		•				•		•		•		•	
Tropical Opportunities																	•			
Health and Wellbeing	•	•	•	•		•		•		•	•						•	•		•
Safeguarding Queensland	•	•																		

Key Point

Investment in science, technology and innovation by the Queensland Government has significantly impacted upon the State's competitiveness in terms of its global reputation for science excellence and its research capability. Queensland Government support has attracted scientists to Queensland and enabled the development of a critical mass of researchers and clustering of expertise across the State.

What has been achieved as a result of the Science Investment in Infrastructure?
Leverage - Commonwealth and Philanthropic Co-Investment

The Queensland Government contribution to the NCRIS and Super Science Initiatives has secured substantial funding from the Commonwealth Government for the grant recipients.

Key Points

$55.675 million of the $863 million investment in infrastructure was co-invested in Commonwealth programs to establish national research infrastructure for which the cost and complexity of acquisition, provision and operation was such that few Australian universities or publicly funded research agencies could expect to acquire on their own.

Co-investment met the capital costs of the facilities however in some instances the funding was needed to support operational, maintenance and refreshment costs or the cost of skilled operators.

There are ongoing operational funding issues associated with funding some infrastructure projects.

Commonwealth Co-Investment

Since 2006, the Queensland Government, along with the other States and Territories, has been required to provide co-investment alongside the Commonwealth Government under a number of Commonwealth programs designed to support research infrastructure including the National Collaborative Research Infrastructure Strategy (NCRIS) and Education Investment Fund (EIF) programs (including SuperScience Initiatives). Where appropriate, Commonwealth NCRIS funding was available for operational costs.

Following a 2008 Review of the National Innovation System, the Commonwealth committed to provide additional funding to a number of NCRIS capabilities through the EIF funded SuperScience Initiative, however EIF funding could only be used for capital and research equipment expenses. This left recipients needing to secure alternate funding sources to operate the facilities and equipment, namely State governments, for the period from 2011-12 onwards. A list of projects, Queensland Government and Commonwealth funding under each roadmap area is provided at Appendix 12 (pages 99-102).

Investment in Research Infrastructure by National Research Infrastructure Roadmap Areas

Investment in Research Infrastructure by National Research Infrastructure Roadmap Areas	Queensland Government Commitment	Commonwealth Government Commitment
Environmentally Sustainable Australia	$12,610,000	$43,432,950
eResearch	$11,700,000	$24,800,000
Frontier Technologies	$8,880,000	$18,244,400
Promoting and Maintaining Good Health	$19,085,000	$64,804,000
Safeguarding Australia	$3,400,000	$2,171,000
Understanding Cultures and Communities	-	-
Total	$55,675,000	$153,452,350

Philanthropic Co-Investment

The Atlantic Philanthropies has made significant funding contributions to support development of Queensland's science and research infrastructure. From 1998 to 2011, The Atlantic Philanthropies invested $288.175 million in research initiatives in Queensland (refer full list in Appendix 13, page 103-104). This has leveraged $461.22 million of Queensland Government funds and $410 million of Commonwealth funds. Highlights include $50 million toward the Translational Research Institute, $27.5 million toward QIMR Central and $22.5 million to the Institute of Health and Biomedical Innovation.

Projects and collaborations: What has been achieved as a result of the Science Investment in Projects?
Projects and Collaborations ($139 million – 2005-06 to 2011-12)

Queensland Government investment in research projects aimed to link research with end-users. For example, a primary goal of the Research Industry Partnerships Program and the Partnerships Alliances Facilitation Program was to establish research partnerships between public sector and end-users including business. In addition, project funding aimed to capture knowledge flows and technology transfer from other states and countries under the National and International Research Alliances Program.

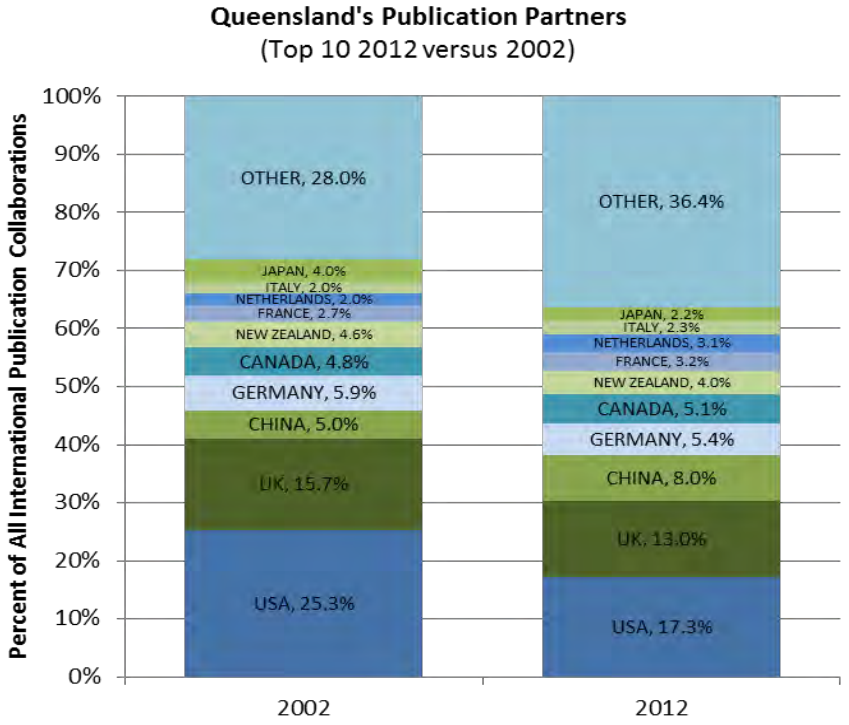
Of the 159 project funding recipients (under Science Development's competitive grant programs, excluding one-offs), 139 are research organisations (87%) and 20 are industry organisations (13%). State Government Departments represent 6% ($8.2 million) of project recipients.

Funding programs together with Memoranda of Understanding and Statements of Intent have contributed to:

- Strong academic-international-industry links (e.g. Boeing, Pfizer, Syngenta, Dow)
- Strong inter-regional links (e.g. North America-Washington State and British Columbia, China-Shanghai and Beijing)
- Strong collaborative funding links (e.g. Bill and Melinda Gates Foundation, Queensland-Smithsonian relationship, Commonwealth Government and other philanthropic, Chinese Academy of Sciences)

Key Points

There has been a big decline in the proportion of collaborations with many of our traditional partners – like the US, UK and Japan - in the past ten years while partnerships with China have increased significantly in the same period. China now (2012) constitutes 8% of our total publication collaborations compared to 5% in 2002. The number of Queensland/China co-authored publications has grown nearly 6.5 fold in the past decade (compared to a 2.5 fold increase in total Qld publications).



Commonwealth funding - What has been achieved as a result of the Science Investment in Projects? Projects and Collaborations - Attracting Commonwealth Government Competitive Grant Funding

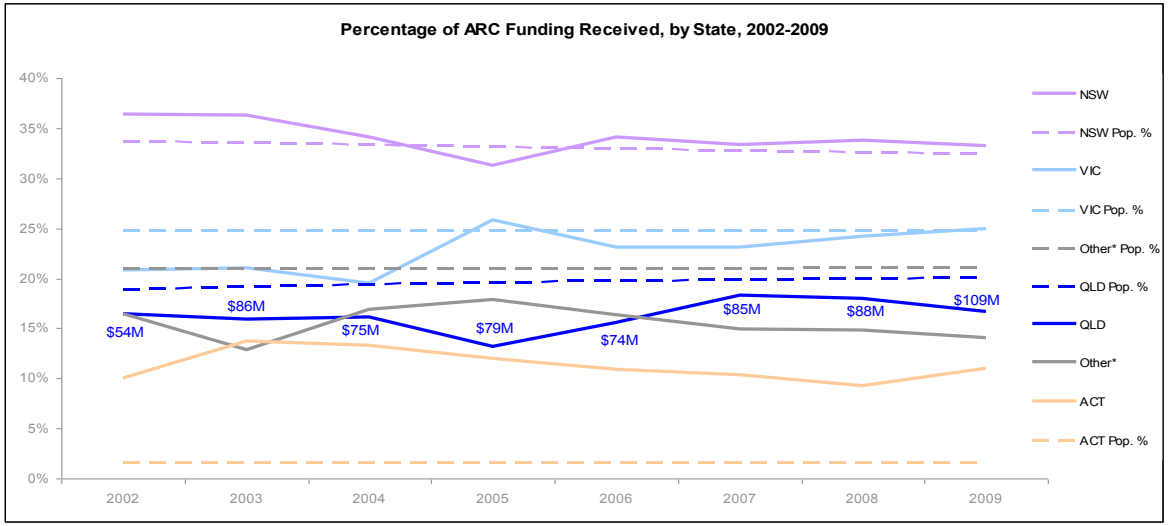
Key Points

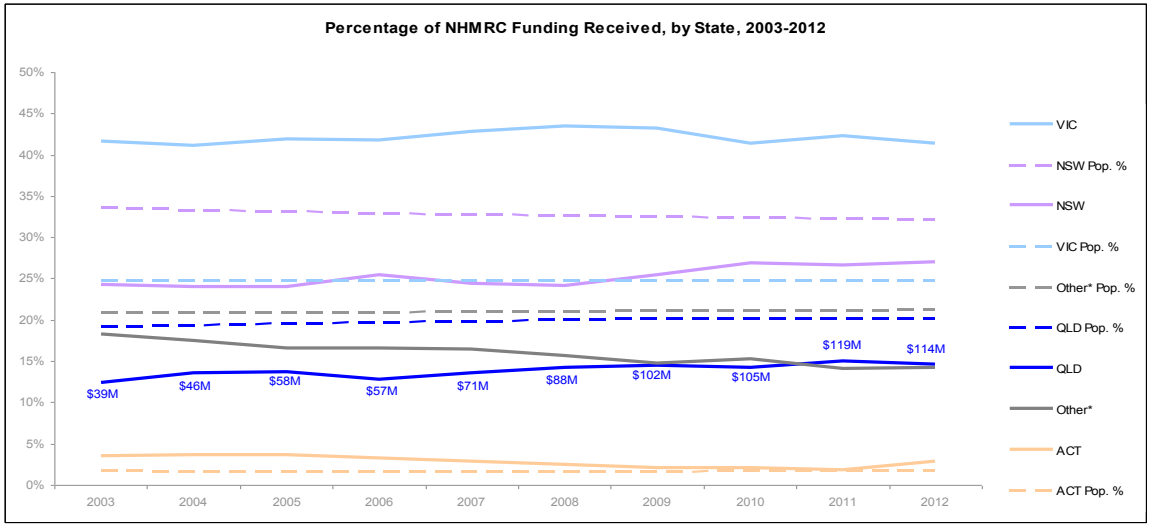
Although in nominal value, while Queensland has doubled the quantum of funding from the Australian Research Council (ARC), the proportion of funding remains below what might be expected based on Queensland's share of the economy and population (20%). This analysis begs the following rhetorical questions:

(a) How further would Queensland have dropped behind if Smart State Investment had not been made? and

(b) Why have Smart State Investments not brought about more success in these bidding processes?

Although in nominal terms the funding Queensland attracts from the National Health and Medical Research Council (NHMRC) has steadily increased over time (except 2006), the proportion of funding remains below what might be expected based on Queensland's share of the economy and population (20%).





** Other includes WA, SA, NT and TAS*

Skills - What has been achieved as a result of the Science Investment in Skills?

Fellowships, PhDs and Internships

A significant proportion of funding from 2005-06 to 2009-10 supported an individual researcher via the prestigious Premier's Fellowships award. Only limited support was given for industry internships with funding provided for two years from 2005-06 to 2006-07. Regional universities received 14 Queensland Government research fellowships (17%). 76 of 82 fellowships awarded to university based researchers, including: 36 for The University of Queensland; 17 for the Queensland University of Technology; 9 for Griffith University, and 9 for James Cook University.

Industry participation

Industry participation was compulsory for the earlier research fellowships (2003-2008), and 32 fellowships were awarded during this period which had industry sponsors or co-sponsors. The State funded these 32 fellowships to a total cost of $6 million, which leveraged $11.19 million in sponsor and co-sponsor contributions. From 2009-2012 industry participation in fellowships was not compulsory, but 17, or 34%, of fellowships awarded had industry participation demonstrating that a significant proportion of applicants recognised the value of industry involvement in research. The State funded these 17 fellowships to a total State cost of $4.14 million, which leveraged $9.88 million in sponsor and co-sponsor contributions.

Missed opportunity for Queensland Government scientists

Although the talent funding was available to all Queensland researchers, initially many Queensland Government researchers thought that they were not eligible to apply for State grants. Only 1 of 82 research fellowship grants has been awarded to a Queensland Government researcher (a BSES researcher in 2004). Even in recent years when the eligibility of Queensland Government researchers was clarified, few fellowships applications were received from Queensland Government researchers. For example, only 3 of 155 fellowships applications were received from Queensland Government researchers in the 2011-12 funding round. This represents a lost opportunity for State scientists to secure funding to undertake specific research projects.

Leverage

The majority of Queensland Government grants require applicants to secure matched funding from sponsor and co-sponsor agencies as a pre-requisite. This means that for every dollar contributed by the Queensland Government, a matching dollar must be supplied by another agency, for example, a university, a research organisation, a company or another research funding provider. In many instances the sponsor/co-sponsor funding exceeds the 1:1 requirement of the Queensland Government - a $1 investment in research fellowships leveraged approximately $2 in sponsored and co-sponsored funding, and an additional $12 in other research grants. This indicates that the funding benefits of securing State research grants substantially exceed the base value of the research grant. In addition, the Queensland Government research grants are often used to leverage other grants by recipients.

What has been achieved as a result of the Science Investment in Skills?

Smart State University Internships Program (2005 – 2011)

Under the Smart State University Internships Program, 3,254 science, engineering and technology undergraduate students were placed with businesses by seven Queensland universities to gain on-the-job work experience in their chosen field of tertiary study. Each university was awarded $116,664 (excluding GST) over three years ($38,888 per year) matched by the administering university, to provide this program to its respective students. A summary of the program is provided at Appendix 5, page 86.

Queensland International Fellowships (2005 – current)

Under the Queensland International Fellowships program, the Queensland Government provided $1.7 million, with 77 fellowships approved from the 152 applications received. Each award helped emerging scientists undertake collaborative research projects with top international institutions. This program also provided the mechanism for DSITIA to deliver fellowships under various international alliance agreements e.g. with China, India and British Columbia.

PhD Scholarship Program (2005 – current)

The Queensland Government provided $2.51 million under the PhD scholarship program. 101 scholarships were approved from 342 applications received.

At the end of 2012, 42 PhD scholars had completed their research and submitted final reports. The remainder are not yet finalised as they commenced during or after 2007-08 and run over a three year period. The 42 completed PhD scholarships resulted in: Queensland Government funding of $806,500, recipients leveraging $1.33 million and securing 52 additional grants; 3 patents sought; 7 new products, processes or services, 138 peer-reviewed publications produced; 37% of scholarships resulting in a change of practice; and 35% of scholars attracted to, or retained in, Queensland.

Other Skills Programs

Queensland-Smithsonian Fellowships Program (2001 – current)

Investment by the Queensland Government of just over $700,000 has leveraged nearly five times the original investment by Queensland home institutions and Smithsonian host institutions resulting in a total value of over $3 million for the program. 39 fellowships have been awarded.

The program has supported in particular, life sciences, education and ecosciences.

The cost of administering the program is relatively small and equates to 0.2 of a Queensland Government FTE. These 39 fellowships form part of the total 318 fellowships noted on page 3.

Fellowships Program; Smart State Fellowships; Smart Futures Fellowships (2005 – current)

	Early career fellowships (0-5 years post-doc)	Mid career fellowships (5-10 years post-doc)	Total
Number of completed Fellowships	18	8	26
Total Queensland Government funding (ex-GST)	$2.7 million	$2.4 million	$5.1 million
Ratio – Government Funds : Additional Grant Funding	1:6.3	1:18.3	1:12
Sponsor/co-sponsor funding (ex-GST)	$5.94 million	$4.39M	$10.33 million
Number of peer-reviewed publications	268	184	452
Number of additional grants secured	48	76	124
Value of additional grants secured (ex-GST)	$17 million	$44 million	$61 million
Fellows attracted to/retained in Queensland	83%	100	88

Note: Excludes Queensland-Smithsonian Fellowships Program

Commercialisation returns research - Commercialisation Returns and Research Impact

Understanding the 'payback' from research

Commercialisation returns

In the early 2000s, emergent scientific disciplines like molecular biology, neuroscience and nanotechnology were seen as having the potential to accelerate the development of new therapies. For example, there was an expectation that increased understanding of biological processes at the molecular level would reduce the failure rate of clinical trials. However, aside from some 'low hanging fruit', the development of these fields is now recognised as being on the more normal 20 to 40 year trajectory for major new technologies, and the commercialisation returns that were anticipated at the time the State invested in these fields therefore have not materialised within the timeframes hoped for. A contributing factor was the strong health and medical focus of State supported university research (discussed under TOR 2) which combines great complexity with long commercialisation lead times.

On the positive side, a residual benefit of these early expectations is a raft of commercialisation proceeds agreements, many of which will remain in place for the next 20 years or longer. These arrangements will ensure that the State will share in any large windfall revenues from the exploitation of State-supported research. Additionally, the prospect of these types of returns is improving as university commercialisation offices become better at identifying and exploiting new intellectual property with commercial potential. A case in point is Uniquest at The University of Queensland, which is now widely recognised as one of Australia's leading technology transfer offices.

Research impact – understanding the 'payback' from research

The 'payback' to Queensland from our science investments comes in the form of beneficial impacts and outcomes for the Queensland population that have a causal link to Queensland's scientific outputs and would not have occurred in the absence of State intervention.

There are two main pathways to these outcomes:

- The 'more irons in the fire' pathway – by generating more science at the global frontier, our investments can potentially accelerate the achievement of breakthroughs that benefit the world, including Queenslanders
- The 'local spillovers' pathway – by having more research done *in Queensland*, local stakeholders can benefit from the skills, facilities, technologies, and graduates associated with a larger local research capacity.

For both pathways, estimating the benefits to Queensland in monetary terms is extremely difficult, if not impossible. Analytical problems such as attribution, appropriability, long timeframes, and additionality are often insurmountable barriers to a straightforward cost-benefit approach. We will never truly know the return on our investment in financial terms.

Instead, the evaluation of research investments has to rely on information about their *impact*.

A useful definition of impact is:

- Impact **includes**, but is not limited to, an effect on, change or benefit to:
  - The activity, attitude, awareness, behaviour, capacity, opportunity, performance, policy, practice, process or understanding
  - Of an audience, beneficiary, community, constituency, organisation or individuals
  - In any geographic location whether locally, regionally, nationally or internationally
- Impact **includes** the reduction or prevention of harm, risk, cost or other negative effects.

Source: UK Research Excellence Framework

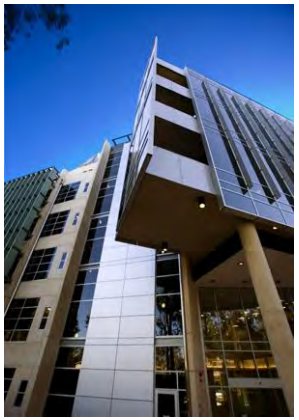
Research impact - How is Queensland positioned as a result of its science investments?

In collaboration with stakeholders and experts, DSITIA is currently developing a robust evaluation methodology based on impact.

It is recommended that future impact measures include provision to capture the more informal engagements such as school visits, community and media presentations, alumni networks, and hosting visiting researchers. These measures will be useful to understand the wider impact of research institutes and facilities on the broader community. Already a few institutes provide data on these activities. It is likely that others are undertaking these activities but the information is not being captured and reported.

To better understand the link between the institutes and end users, it would be useful to capture data such as contract research, faculty consulting, and providing access to specialised instrumentation and equipment. As most of the institutes are new, it is recommended that future reporting includes these metrics to assist the government in actively managing these assets to ensure they address Queensland's needs and priorities.

Institute for Molecular Bioscience (IMB)



Australian Institute for Bioengineering and Nanotechnology (AIBN)

Queensland Brain Institute (QBI)

Challenges to be addressed include:

- Maintaining a coordinated approach to dealing with science funding requests from universities, research institutes and others.
- Queensland still underperforms in competing for external competitive grant funding.
- Ensuring operationally funded research infrastructure (including facilities and equipment) continues to perform at full capacity if alternative funding sources cannot be secured.
- Encouraging greater engagement between universities and businesses in order to convert research outputs to practical outcomes.
- How to improve the translation of research into quantifiable economic outcomes, which remains problematic.

The establishment of centrally managed science investment and funding programs across the Queensland Government has ensured a more systematic approach to State funding support for universities and research institutes, as opposed to the ad-hoc, decentralised approach prior to 2000. Whilst ad-hoc funding requests will always be received by governments, it would be advisable to retain a more strategic, centralised approach to funding requests to limit these approaches and provide a mechanism to compare and prioritise requests from a whole of Government perspective.

Alternatives to the input focussed grants based approach which warrant further investigation include mechanisms to encourage demand driven research through:

- a considerable increased emphasis on knowledge exchange and end user engagement, and
- maximising the opportunities from the Queensland Government's significant investment in world-class infrastructure, projects and talent throughout the State, through greater promotion and facilitation of targeted investment and collaborative opportunities, including through the State's international alliances and from other non-government sources.

It is also recommended that consideration be given to creating a more stable future funding and investment platform through creation of a revolving innovation/ endowment type fund, which is addressed in the following pages.

Regardless of whether further science funding is made available, the following non-grant based activities to improve engagement between science and research, and business and industry, should be considered.

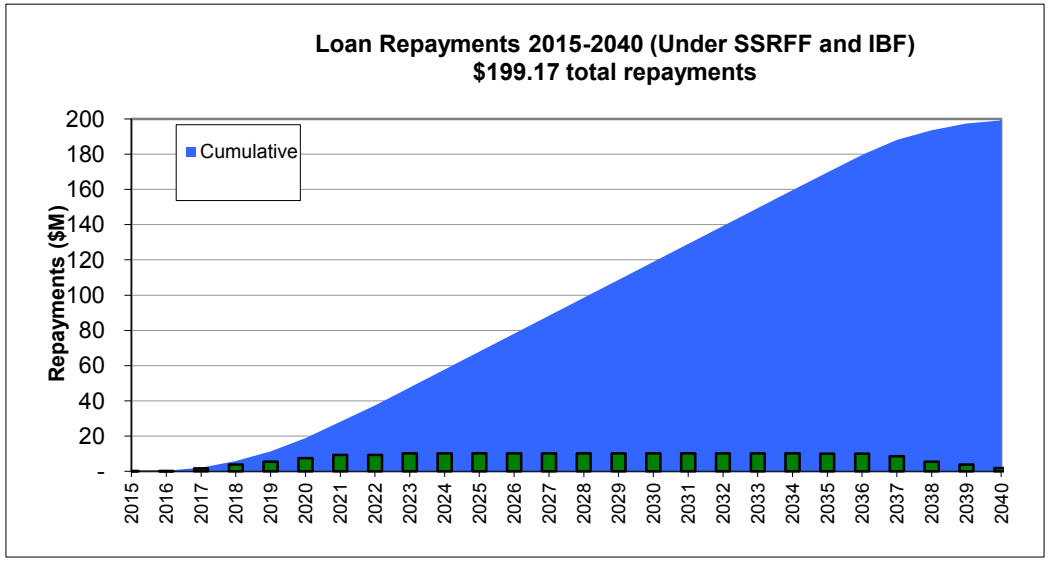
- *Business engagement forums:* The promotion to business of the potential to engage with research could be communicated through forums around the State. These forums would link specific businesses with researchers in the field, so that there would always be a flow through of people in the field for businesses to link to. Suggestions such as tech-clinics have been proposed (and previously used) and these would be an excellent way for business to see the value in working with researchers, again focusing on specific fields of expertise. It would be important to engage professional facilitators at these events to maximise the potential for engagement between businesses and universities to occur.
- *Pro-Vice Chancellors – Industry Engagement:* Ultimately universities need to be encouraged to appoint a senior person to deal with industry engagement, at the Deputy Vice Chancellor or Pro Vice Chancellor (PVC) level, as some have already done. The role of this person, lets say a PVC-Industry Engagement, would be specifically to engage with local industry and to spearhead the relationship between universities and business. The time is right for the sort of individual with business and research skills to be brokering the relationships between universities and business. Universities should see the benefit of appointing such a person.

Alternative Mechanisms - Revolving Science and Innovation Endowment Fund

Smart State Research Facilities Fund (SSRFF) and Innovation Building Fund (IBF) Loan Arrangements

Loans under SSRFF and IBF are for 30 years, interest free, with one third forgiven. Repayments commence in the eleventh year, and at year thirty the Queensland Government forgives one third of the loan amount. As a trade off for the forgiven part of the loan, the Queensland Government is entitled to a percentage of commercialisation (under specific conditions and the percentage varying per Institute). To date, no proceeds have returned to the State.

The original intent of the loan repayments was to create a Revolving Science and Innovation Fund, funded by these repayments. The total quantum of repayments due is $199,172,896 (figure includes one third of the loan being forgiven).



Note: *Loan repayment figures based on one third of the loan having been forgiven*

"The State has done a fantastic job in building capacity across a range of scientific research and this has been very good for Queensland's reputation and is critical to maintain."

Key Points

- Science funding in the State has been visionary
- Risk that if the funding ceases then the State risks a brain drain
- Supporting talent through fellowships
- Engagement of research with business
- Industry needs to be targeted
- Regional research needs to be supported
- Asia needs to be an ongoing emphasis
- Better communication of results is needed

Summarising the rationale behind the recommendations

Throughout consultation, there was overwhelming support for the science funding in the State, from industry, government and researchers. Not only have the Queensland universities lifted their performance considerably over the last decade but Queensland is now seen as the site of some of the best scientific researchers and facilities in the country. Clearly the State has benefitted not only directly in terms of its universities which have been boosted as a result of the Smart State funding, but importantly in terms of the flow-on effect to other businesses associated with the building of infrastructure and capacity in science.

With uncertain funding over the next few years, and a change in emphasis of the government, there is clearly a need to reframe the nature of science funding to better meet the State's objectives. At the same time it is important that the radical transformation of science in the State not be tampered with too greatly as this could have profound effect on the State's competitive advantage. The focus over the coming years should be aimed at maintaining the momentum of the first decade of funding and in building on the investment focus. If the following areas are developed simultaneously, then Queensland will maximise its investments to date and further build on Queensland's reputation in science capability as a beacon for the rest of the country to follow.

Key long term recommendations

In order to maintain the momentum of science development in the State, building on Queensland's world-class infrastructure, capabilities and attracted and retained talent, it recommended that the following be closely examined in the Queensland Government's forward R&D investment planning.

Recommendation 1:

The continuation of new science funding, within State Budget constraints, and with a focus on achieving tangible societal outcomes aligned with the government's priorities. A small amount of funds, which are currently committed under contracts, may become available due to anticipated claims not eventuating (e.g. due to projects finishing early). Any such unspent funding could contribute to a new science funding allocation.

Recommendation 2:

The use of science loan repayments to support the State's science investment in the future. This would establish a revolving science investment fund as an endowment, but noting sufficient funds would not be generated until the 2020s. This could be supplemented by philanthropic and other sources (including additional government funding, where available).

Recommendation 3:

This funding would be allocated to a more focused Fellowship program with an emphasis on the engagement of early and mid career researchers in research with business, an increase in funding to regions in Queensland and building a capacity for Queenslanders from across the economy to work with Asia. The Queensland-Smithsonian program, highly regarded by both the Queensland and international research community, should continue as the means by which Queensland delivers on its international obligations.

Recommendation 4:

In order to increase the wider recognition of the capability that has developed in Queensland, more effort is required in demonstrating to the community the benefits of scientific research. This would be through increased outreach by funded fellows, greater engagement through public events, art and media.

Recommendation 5:

A review of the outcomes and impact of the science funding program needs to be implemented every 3 to 5 years, in order to assess the schemes in terms of measurable outcomes for the State.

What recommendations are proposed for the future provision of science funding and investment programs?

Specific Sub-Recommendations relating to key long term recommendations

Recommendation 3: Sub-Recommendations - Supporting Talent through a Targeted Fellowships Program

3.1 Refocussing of fellowships with consideration of the following emphases during program guideline development:

- *Fellowships in industry:* e.g. 20% of the score in the competitive round for the translation of innovation into a commercial outcome, requiring quality time of researchers working in industry.
- *Entrepreneurs in residence at universities:* annually, several successful business people given a year in residence at Queensland universities.
- *Regional emphasis:* e.g. 5% of the scoring of fellowships in a competitive round for the regional emphasis, with fellowships extended to those who are working in the four pillars in regional areas, or to those who significantly enhance the investment in infrastructure that has already been made in regional areas.
- *Asia:* e.g. 5% of the scoring of fellowships in a competitive round would be for researchers working on joint projects with Asian counterparts, or for researchers to work with Queensland businesses who have partnerships with businesses in China.

3.2 Renaming of the fellowship program: as 'innovation' is recognised as a key to a future-focused economy, and in creating new products and services, the new fellowships could be called Queensland Innovation Fellowships (QIFs) to indicate that today it is not simply a matter of being 'smart' but also in adding value to the economy. Another possible title is Queensland Research Fellowships (QRFs).

3.3 The State could also support the development of the smaller, less research intensive universities by having a small competitive fund based on the CRNs (Collaborative Research Networks) which would team research intensive universities in the State with regional universities to encourage less research intensive regional universities to focus their research activities in areas of excellence.

3.4 *Administration* - Provision of a web-enabled grants application and database system would also streamline processes and provide efficiencies both in administration and for funding applicants and recipients.

3.5 *Business and industry engagement:* The promotion to business of the potential to engage with research could, for example, be better communicated through forums around the State. These forums would link specific businesses with researchers in the field, so that there would always be a flow through of people in the field for businesses to link to. Suggestions such as tech-clinics have been proposed (and used) and these would be a positive way for business to see the value in working with researchers, again focusing on specific fields of expertise. It would be important to engage professional facilitators at these events to maximise the potential for engagement between businesses and universities to occur.

3.6 Ultimately universities need to be encouraged to appoint a senior person to deal with industry engagement, at the Deputy Vice Chancellor or Pro Vice Chancellor level. The role of this person, lets say a PVC-Industry Engagement, would be specifically to engage with local industry and to spearhead the relationship between universities and business. The time is right for the sort of individual with business and research skills to be brokering the relationships between universities and business. Universities should see the benefit of appointing such a person.

Recommendation 4:
Sub-Recommendation – Better Communication of Results

There are a variety of mechanisms that could better help communicate research advances and positive scientific outcomes, e.g.

4.1 Fellows could provide the outcomes of their research to the community at public events. That is once per year, in different parts of the State, the researchers could attend an event where they were briefly presenting the outcomes of their research.

4.2 There could be a public lecture series on science run jointly by the Queensland universities.

4.3 Outreach in communities for fellows, with a specific emphasis on rural and regional areas, or disadvantaged areas in cities.

4.4 Incorporate funding for public engagement that directly commissioned work in the arts to support scientific engagement of the wider community, into the science budget.

Index of appendices

Appendix 1: Consultation list

Queensland Government

Department of Science, Information Technology, Innovation and the Arts (DSITIA)

- Mr Darren Crombie, Deputy Director-General, Innovation and Science Development (I&SD)
- Dr Christine Williams, Assistant Director-General, Science Delivery (science program area)
- Dr Mark Jacobs, Executive Director, Science Development
- Ms Leigh Roach, General Manager, Innovation, Intellectual Property and Contract Management, I&SD
- Mr Stephen Lamb, Director, Contract and Investment Management (CIM), I&SD
- Mr Brad Scholz, Principal Project Officer, CIM, I&SD
- Ms Sue Coke, Principal Project Officer, Science Policy and Evaluation Services (SPES), I&SD
- Mr Grant Woollett, Principal Project Officer, SPES, I&SD
- Mr Stewart MacIntyre, Director, Science Capability, Engagement and Collaboration, I&SD

Department of Agriculture, Fisheries and Forestry

- Prof. Beth Woods, Deputy Director-General, Agriculture, Fisheries and Forestry

Department of Health

- Prof. Robin Mortimer, Executive Director, Office of Health and Medical Research, Health and Clinical Innovation Division

Department of Environment and Heritage Protection

- Mr David Campin, Project Manager, Energy Regulatory Project

Department of State Development, Infrastructure and Planning

- Mr Jamie Merrick, Deputy Director-General

Department of Natural Resources and Mines

- Mr Dan Hunt, Director-General

Department of the Premier and Cabinet

- Ms Pamela Muir, Director, Economic Policy

Industry

- Dr Tracie Ramsdale, Alchemia Limited
- Prof. Mark Harvey, Partner, CM Capital Investments*
- Prof. Peter Robinson – CEO, Rob Tech Consulting Pty Ltd
- Mr Paul Bidwell, Director – Housing Policy, Master Builders Association
- Dr Peter Riddles, Director, Vicibio
- Mr Dale Miller, Senior Policy Advisor, AgForce
- Mr John McGagh, Head of Innovation, Rio Tinto
- Mr Michael Edwards, General Manager, Boeing Research and Technology Australia

External Partners

Commonwealth Scientific and Industrial Research Organisation (CSIRO)

- Dr Andrew Johnson, Group Executive, Environment

Universities

The University of Queensland

- Prof. Debbie Terry, Senior Deputy Vice Chancellor
- Prof. Max Lu, Deputy Vice Chancellor (Research)
- Prof. Paul Meredith, Centre for Organic Photonics & Electronics, School of Mathematics and Physics
- Prof. Peter Gray, Australian Institute for Bioengineering and Nanotechnology
- Prof. Mark Dodgson, Director, Technology and Innovation Management Centre, UQ Business School
- Mr David Henderson, Managing Director, Uniquest PL.
- Ms Melanie Gray, Research Partnerships Manager

University of the Sunshine Coast

- Prof. Roland De Marco, Pro Vice Chancellor (Research)

James Cook University

- Mr Jasper Taylor, Director Research Services

Queensland University of Technology

- Dr Mark Harrison, Senior Research Fellow, Centre for Tropical Crops and Biocommodities & Syngenta Centre for Sugarcane Biofuel Development
- Mr Michael McArdle, Director, Office of Research

Griffith University

- Prof. Ned Pankhurst, Deputy Vice Chancellor (Research)
- Prof. Mark Von Itzten, Director, Institute for Glycomics

University of Southern Queensland

- Prof. Mark Harvey, Deputy Vice Chancellor (Research and Innovation)**,

Central Queensland University

- Prof. Hilary Winchester, Deputy Vice Chancellor (Research)

*Note: * First interview occurred prior to Prof. Harvey taking up the role of DVC (Research and Innovation) at the University of Southern Queensland ** Second interview occurred subsequent to taking up the role of DVC (Research and Innovation) at USQ*

Name of Program	Available Funding	Clients	Program Objectives
Innovation Building Fund			
Smart State Research Facilities Fund (SSRFF) 2001-2004	30 year interest free loans.	Queensland-based entities which have an Australian Business Number, are registered for GST, and are seeking funding for the construction of new research facilities, or the refurbishment of existing research facilities.	To build Queensland's research infrastructure by supporting the construction of new research facilities, the refurbishment of existing research facilities and/or the acquisition of major research plant and equipment.
Innovation Building Fund (IBF) 2006 and 2008	30 year interest free loans.	Queensland-based entities which have an Australian Business Number, are registered for GST, and are seeking funding for the construction of new research facilities, or the refurbishment of existing research facilities.	To build Queensland's research infrastructure by supporting the construction of new research facilities, the refurbishment of existing research facilities and/or the acquisition of major research plant and equipment.

Appendix 2: Science Funding Programs – Details of Funding Schemes (TOR 1)

Name of Program	Available Funding	Clients	Program Objectives
Innovation Projects Fund			
National and International Research Alliances Program (NIRAP) 2005 - 2010	Up to $2 million (excl. GST) over a maximum of 3 years.	Queensland-based entities which have an Australian Business Number, are registered for GST, and are collaborating with national or international entities. including universities, research institutes, companies and not-for-profit organisations.	To build Queensland's national and international alliances and support the delivery of research, development and innovation outcomes that will benefit Queensland.
Research Industry Partnership Program (RIPP) 2005 - 2010	Up to $1 million (excl. GST) over a maximum of 3 years.	Queensland-based entities which have an Australian Business Number and are registered for GST, including universities, research institutes, companies and not-for-profit organisations.	To support industry and research organisations to undertake collaborative projects to develop new or improved products, processes and systems that will achieve a commercial return or deliver public good within four years.
Partnerships Alliance Fund Program (PAFP) 2005 - 2010	Up to $50,000 (excl. GST) over 1 year.	Queensland-based entities collaborating with other entities of which at least one must be a research partner.	Support to Queensland-based applicants to formulate and facilitate collaborative funding proposals for submission to relevant Queensland, national or international funding schemes.
Indo-Queensland Biotechnology Projects Fund 2010 – current	Up to $250,000 (excl. GST) over a maximum of 3 years.	Queensland-based entities which have an Australian Business Number, are registered for GST, and are collaborating with a research partner in India.	To assist Queensland-based researchers to jointly undertake highly innovative agricultural and medical biotechnology research projects with leading-edge Indian researcher organisations.
Queensland-Chinese Academy of Sciences (Q-CAS) Biotechnology Projects Fund 2010 – current	Up to $250,000 (excl. GST) over a maximum of 3 years.	Queensland-based entities which have an Australian Business Number, are registered for GST, and are collaborating with a research partner funded by the Chinese Academy of Sciences.	To assist Queensland-based researchers to jointly undertake highly innovative agricultural, medical or industrial biotechnology research projects or projects involving biodiversity conservation with organisations funded by the Chinese Academy of Sciences.
Queensland-Chinese Academy of Sciences (Q-CAS) Researcher International Visit Program 2010 only	Up to $5,000 (excl. GST) over 1 year.	Queensland-based entities which have an Australian Business Number, are registered for GST, and are collaborating with a research partner in China.	To assist in the advancement of strategic collaborative relationships and the identification of new collaborative research opportunities in China.

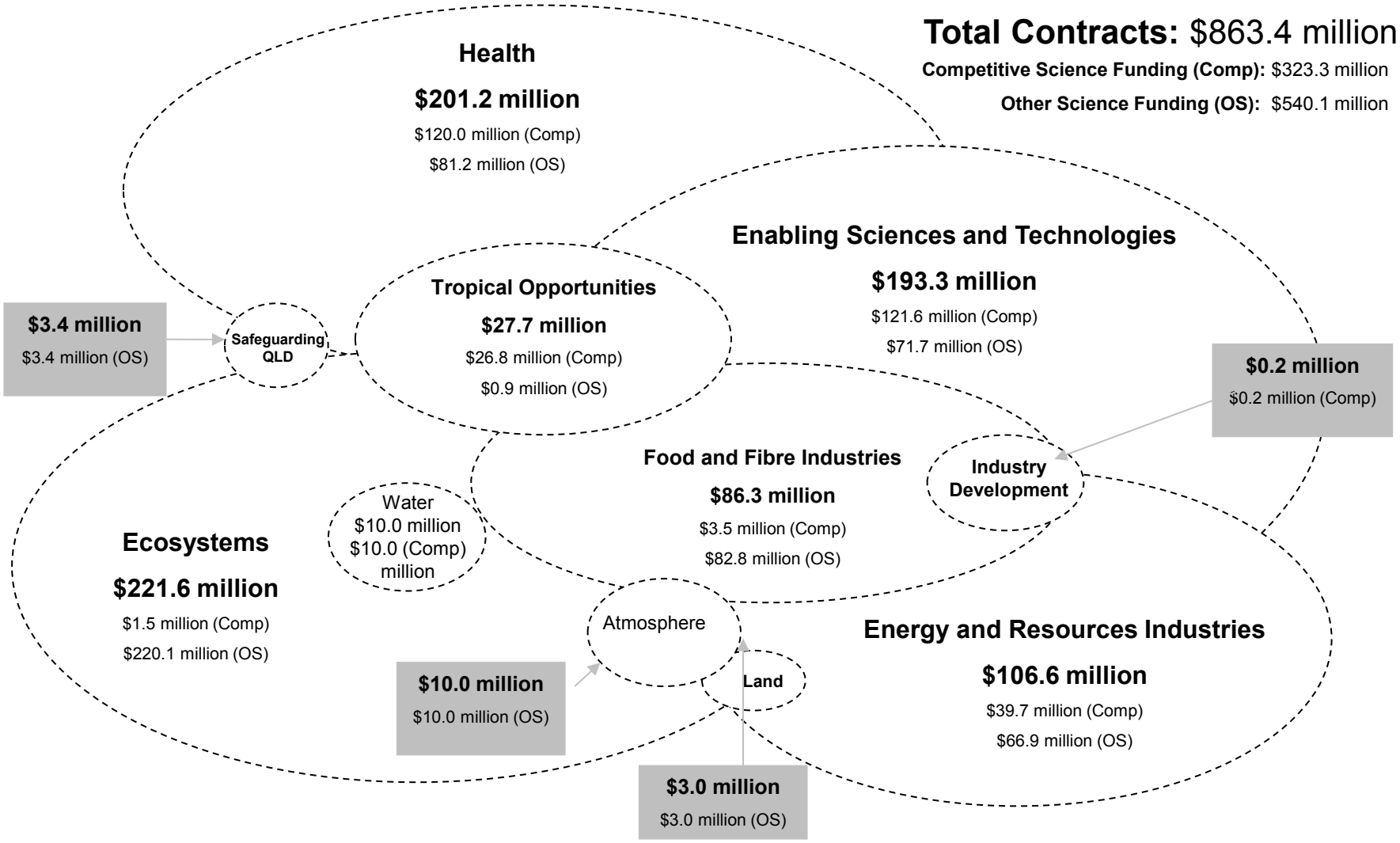
Appendix 2: Science Funding Programs – Details of Funding Schemes (TOR 1)

Name of Program	Available Funding	Clients	Program Objectives
Innovation Skills Fund			
Smart Futures PhD Scholarships (previously the Smart State PhD Scholarships) 2005 - current	$24,000 (GST exempt) over 3 years, plus $2,000 (excl. GST) bonus if thesis submitted within 3.5 years of commencement.	New PhD students studying at a Queensland university who hold Australian Postgraduate Awards.	To build the foundations of a sustainable research community by supporting promising researchers to conduct PhD research at a Queensland university.
Smart Futures Fellowships (previously the Smart State Fellowships) 2005 - current	$300,000 (excl. GST) over 3 years (Level One Fellowships). $150,000 (excl. GST) over 3 years (Level Two Fellowships).	Outstanding early and mid career PhD qualified researchers.	To build a critical mass of internationally recognised researchers in Queensland undertaking world leading research.
Smart Futures Premier's Fellowships (previously the Smart State Premier's Fellowships) 2005 - 2010	$1.25 million (excl. GST) over 5 years.	Eminent research leaders of national and international prominence.	To build Queensland's research leadership capacity, and position Queensland at the forefront of cutting-edge research, innovation and development.
Queensland International Fellowships 2009 – current	Up to $44,000 (excl. GST) for 12-39 weeks international travel.	Researchers seeking collaboration and knowledge exchange with international research agencies.	To foster an international exchange of knowledge and skills with leading research agencies in other countries.
Smart State University Internships 2005 – 2006	$116,664 (excl. GST) over 3 years	Queensland universities.	To assist science, engineering and technology undergraduate students to develop work-ready skills by completing work placements in business/industry.
Early Career Fellowships (ECFs) 2010-current	Up to $80,000 (excl. GST) for 12-36 weeks targeted international travel.	**Queensland-Chinese Academy of Sciences (Q-CAS) ECFs** Researchers seeking collaboration and knowledge exchange with researchers in Chinese Academy of Sciences institutes. **Indo-Queensland ECFs** Researchers seeking collaboration and knowledge exchange with researchers in the Indian Department of Biotechnology, Ministry of Science and Technology.	**Queensland-Chinese Academy of Sciences (Q-CAS) ECFs** To foster an international exchange of knowledge and skills with leading researchers based in institutes within the Chinese Academy of Sciences. **Indo-Queensland ECFs** To foster an international exchange of knowledge and skills with leading researchers based in institutes within the Indian Department of Biotechnology, Ministry of Science and Technology, with a focus on agricultural and medical biotechnology.

Appendix 2: Science Funding Programs – Details of Funding Schemes (TOR 1)

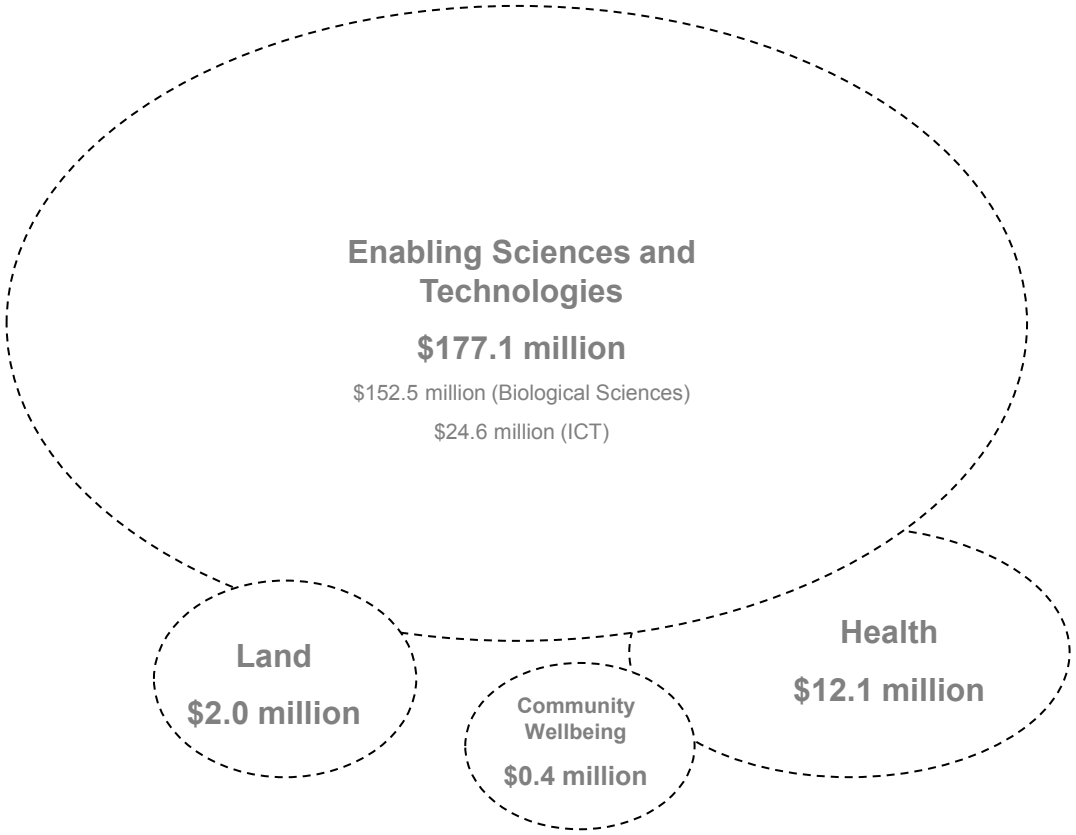
Name of Program	Available Funding	Applicants	Program Objectives
Smart Futures Fund 2011-12 Grant Programs			
Partnerships Stream			
Co-Investment Fund	$200,000 to $2 million over 1-2 years.	Queensland-based research institutions or a Queensland Government agency.	A fund to leverage Commonwealth Government or philanthropic organisation funding in areas of research that will deliver real benefits for Queensland.
Research Partnerships Program	$200,000 to $1 million over 3 years.	Queensland-based entities seeking to undertake collaborative research with leading national and international research organisations and/or industry organisations.	To support research and development projects that have progressed beyond the concept stage and will be undertaken in collaboration with partner organisations either in Australia and/or overseas, including the transfer of innovative research to end users.
Talent Stream			
Smart Futures PhD Scholarships	$36,000 (GST exempt) over 3 years.	New PhD students studying at a Queensland university who hold Australian Postgraduate Awards or approved university PhD research awards.	To build the foundations of a sustainable research community by supporting promising researchers to conduct PhD research at a Queensland university.
Smart Futures Fellowships	$360,000 (excl. GST) over 3 years (Mid-Career Fellowships). $180,000 (excl. GST) over 3 years (Early-Career Fellowships).	Outstanding early and mid career PhD qualified researchers.	To build a critical mass of internationally recognised researchers in Queensland undertaking world leading research.
Queensland International Fellowships	Up to $25,000 (excl. GST) for 12-20 weeks international travel.	Researchers seeking collaboration and knowledge exchange with international research agencies.	To foster an international exchange of knowledge and skills with leading research agencies in other countries.
Smart Futures Premier's Fellowships	$1.25 million (excl. GST) over 5 years.	Eminent research leaders of national and international prominence.	To build Queensland's research leadership capacity, and position Queensland at the forefront of cutting-edge research, innovation and development.

Science Infrastructure Funding (Contracted Agreements) 1998-2011/12



Science Operational Funding (Contracted Agreements) 1998-2011/12

Total Contracts: $191.6 million

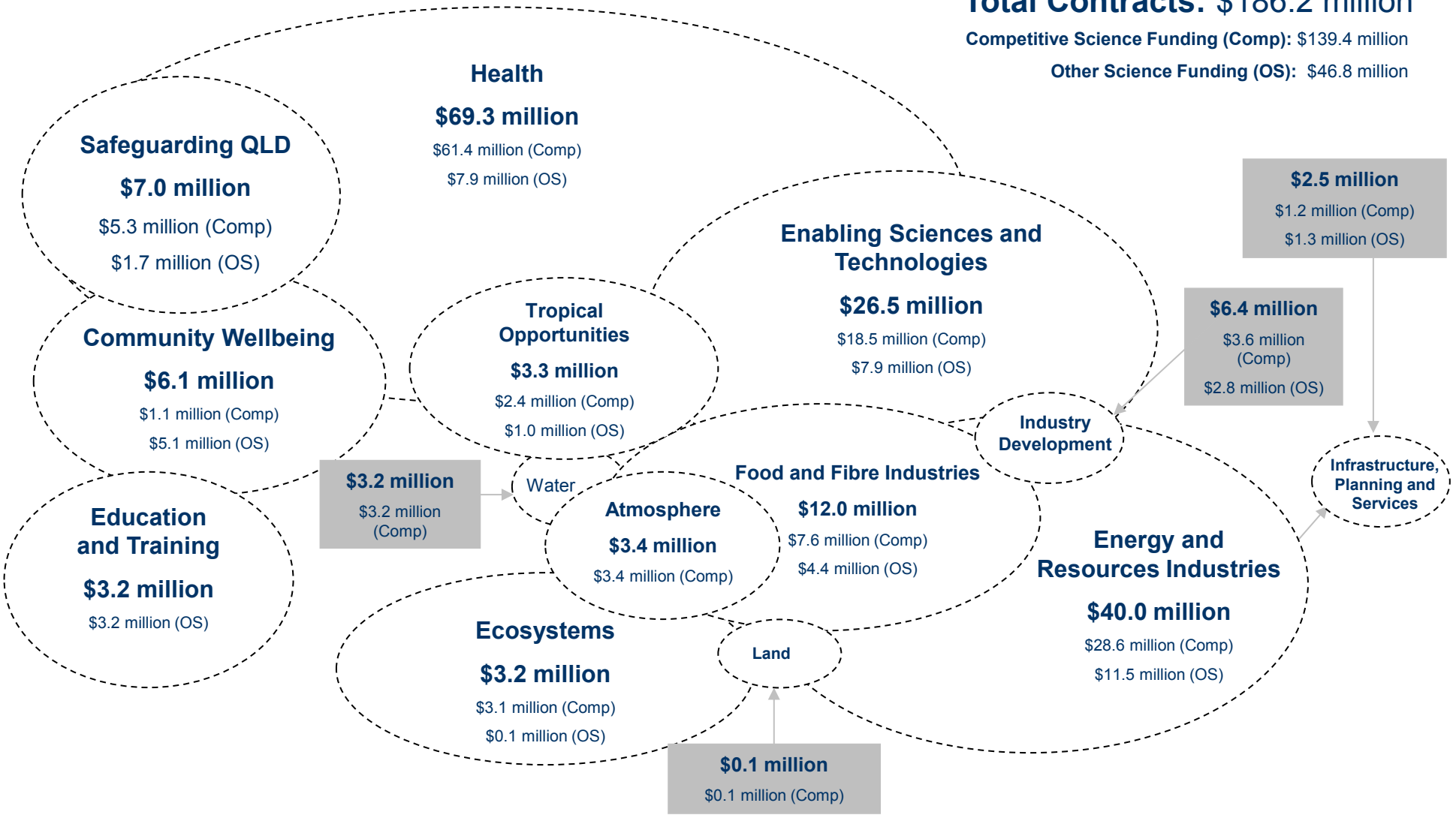


Science Projects Funding (Contracted Agreements) 1998-2011/12

Total Contracts: $186.2 million

Competitive Science Funding (Comp): $139.4 million

Other Science Funding (OS): $46.8 million

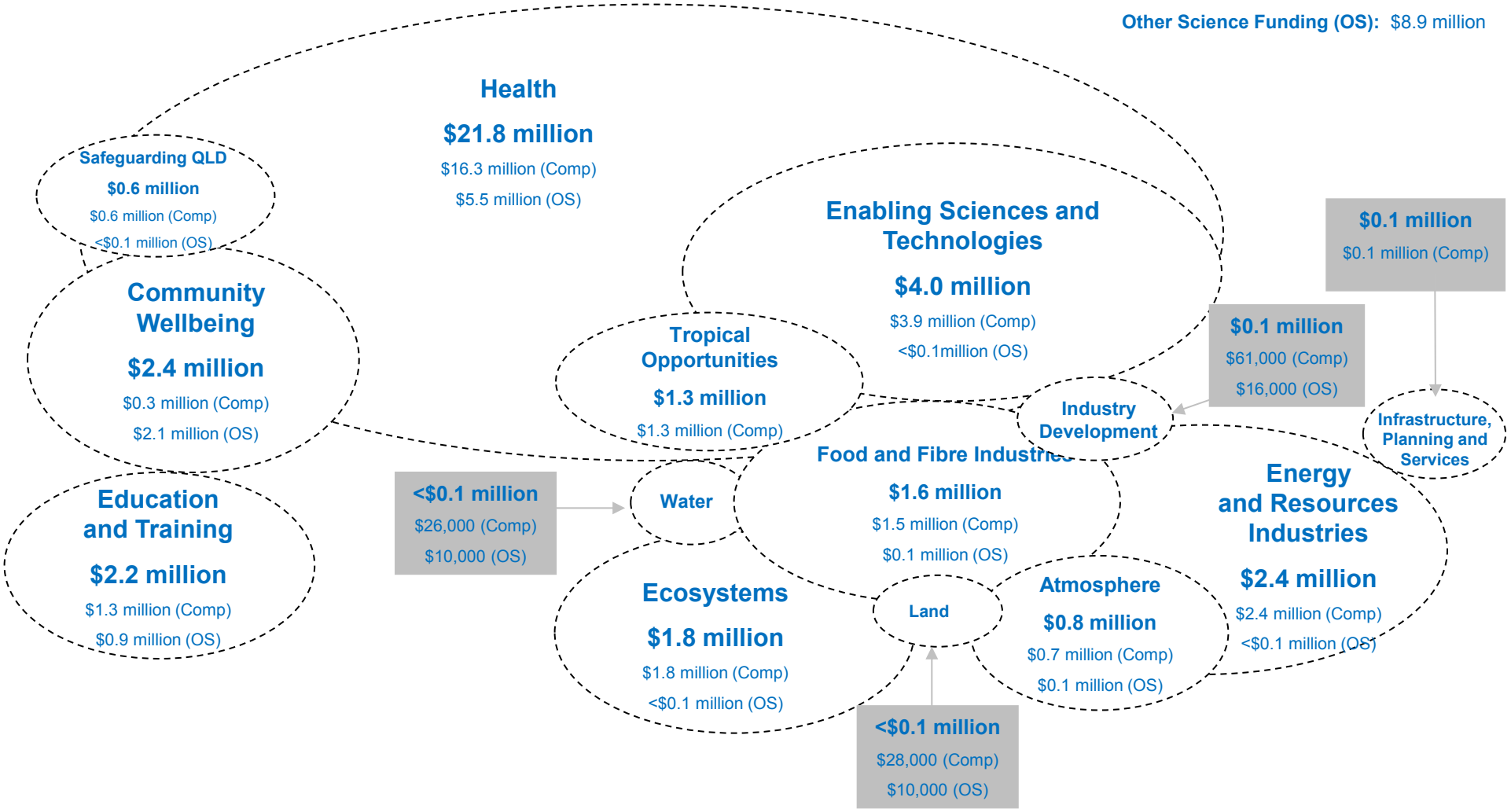


Science Skills Funding (Contracted Agreements) 1998-2011/12

Total Contracts: $39.2 million

Competitive Science Funding (Comp): $30.2 million

Other Science Funding (OS): $8.9 million



Science Smart State Funding 1998-2011/12 ($1.28b)

Smart State Program	Details	Science Column $ m	Competitive Science Funding Grants (ISF,IPF, IBF) $ m	Other Science Grants $ m
Smart State 1 (1998-2004)				
SS1 Infrastructure:				
Bioindustries Strategy	Queensland Bioscience Precinct construction	**15.0**		15.00
	Institute for Glycomics	**8.0**		8.00
	Centre for Immunology and Cancer Research	**0.5**		0.50
Smart State Research Facilities Fund- Round 1	Institute of Health and Biomedical Innovation	**22.5**	22.50	
	Australian Computational Earth Systems Simulator	**4.5**	4.50	
	Cryo-electron Microscopy Facility	**1.5**	1.45	
	Australian Institute for Bioengineering and Nanotechnology	**20.0**	20.00	
	Centre of Excellence in Engineered Fibre Composites Design and Development	**7.4**	7.43	
	Australian Tropical Forest Institute	**7.8**	7.81	
Smart State Research Facilities Fund- Round 2	Mater Medical Research Institute Clinical Trials Centre	**10.0**	10.00	
	Wesley Research Institute Clinical Research Centre	**0.8**	0.80	
	Institute for Cellular and Molecular Therapies	**12.0**	12.00	
	Queensland Microtechnology Facility	**3.0**	3.00	
	Tropical Marine Science Centre of Excellence	**5.0**	5.00	
	Queensland Animal Breeding Facility	**1.7**	1.70	
Smart State Research Facilities Fund- Round 3	Queensland Pre-Clinical Drug Development Facility	**8.1**	8.10	
	Translational Research Institute (Money redirected from BPA)	**2.5**	2.50	
	Queensland Crop Development Facility	**3.5**	3.50	
	Centre for Advanced Animal Science	**9.5**	9.50	
	Mater Medical Research Institute Enhancements	**3.0**	3.00	
	Medical Engineering Research Facility	**5.0**	5.00	
	Queensland Hypersonic Testing Facility Centre	**2.2**	2.20	
Research Infrastructure- (One-off)	Queensland Centre for Advanced Technologies	**24.0**		24.00
	Sustainable Minerals Institute	**10.0**		10.00
	Process Engineering and Light Metals Centre	**4.0**		4.00
	Australian Microelectronics Centre	**2.8**	2.75	
	Queensland Manufacturing Institute	**21.8**		21.76
	Pharmacy Australia Centre of Excellence	**3.4**		3.35
	Queensland Parallel Supercomputing Foundation	**10.0**		10.00
	Institute for ICT Innovation (e-health and e-security)	**11.4**		11.40
	Queensland Linked ARC Centres of Excellence	**8.0**		8.00
	Centre of Excellence in clean energy technologies	**9.0**		9.00
	Bundaberg Turtle Interpretive Centre	**4.4**		4.39
	Centre for Native Floriculture establishment	**2.0**		2.00
Smart State Building Fund	Queensland Brain Institute Construction	**20.0**	20.00	
	SS1 Infrastructure Sub-total:	***$ 284.1***	***$ 152.7***	***$ 131.4***

Appendix 4: Science Funding Overview (TOR 1)

Smart State Program	Details	Science Column $ m	Competitive Science Funding Grants (ISF,IPF, IBF) $ m	Other Science Grants $ m
SS1 Projects:				
Cooperative Research Centres	Cash	**18.8**		18.84
Industry Development	Queensland Clinical Trials Network	**5.0**		5.00
	Biodiscoveries Network	**1.15**		1.15
	BioBus	**1.8**		1.80
	Promoting the adoption of ICT by existing industries	**0.3**		0.33
	New technologies for the fibre industry	**0.6**		0.55
	SS1 Projects Sub-total:	***$ 27.7***	***$ -***	***$ 8.8***
SS1 Skills:				
Education and Skills	QUT Innovation Train	0.10		0.10
	Smart State Fellowships	1.50	1.50	
	Bachelor of Biotechnology Innovation Degree	0.20		0.20
	International Biology Olympiad	0.02		0.02
Strategic Partnerships	Queensland-Smithsonian Fellowships Program (includes funding committed in Smart State 2)	**0.61**		0.61
Medical Research	Smart State Health and Medical Research Fund	**5.15**		5.15
	SS1 Skills Sub-total:	***$ 7.6***	***$ 1.5***	***$ 6.1***
SS1 Operational Funding:				
Bioindustries Strategy	Queensland Bioscience Precinct Operational Funding (1999-2009)	**77.5**		77.50
Miscellaneous (one-off)	Queensland Cyber Infrastructure Foundation Operational Funding (2004-2007)	**6.0**		6.00
	SS1 Operational Funding Sub-total:	***$ 83.5***	***$ -***	***$ 83.5***

	Science Investment	Competitive Science Funding Grants (ISF,IPF, IBF)	Other Science Grants
SS1 Total ($M)	**$ 402.9**	**$ 154.2**	**$ 229.8**

Appendix 4: Science Funding Overview (TOR 1)

Smart State Program	Details	Science Column $ m	Competitive Science Funding Grants (ISF,IPF, IBF) $ m	Other Science Grants $ m
Smart State 2 (2005-2015); *includes 2006 one-off investments*				
SS2 Infrastructure:				
Smart State Innovation Funds - Innovation Building Fund	Mineral Characterisation Research Facility	**6.10**	6.10	
	Queensland Tropical Health Alliance	**19.45**	19.45	
	Queensland Centre for Advanced Materials Processing and Manufacturing	**15.00**	15.00	
	Molecular and Clinical Pathology Research Laboratory	**2.96**	2.96	
	Queensland Smart Water Research Facility	**10.00**	10.00	
	Bionano-product Development Facility	**6.50**	6.50	
	Mackay Renewable Biocommodities Pilot Plant	**3.10**	3.10	
	Tropical Science and Innovation Precinct (TSIP)	**9.00**	9.00	
	Health and Medical Research Unit	**10.00**	10.00	
	MedTeQ - A Facility for Medical Diagnostic Technologies in Queensland	**1.83**	1.83	
	Translational Research Institute	**0.47**	0.47	
	Science and Technology Precinct (STEM)	**35.00**	35.00	
Smart State Research Facilities Fund - Round 4	Lizard Island Research Station Upgrade	**1.50**	1.50	
	Wesley Research Institute Tissue Bank	**1.42**	1.42	
	Queensland Compound Library	**3.50**	3.50	
	Queensland NMR Network	**5.04**	5.04	
	Australian Research Centre for Aerospace Automation	**3.53**	3.53	
	Tropical Science and Innovation Precinct	**5.00**	5.00	
	The University of Qld and Qld Health Centre for Clinical Research (UQ/QH CCR)	**20.00**	20.00	
Research Infrastructure- (One-off)	Institute of Glycomics Expansion (Stages 1 and 2)	**11.00**	11.00	
	Australian Tropical Herbarium molecular systematics laboratory	**0.92**		0.92
	UQ Technology and Innovation Building Construction (Stage 1)	**4.00**		4.00
	Office of Commercialisation (USQ)	**0.15**	0.15	

Appendix 4: Science Funding Overview (TOR 1)

Smart State Program	Details	Science Column $ m	Competitive Science Funding Grants (ISF,IPF, IBF) $ m	Other Science Grants $ m
National Collaborative Research Infrastructure Strategy	Population Health Research Network: QLD Node (NCRIS Capability 5.7 - Population Health)	**1.00**		1.00
	Queensland Cyber Infrastructure Foundation	**5.10**		5.10
	Analytical Electron Microscopy Facility Linked Laboratory (NCRIS Capability Area 5.3 - Characterisation - Sub-capability Microscopy)	**0.50**		0.50
	Terrestrial Ecosystem Research Network: QLD Node (NCRIS capability area 5.11 - Terrestrial Ecosystem Research Network)	**4.10**		4.10
	Australian Genome Research Facility: QLD Node (NCRIS Capability Area 5.1 - Evolving Bio-Molecular Platforms and Informatics - Sub capability Genomics)	**1.25**		1.25
	The Great Barrier Reef Ocean Observing System (NCRIS Capabilty Area 5.12 - Integrated Marine Observing System)	**4.21**		4.21
	Protein Discovery Centre (NCRIS capability 5.1 - Evolving Bio-Molecular Platforms and Informatics - Sub capability Proteomics)	**2.00**		2.00
	Auscope Simulator (NCRIS capability 5.13 - Structure and Evolution for the Australian Continent - sub capability Auscope Simulator)	**1.00**		1.00
	PET and MRI Facility: UQ (NCRIS capability 5.3 - Characterisation - sub capability Imaging)	**2.73**		2.73
	Developing models required for fluxomics: AIBN (NCRIS capability 5.1 - Evolving Bio-Molecular Platforms and Informatics - sub capability Metabolomics)	**0.50**		0.50
	Soft Materials Processing Facility and Bionano & Organic Device Fabrication Facility (NCRIS Capability 5.4 - sub capability Fabrication)	**3.00**		3.00
	Manufacture of recombinant proteins as potential therapeutics: AIBN (NCRIS capability 5.5a - Biotechnology Products -sub capability Proteins)	**4.00**		4.00
	Australian Microscopy and Microanalysis Research Facility: QLD Node (NCRIS Capability 5.3 - Characterisation - sub capability Microscopy)	**2.00**		2.00
	The NCRIS capability area 5.1 - Evolving Bio-Molecular Platforms and Informatics - sub capability Genomics	**0.13**		0.13
	Development and production of biotechnology products: QIMR (NCRIS capability 5.5 - Biotechnology Products - Subcategory - A Human Cell Expansion)	**0.89**		0.89
	Australian Coastal Ocean Radar Network - Great Barrier Reef Ocean Observing System: QLD Node (NCRIS Capability 5.12 - Integrated Marine Observing System)	**0.30**		0.30
	Translating Health Discovery -UQ Biologics Facility	**1.20**		1.20
	Metabolomics Australia-UQ Metabolomics Facility	**0.25**		0.25
	Translating Health Discovery - Queensland Collaborative Facility (TIA - Qld Node)	**2.00**		2.00
	Translating Health Discovery - Expanding the Qld Compound Library Functional Capability	**0.55**		0.55
	BioPlatforms Australia - Stem Cells Ltd/UQ	**0.47**		0.47
	Research Data Storage Infrastructure project National eResearch Collaborative tools and resources project National Research Networks project	**3.60**		3.60
	Sustainability (Higher Education): Sir Samuel Griffith Centre (SSGC) for Sustainable Excellence	**1.00**		1.00
	University of Queensland: Australian National Fabrication Facility	**1.50**		1.50
	Research: Centre for Advanced Imaging	**2.00**		2.00
	University of Queensland: European Bioinformatics Institute Mirror	**1.00**		1.00
	Protein Discovery Centre	**2.00**		2.00
	Australian Biosecurity Intelligence Network (ABIN)	**1.70**		1.70
	Australian Institute of Marine Science: Queensland's Integrated Marine Observing System (Q-IMOS)	**2.00**		2.00
	Queensland Cyber Infrastructure Foundation (Super Science)	**2.00**		2.00
	QPIF 5.6: Australian Biosecurity Network	**1.70**		1.70

Appendix 4: Science Funding Overview (TOR 1)

Smart State Program	Details	Science Column $ m	Competitive Science Funding Grants (ISF,IPF, IBF) $ m	Other Science Grants $ m
Smart Therapies Institute, Smart State Medical Research Centre	Translational Research Institute	**46.47**		46.47
	Smart State Medical Research Centre (EED)	**5.70**		5.70
Boggo Road Ecosciences Precinct and Coopers Plains Health and Food Science Precinct	Boggo Road and Coopers Plains	**291.73**		291.73
Queensland Ethanol Industry Action Plan	Development of Queensland ethanol industry	**4.17**		4.17
	SS2 Infrastructure Sub-total:	***$ 579.2***	*$ 170.5*	*$ 408.7*
SS2 Projects:				
Smart State Innovation Funds - Innovation Projects Fund	National and International Research Alliances Program	**43.00**	43.00	
	Research Industry Partnerships Program	**13.75**	13.75	
	Partnerships Alliances Facilitation Program	**1.54**	1.54	
	Strategic Initiatives	**-1.89**		
ICT Development	Establishment of the Queensland Internet Security Alliance	**0.75**		0.75
Innovation and Commercialisation (science based projects)	Australian Aerospace Limited operational enhancement	**0.68**		0.68
	Business and Industry Transformation Incentive	**2.31**		2.31
	International Trade Show Assistance Program Extension	**0.01**		0.01
Other	Other one-offs	**0.98**		0.35
Horticulture, Aquaculture and Agriculture	Sugar Research- Renewable Energy Program	**4.10**		4.10
Strategic Partnerships	Queensland-Israeli Cooperation in Agricultural Research	**0.30**		0.30
	SS2 Projects Sub-total:	***$ 65.5***	*$ 58.3*	*$ 8.5*
SS2 Skills:				
Smart State Innovation Skills Funds	Innovation Skills Fund			
	-Premier's Fellowships	**3.75**	3.75	
	-Early Career Fellowships	**1.94**	1.94	
	-Mid Career Fellowships	**2.65**	2.65	
	-PhD Scholarships	**0.77**	0.77	
	-University Internships	**1.05**	1.05	
	-Strategic Initiatives	**0.77**		
	SS2 Skills Sub-total:	***$ 10.9***	*$ 10.2*	*$ -*

Appendix 4: Science Funding Overview (TOR 1)

Smart State Program	Details	Science Column $ m	Competitive Science Funding Grants (ISF,IPF, IBF) $ m	Other Science Grants $ m
SS2 Operational Funding:				
Bioindustries Strategy	Queensland Bioscience Precinct Operational Funding (2009-2014)	**50.00**	50.00	
	Biopharmaceuticals Australia operational funding (2009-2011) and design costs (2008-2011)	**7.09**	6.09	1.00
Miscellaneous - (One-off)	Centre for Native Floriculture additional expansion and operational funding	**1.98**		1.98
	Institute for Sustainable Regional Development research activities (2006-2008)	**0.40**		0.40
	Queensland Brain Institute Operational Funding (2007-2012)	**25.00**	25.00	
ICT Development	Queensland Cyber Infrastructure Foundation Operational Funding (2007-2011)	**8.50**		8.50
	E-health research centre operational funding (2007-2012)	**5.00**		5.00
	NICTA QLD Laboratory Operational Funding (2007-2012)	**10.05**		10.05
	SS2 Operational Funding Sub-total	***$ 108.0***	***$ 81.1***	***$ 26.9***

	Science Investment	Competitive Science Funding Grants (ISF,IPF, IBF)	Other Science Grants
SS2 Total ($M)	**$ 763.7**	**$ 320.1**	**$ 444.1**

Smart State 3 (2008-2012)				
SS3 Projects:				
Enhanced Innovation Projects Fund	National and International Research Alliances Program	**30.20**	30.20	
	Research Industry Partnerships Program	**5.36**	5.36	
	Partnerships Alliances Facilitation Program	**0.32**	0.32	
	China Program - NIRAP and RIV	**1.30**	1.30	
	India Program - NIRAP	**0.73**	0.73	
	Strategic Intiatives	**0.20**		
Research Hubs and Brand Building	Centre for Social Science and Innovation	**5.00**		5.00
	Centre for Emerging and Infectious Diseases	**1.50**		1.50
	Queensland Life Sciences Industry	**1.86**		1.86
Tropical Connections	Qtropics Action Agenda	**0.99**		0.99
Investment Ready Program	R&D Forums and Workshops	**0.30**		0.30
	Technology Clinics	**0.00**		0.00
Enabling Technologies Program	Improving ICT productivity, biotechnology and therapeutic medicines/devices competitiveness, creative industries market development and nanotechnology discovery program	**1.91**		1.91
Ideas to Market	Incubation services, capability development and commercialisation advice	**0.06**		0.06
	SS3 Projects Sub-total:	***$ 49.7***	***$ 37.9***	***$ 11.6***

Appendix 4: Science Funding Overview (TOR 1)

SS3 Skills				
Enhanced Innovation Skills Fund	Increased funding to Skills Fund over 4 years			
	Queensland International Fellowships	**1.10**	1.10	
	China & India Early Career Fellowships	**0.11**	0.11	
	Premier's Fellowships	**2.50**	2.50	
	Mid Career Fellowships	**2.40**	2.40	
	Early Career Fellowships	**2.25**	2.25	
	PhD Scholarships	**0.95**	0.95	
Q-Science Program	Q-Science over 4 years	**2.00**		2.00
Queensland-China Climate Change Fellowships	Queensland-China Climate Change Fellowships	**0.09**		0.09
	SS3 Skills Sub-total:	***$ 11.4***	***$ 9.3***	***$ 2.1***

	Science Investment	Competitive Science Funding Grants (ISF,IPF, IBF)	Other Science Grants
SS3 Total ($M)	$ 61.1	$ 47.2	$ 13.7

Smart State 3a				
SS3a Projects				
SS3a Innovation Projects Fund	Partnerships	43.20	43.20	
	SS3a Projects Sub-total	***43.20***	***43.20***	***0.00***
SS3a Skills				
SS3a Innovation Skills Fund	Premier's Fellowships	1.25	1.25	
	Mid-Career Fellowships	3.60	3.60	
	Early-Career Fellowships	2.88	2.88	
	PhD Scholarships	0.79	0.79	
	Queensland International Fellowships	0.59	0.59	
	Inspiring Australia and Rod Walker Awards	0.16	0.16	
	SS3a Skills Sub-Total	***9.27***	***9.27***	

	Science Column	Competitive Science Funding Grants (ISF,IPF, IBF)	Other Science Grants
SS3a Total ($M)	$ 52.5	$ 52.5	$ -

	Science Column	Competitive Science Funding Grants (ISF,IPF, IBF)	Other Science Grants
Total Smart State Infrastructure (SS1, SS2, SS3, SS3a)	***$ 863.4***	***$ 323.3***	***$ 540.1***
Total Smart State Projects (SS1, SS2, SS3, SS3a)	***$ 186.1***	***$ 139.4***	***$ 27.9***
Total Smart State Skills (SS1, SS2, SS3, SS3a)	***$ 39.2***	***$ 30.2***	***$ 8.2***
Total Smart State Op Funding (SS1, SS2, SS3, SS3a)	***$ 191.5***	***$ 81.1***	***$ 110.4***
Total Smart State (SS1, SS2, SS3,SS3a)	***$ 1,280.1***	***$ 574.8***	***$ 686.6***

All figures $ m

Smart State University Internships Program (2005-06 to 2006-07)

Overview

- For science, engineering and technology undergraduate students
- Financial assistance provided in 2005-06 and 2006-07 to Queensland's universities to create new, or enhance existing, industry links
- Students placed with industry to gain on-the-job work experience in their chosen field of tertiary study
- Each university was awarded $116,664 (excluding GST) over three years ($38,888 per year) matched by the administering university
- Universities typically used funds to appoint internship co-ordinators
- Non-competitive program therefore open to each of Queensland's nine universities provided the internship proposal was assessed as suitable

Review findings

- 3,254 students were placed with businesses by seven Queensland universities

Participating students	Participating businesses
Provided opportunity to: ✓ test skills learned in the classroom ✓ become known by potential employers ✓ expand knowledge through practical, work related experience ✓ enhance the likelihood of gaining graduate employment ✓ work on a project that is often at a higher level than that of their peers on campus ✓ develop stronger communication skills, planning and organising skills, teamwork and problem solving skills ✓ affirm or redefine career choice	✓ Students brought new ideas, fresh perspectives and enthusiasm to the workplace ✓ A host agency had access to technical expertise, technology and cutting edge infrastructure ✓ Intern student completed a piece of work for the business that was relevant and may not otherwise have been completed ✓ Potential employers had the opportunity to view students through an extended period of work experience for future employment ✓ An industry organisation established a co-operative working relationship with the university

Excellence in Research for Australia (ERA) Analysis

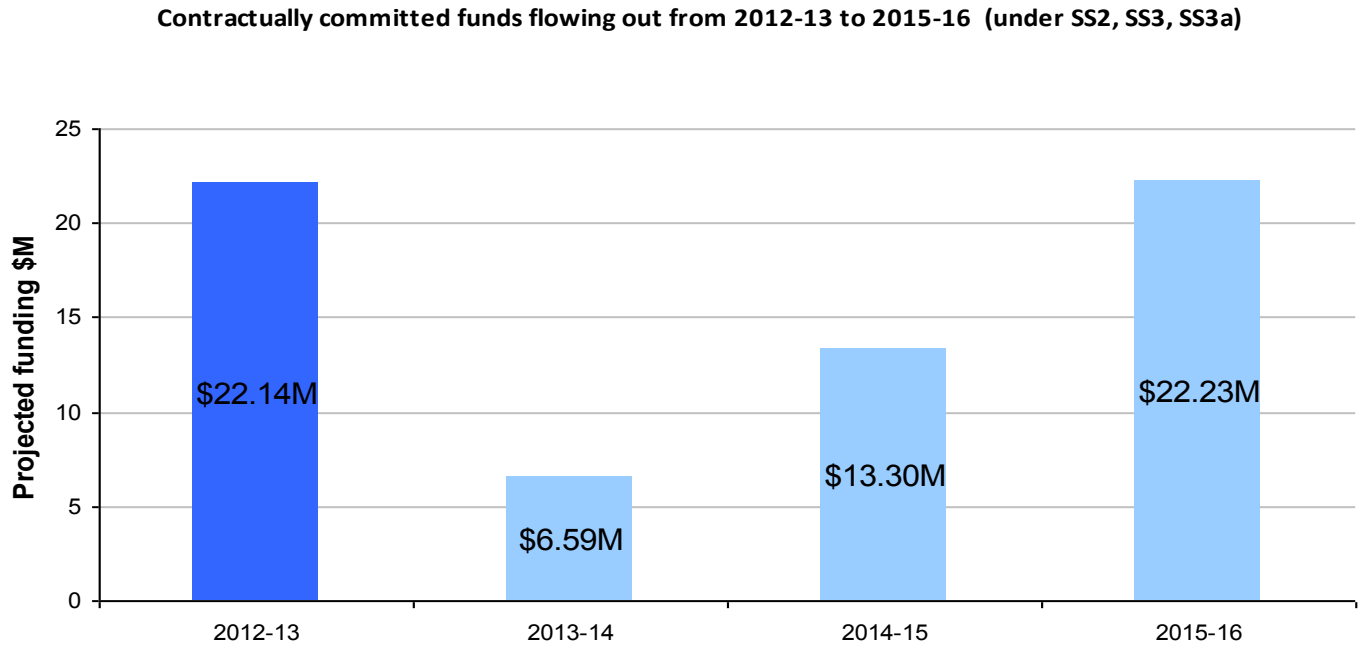
Rating Descriptor		
5 = Outstanding performance **well above world standard**	3 = Average performance **at world standard**	1 = Performance **well below world standard**
4 = Performance **above world standard**	2 = Performance **below world standard**	N/A = Not assessed due to low volume. The number of research outputs doesn't meet volume threshold standard for ERA evaluation.

		Discipline												
		Mathematic Sciences	Physical Sciences	Chemical Sciences	Earth Sciences	Environment Sciences	Biological Sciences	Agricultural & Veterinary Sciences	Information & Computer Sciences	Engineering	Technology (BB)	Technology (MIC)	Health Sciences (BC)	Health Sciences (PA)
Bond University	2012								2 ↑				4 ↑	
	2010												3	2
Central Queensland University	2012	5 ↑				2 ↑	1 -	5 ↑	2 ↑	2 ↓			3 -	
	2010					1	1	2		3				3
Griffith University	2012		3 ↓	3 -	3 ↓	3 -	3 -	4 -	3 -	2 -			3 -	
	2010		5	3	4	3	3	4	3	2			3	3
James Cook University	2012	3 ↑	3 ↑	3 -	4 -	5 -	4 -	4 ↑	2 ↑	3 ↑			2 ↑	
	2010	2	2	3	4	5	4	3		2			2	1
Queensland University of Technology	2012	4 -	3 ↓	3 ↓	3 -	4 ↑	3 -	↓	3 ↓	3 -	3 ↑		3 -	
	2010	4	4	4	3	3	3	1	4	3			3	4
The University of Qld	2012	4 -	5 -	5 -	3 -	4 ↓	5 -	4 ↑	4 ↑	5 -	5 -		5 -	
	2010	4	5	5	3	5	5	3	3	5	5	4	5	4
University of Southern Qld	2012	3 -	3 -				↓	3 ↓	2 ↑	2 ↑			2 -	
	2010	3	3				1	4		1				2
University of Sunshine Coast	2012			2 ↑			3 ↑	4 ↑	1 ↑				1 -	
	2010						1						2	1

Infrastructure Funding

Key Points

- All Innovation Building Fund (SS3) expenditure will end in 2012-13.
- Note: The AITHM is a $42.12 million election commitment to strengthen Queensland's tropical health defences.
- The project will deliver capital and operational funding (collaborative networks) for James Cook University to construct infrastructure across three sites in North Queensland (Townsville, Cairns and Torres Strait).



These figures show contractually committed funds flowing from funding programs listed on page 22.

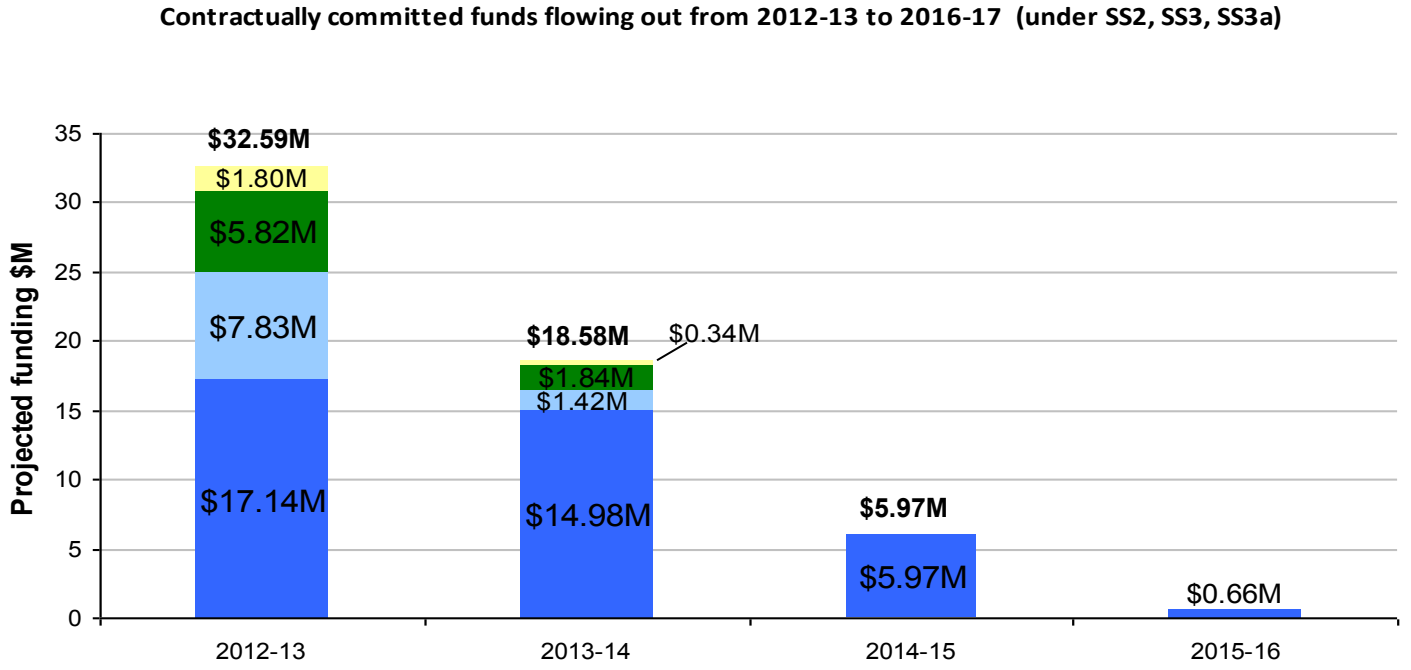
	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Innovation Building Fund (SS3)	$22,141,425	-	-	-	-	-
Australian Institute for Tropical Health and Medicine (AITHM) – Election Commitment	-	$6,590,000	$13,300,000	$22,230,000	-	-
Total	$22,141,425	$6,590,000	$13,300,000	$22,230,000	-	-

Queensland Government Science Investment and Funding Commitments and Project Payments 2012-13 to 2017-18

Collaborative Projects Funding

Key Points

- Of 159 project funding recipients under SS2, SS3 and SS3a, 139 were from research organisations and 20 from industry.
- Collaborative partners represented national or international (non-Queensland) organisations (305), Queensland organisations (236) and industry organisations (186).



These figures show contractually committed funds flowing from funding programs listed on page 22.

	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Innovation Projects Fund (SS2)	$1,798,323	$341,667	-	-	-	-
Enhanced Projects Fund (SS3)	$7,832,636	$1,419,445	-	-	-	-
Partnerships (SS3a)	$17,141,211	$14,975,710	$5,971,840	$661,700	-	-
NCRIS	$5,817,400	$1,840,000	-	-	-	-
Total	$32,589,570	$18,576,822	$5,971,840	$661,700	-	-

Queensland Government Science Investment and Funding Commitments and Project Payments 2012-13 to 2017-18

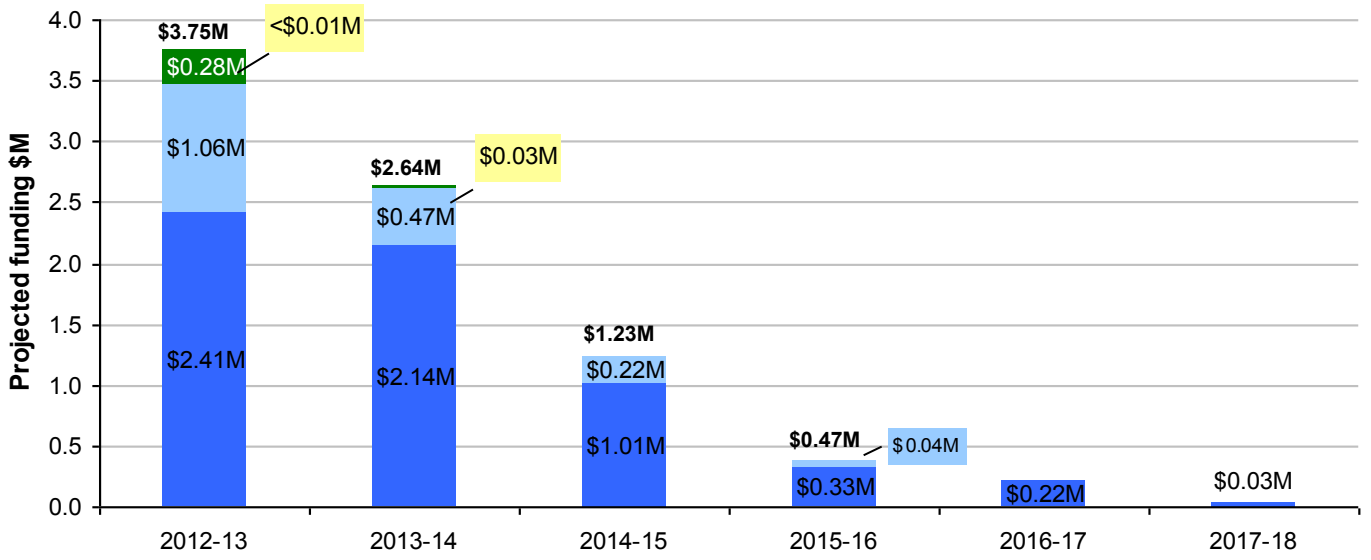
Skills and Fellowships Funding

Key Points

- Innovation Skills committed funding flows until 2013-14, Enhanced Skills until 2015-16 and Talent (under SS3a) will flow until 2017-18.
- A minor amount of PhD Scholarships funding ($4,972) will be completed in 2012-13.

These figures show contractually committed funds flowing from funding programs listed on page 22.

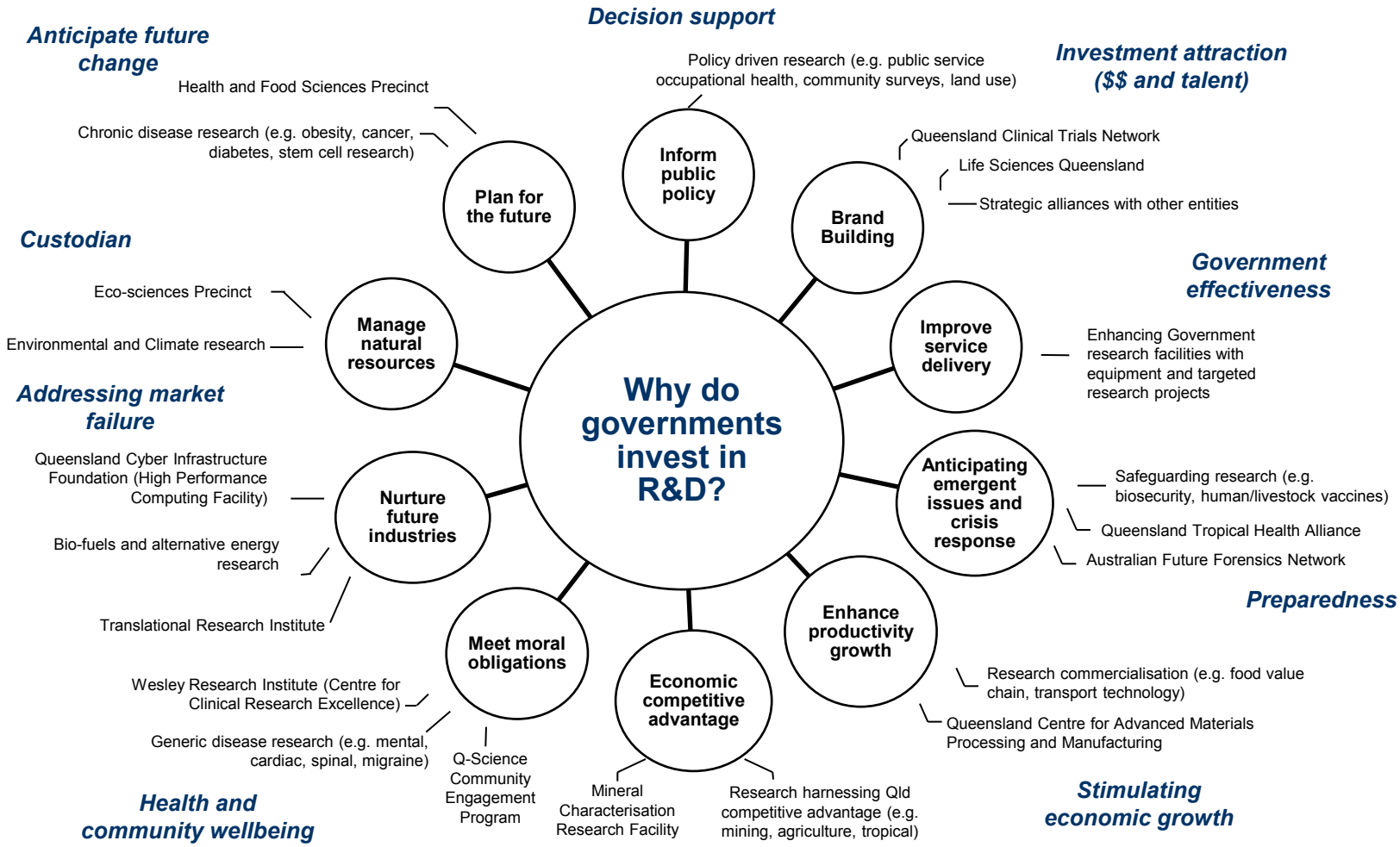
Contractually committed funds flowing out from 2012-13 to 2017-18 (under SS2, SS3, SS3a)



	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Innovation Skills Fund (SS2)	$278,000	$25,000	-	-	-	-
Enhanced Skills Fund (SS3)	$1,055,500	$469,500	$221,500	$40,000		
Talent (SS3a)	$2,409,436	$2,143,000	$1,006,000	$325,000	$220,000	$30,000
Growing the SS PhD Scholarships	$4,972	-	-	-	-	-
Total	$3,747,908	$2,637,500	$1,227,500	$365,000	$220,000	$30,000

Key Points: The Queensland Government has invested in science for a range of reasons, however the majority of the funding has been directed towards preparing Queensland for the future ($502 million - 41% of the total science investment of $1.28 billion), managing natural resources ($265 million – 21% of the total science investment), and nurturing future industries ($123 million – 10% of the total science investment). Examples of the type of infrastructure, projects and skills are provided next to each driver. For example, the Ecosciences Precinct is a piece of world class infrastructure which supports management of the State's natural resources. Funding has been categorised against these key drivers and the allocation according to infrastructure, projects and skills are illustrated in the charts on following pages.

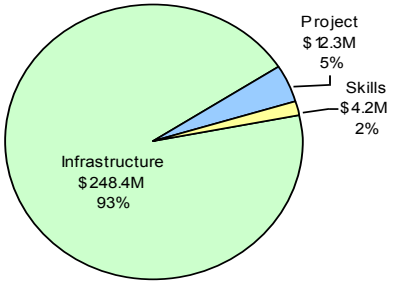
Government Investment in Science Investment Rationale



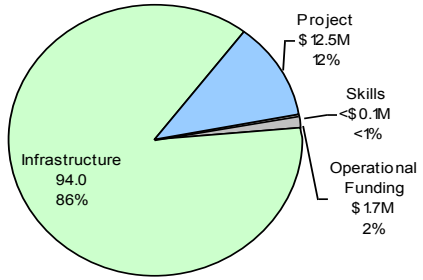
Where does Government invest in science? Economic, social and environmental drivers allocated against investment drivers

Key Points: The pie charts align with the level of funding allocated to infrastructure, skills, projects and operational funding as categorised against each driver on the Investment Rationale diagram (refer previous page). For example, the $36.7 million categorised as supporting anticipating emergent issues, has included infrastructure and projects such as 'Safeguarding research' (e.g. biosecurity, human/livestock vaccines), 'Queensland Tropical Health Alliance' and 'Australian Future Forensics Network'.

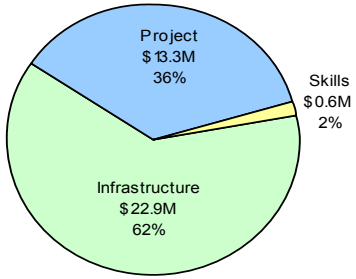
Manage Natural Resources (Total: $264.9M)



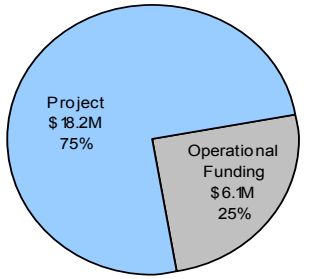
Economic Competitive Advantage (Total: $108.3M)



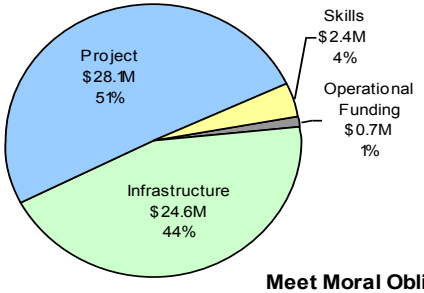
Anticipating Emergent Issues (Total: $36.7M)



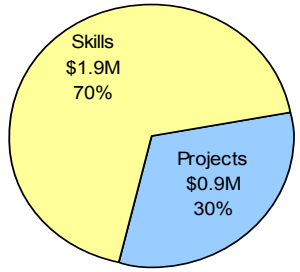
Brand Building (Total: $24.3M)



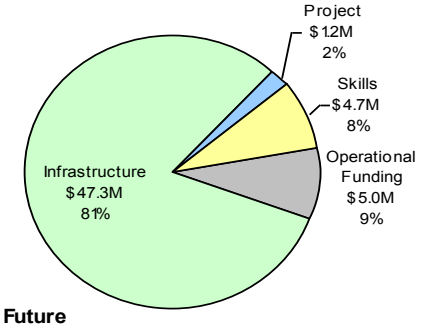
Enhance Productivity Growth (Total: $55.8M)



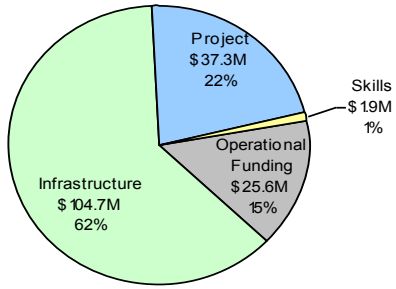
Inform Public Policy (Total: $2.7M)



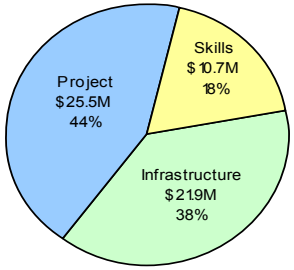
Improve Service Delivery (Total: $58.3M)



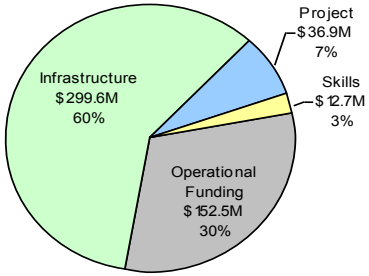
Nurture Future Industries (Total: $169.5M)



Meet Moral Obligations (Total: $58.1M)



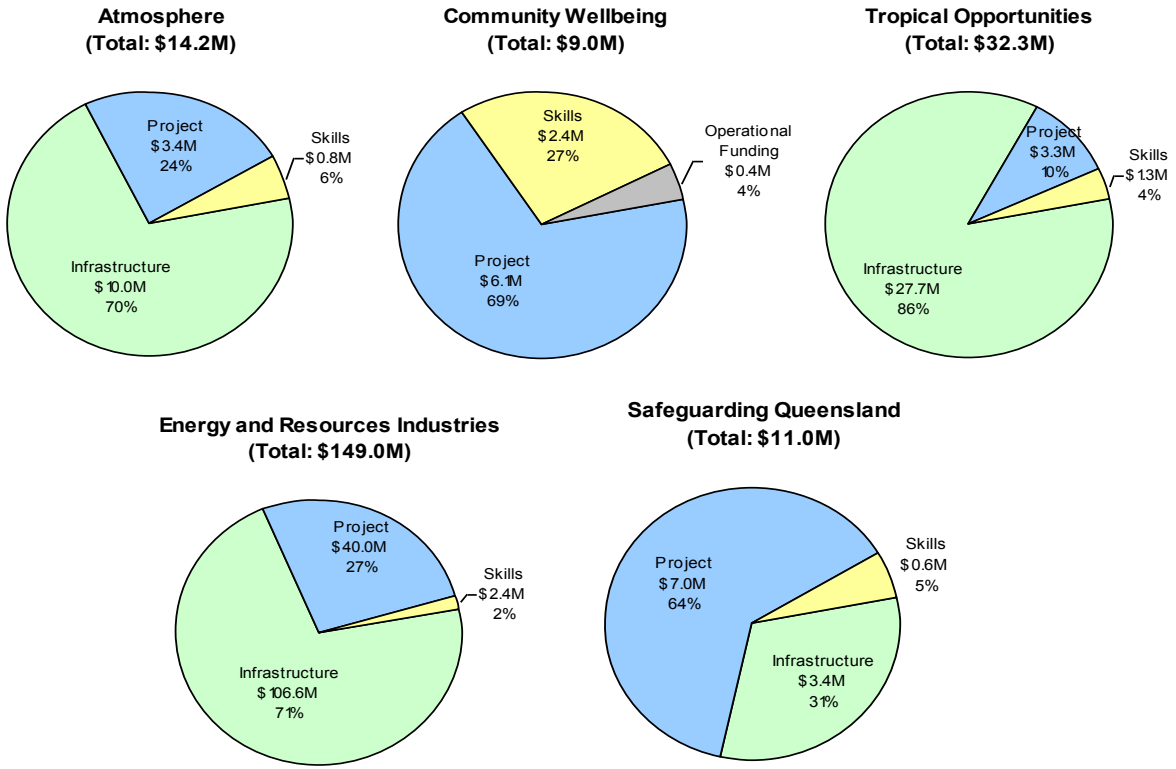
Plan For The Future (Total: $501.8M)



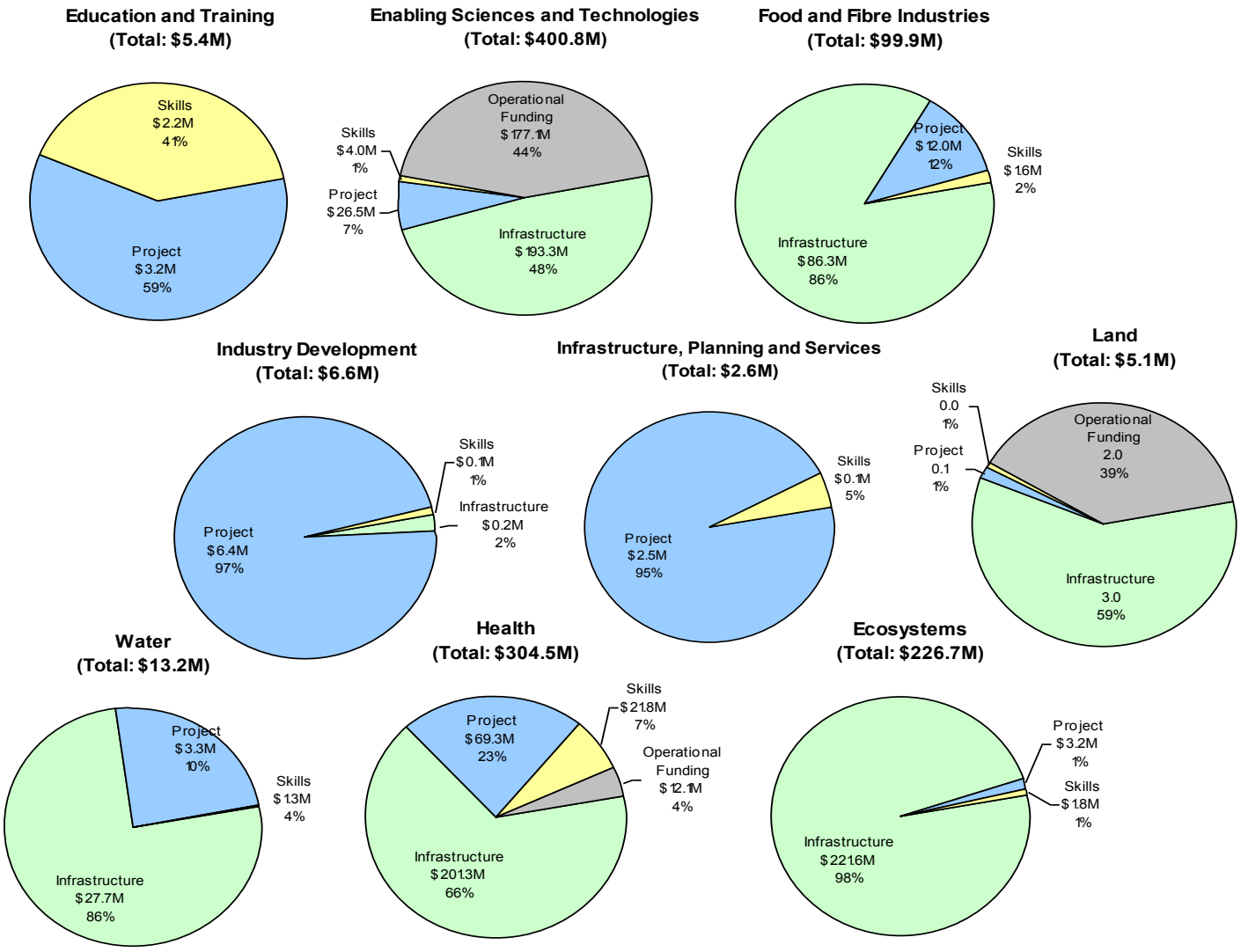
Total Science Investment: $1.28 billion

Where does Government invest in science? Economic, social and environmental drivers allocated against R&D priorities

Key Points: The pie charts below and overleaf show the alignment of infrastructure, skills, projects and operational funding by R&D objective. This shows that against the agriculture and construction pillars, a total of $99.9 million (food and fibre industries) and $2.6 million (infrastructure, planning and services) respectively has been expended. Of the food and fibre industries funding of $99.9 million, $86.3 million or 86% was expended against infrastructure, $12 million or 12% against projects, and $1.6 million or 2% against skills. The total $2.6 million infrastructure, planning and services funding has been allocated primarily against projects, $2.5 million or 95%, with the remaining $0.1 million or 5% allocated to skills. $149 million has been expended in energy and resources industries comprising $106.6 million or 71% on infrastructure, $40 million or 27% on projects, and $2.4 million or 2% on skills.



Where does Government invest in science? Economic, social and environmental drivers allocated against R&D priorities

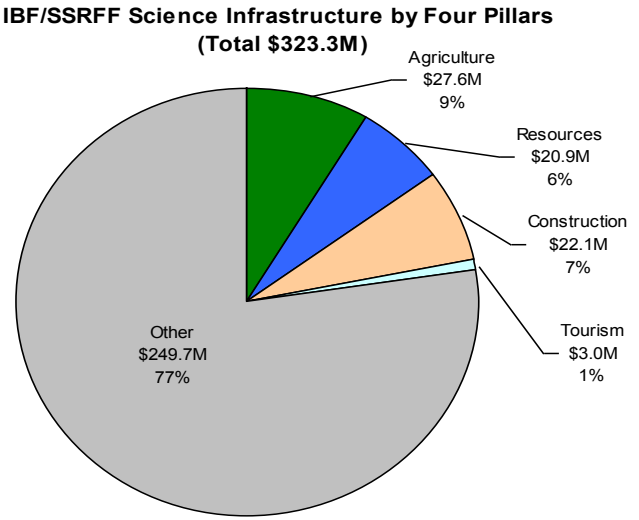


Alignment with the Four Economic Pillars - Infrastructure Projects

Infrastructure funding against the Four Pillars (Competitive funding)

- Of the Queensland Government's four pillars of agriculture, construction, resources and tourism, agriculture has received the greatest share of the four pillar areas at 9%, or $27.6 million, of infrastructure funding. These figures reflect the fact that the focus on a four pillar economy was introduced subsequent to the completion of previous funding rounds.

Graph note: *Excludes one off special projects conducted outside of competitive funding rounds - Innovation Building Fund and Smart State Research Facilities Fund. One off specials not shown include the Health and Food Sciences Precinct and Ecosciences Precinct.*

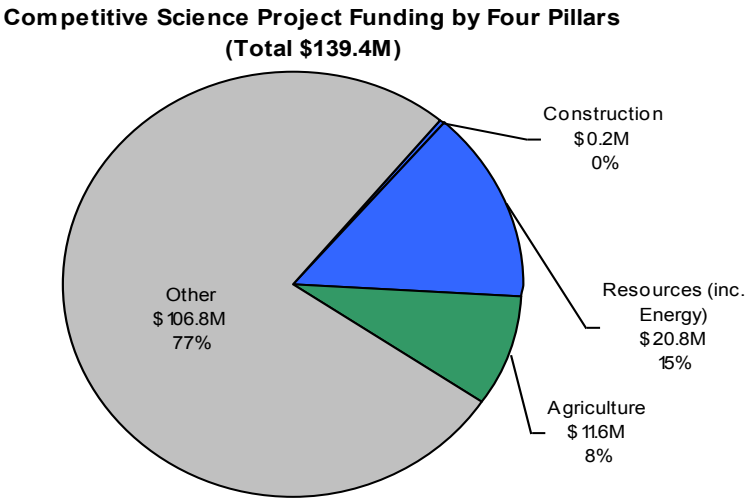


Project funding breakdown against the Four Pillars (Competitive funding)

- Of the Queensland Government's four pillars of agriculture, construction, resources and tourism, resources (including energy) has received the greatest share of the four pillar areas at 15%, or $20.8 million, of projects funding.
- Independent of this competitive funding, the government has made significant investment into agriculture and biosecurity through the Department of Agriculture, Fisheries and Forestry (DAFF). A DAFF Science Audit has been completed under the oversight of the Queensland Chief Scientist.
- The DAFF Audit notes that in 2011-12, the Queensland Government funding to DAFF science activities of $73.5 million leveraged $48.8 million, bringing the total investment to $122.3 million. Leverage sources included Commonwealth Government ($7.3 million), industry ($3.5 million), universities ($5.6 million) and fee-for-service ($5.9 million).

Graph notes: Figures include: *Research Partnerships Program, Co-Investment Fund, National and International Research Alliances Program, Research Industry Partnerships Program, Queensland-Chinese Academy of Sciences Biotechnology Projects Fund and international visits, Indo-Queensland Biotechnology Projects Fund, Partnerships Alliances Facilitation Program.*

Figures exclude: *one off special projects conducted outside competitive funding rounds and international programs run by others within the Innovation and Science Development Group, DSITIA i.e. Queensland-Smithsonian program.*



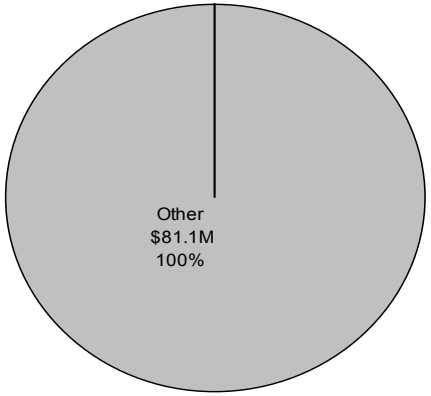
Alignment with the Four Economic Pillars - Operational Skills

Operational funding breakdown against the Four Pillars

- None of the operational funding was administered in the specific four pillars of agriculture, construction, resources and tourism.

***Graph note**: Excludes one off special projects administered outside of the Innovation Building Fund. One off specials not shown include the Institute for Molecular Bioscience (1999-2009), Queensland Cyber Infrastructure Foundation (2007-2011) and National ICT Australia QLD (2007-2012)*

IBF Science Operational Funding by Four Pillars (Total $81.1M)

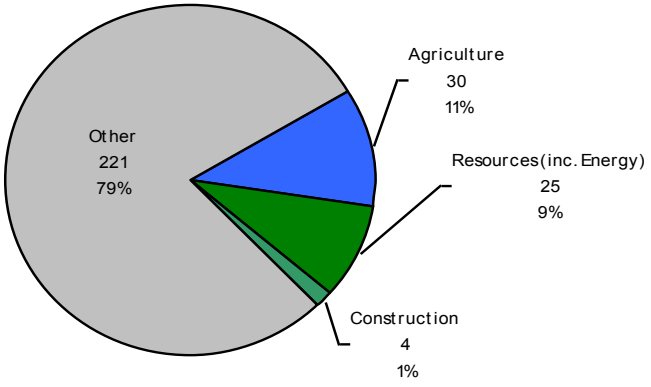


Skills funding breakdown against the Four Pillars (Competitive funding)

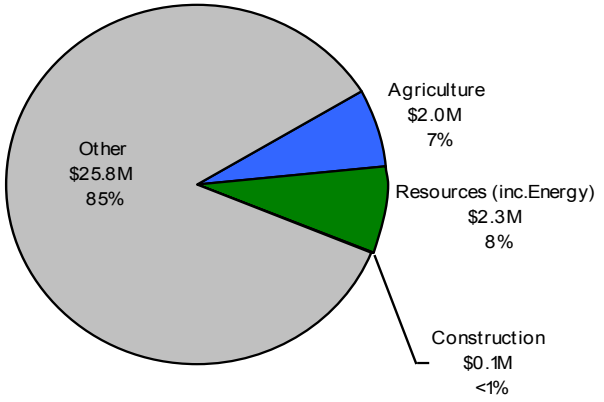
- Of the Queensland Government's four pillars of agriculture, construction, resources and tourism, resources (including energy) has received the greatest share of the four pillar areas at 8%, or $2.3 million, of skills funding, closely followed by agriculture at 7%, or $2 million.

***Graph note**: Excludes international programs run by others within the Innovation and Science Development Group, DSITIA i.e. Smithsonian programs ($700,000 - 39 fellowships).*

Competitive Science Skills Grants by Four Pillars (Total 280 Grants)



Competitive Science Skills Funding by Four Pillars (Total $30.2M)



Science Investment and Policy Stakeholders

1. Universities and Research Institutes

Deputy Vice-Chancellors (Research)

The University of Queensland

- Institute for Molecular Bioscience
- Queensland Brain Institute
- Centre for Advanced Materials Processing and Manufacturing
- Australian Computational Earth Systems Simulator (ACcESS)
- Centre for Microscopy and Microanalysis
- Australian Institute for Bioengineering and Nanotechnology (AIBN)
- Queensland Animal Breeding Facility
- Queensland Centre for Climate Change and Coastal Ecosystems
- Centre for Integrated Preclinical Drug Development Incorporating TetraQ
- Centre for Advanced Animal Science
- Queensland Hypersonic Testing Facility
- Queensland Nuclear Magnetic Resonance Network
- UQ Centre for Clinical Research (UQCCR)
- Bionano-products Development Facility (BnDF)
- Mineral Characterisation Research Facility
- MedTeQ – a Facility for Medical Diagnostic Technologies in Queensland

Griffith University

- ESKITIS Institute for Cell and Molecular Therapies
- Queensland Microtechnology Facility
- Queensland Compound Library
- Queensland Smart Water Facility
- Queensland Tropical Health Alliance (GU Node)
- Institute for Glycomics

University of Southern Queensland

Centre of Excellence in Engineered Fibre Composites

Central Queensland University

University of the Sunshine Coast

Bond University

Queensland University of Technology

- Institute of Health and Biomedical Innovation (IHBI)
- Queensland Crop Development Facilities
- Medical Engineering Research Facility
- Australian Research Centre for Aerospace Automation
- Mackay Renewable Biocommodities Pilot Plant
- Institute for Future Environments

James Cook University

- Australian Institute for Tropical Health and Medicine
- Australian Tropical Forest Institute
- Australian Tropical Science and Innovation Precinct
- Queensland Tropical Health Alliance

2. Research Organisations

- Queensland Institute of Medical Research
- Commonwealth Scientific and Industrial Research Organisation (CSIRO)
- Australian Institute for Marine Science

3. Queensland Government Departments

- Department of Agriculture, Fisheries and Forestry
- Queensland Health
- Queensland Treasury
- Trade and Investment Queensland
- Department of the Premier and Cabinet

4. National

- Australian Synchrotron
- Commonwealth Government: Department of Industry, Innovation, Science, Research and Tertiary Education; and Office of the Gene Technology Regulator
- Australian Nuclear Science and Technology Organisation

5. Philanthropic

- Atlantic Philanthropies
- Bill and Melinda Gates Foundation

Appendix 11: Clients and stakeholders (TOR 3)

6. Industry (Partners)

- Hospitals that undertake research e.g. Wesley Research Institute, Princess Alexandra Hospital
- Companies undertaking research e.g. Tissue Therapies Ltd, Alchemia Pty Ltd, Magnetica Ltd, CAST CRC Ltd
- BioPharmaceuticals Australia
- DSM Biologics Australia
- Life Sciences Queensland
- LSM Advanced Composites (Toowoomba)
- QMI Solutions (Brisbane)
- Advanced Composites Structures Cooperative Research Centre (VIC)
- Buchanan Advanced Composites (Toowoomba)
- Animal Health Australia
- Australian Pork Limited
- Sulllivan and Nicolaides Pathology
- Bovis Lend Lease (NSW)
- Delfin Lend Lease (NSW)
- General Property Trust Group (NSW)
- Investa Property Services (NSW)
- John Holland Group (NSW)
- Mirvac Group (NSW)
- Woods Bagot (Brisbane)
- Visy Industries (VIC)
- Parsons Brinckerhoff Australia Pty Ltd (NSW)
- Rider Levett Bucknall (NSW)
- Rio Tinto
- Sunwater (Brisbane)
- Delta Electricity (NSW)
- Defence Science and Technology Organisation
- Australian Submarine Corporation (SA)
- Genetic Technologies (VIC)
- Agilent Technologies (VIC)
- Olympus (VIC)
- Colgate-Palmolive (NSW)
- Mackay Sugar Limited (Mackay)
- Boeing Defence Australia (Brisbane)
- IOR Energy Pty Ltd (Brisbane)
- General Electric International (NSW)
- Pfizer Australia Pty Ltd (VIC)

7. International (Partners)

- Microsoft (Washington, USA)
- University of California (USA)
- Washington University in St Louis (USA)
- Queen Mary University of London (UK)
- Government of NRW (Germany)
- Fred Hutchinson Cancer Research Center (USA)
- University of Washington (USA)
- Seattle Biomedical Research Institute (USA)
- Indian Institute of Science (India)
- Euroscreen (Belgium)
- Jastec (Japan)
- Department of Agriculture (USA)
- Riken Genome Sciences Centre of Japan
- Harvard School of Public Health (USA)
- University of Copenhagen (Denmark)
- Boeing Phantom Works (St Louis, USA)
- World Heath Organization
- Medicines for Malaria Venture (Switzerland)
- Syngenta (Switzerland)
- Korea Advanced Institute of Science and Technology
- GS Caltex (Korea)
- Istituto Superiore Mario Boella (Italy)
- Politecnic di Milan (Italy)
- Torino Foundation (Italy)
- Medical University of South Carolina (USA)
- Dalian Institute of Chemical Physics, Chinese Academy of Sciences (CAS)
- Institute of Metals Research, CAS
- Institute of Biophysics, CAS (China)
- Institute of Psychology, CAS (China)
- Vancouver General Hospital (Canada)
- Prostate Cancer Research Foundation of Canada
- University of North Texas (USA)
- Biomatrica Inc (USA)
- University of Lausanne (Switzerland)
- Emory Vaccine Centre (Atlanta, USA)
- Roma Tor Vergata and Dyesol Italia (Italy)
- National Renewable Energy Laboratory (USA)
- Washington Vaccine Alliance (USA)
- Michael Smith Foundation for Health Research (Canada)
- Spinal Cord Injuries Solutions Network (Canada)
- Amyris (California, USA)
- Centre for Drug Research and Development (Canada)
- Kellogg Brown & Root Inc (USA)
- Neste Oil Corp (Finland)
- Ottawa Hospital Research Institute (Ottawa, Ontario, Canada)
- Tianjin University (China)
- TU Dortmund University (Germany)
- University of Duisburg-Essen (Germany)
- RWTH Aachen University (Germany)
- The Foundation for the National Institutes of Health (USA)
- Institute of Pathology (Delhi, India)
- McMaster University (Ontario, Canada)
- University of British Columbia (Canada)

National Collaborative Research Infrastructure Strategy (NCRIS)

These tables provide details of the amount of funding committed by the Queensland Government alongside the Commonwealth Government under NCRIS and Education Investment Fund programs in the period from 2006 until present. Projects are detailed under each road map area, corresponding with the summary table on page 54(TOR 6 - Leverage).

Investment in Research Infrastructure by National Research Infrastructure Roadmap Area – Environmentally Sustainable Australia

Program / Round	Recipient	Lead Agency	Total Commonwealth Government Funding	Queensland Government Funding
Environmentally Sustainable Australia				
NCRIS Round 1, Stage 1	AIMS 5.12: Integrated Marine Observation System (IMOS) - Great Barrier Reef Ocean Observing System (GBROOS)	University of Tasmania	$4,680,000.00	$4,210,000.00
NCRIS Round 1, Stage 1	JCU: 5.12 IMOS - Australian Coastal Ocean Radar Network (ACORN) - GBROOS Node	University of Tasmania	$5,460,000.00	$300,000.00
NCRIS Round 1, Stage 1	UQ: 5.13 Structure and Evolution of the Australian Continent - AuScope Simulator (AuSim)	AuScope Pty Ltd	$3,780,000.00	$1,000,000.00
NCRIS Round 1, Stage 2	UQ: 5.11: Terrestrial Ecosystems Research Network (TERN)	UQ	$5,360,000.00	$4,100,000.00
NCRIS / Super Science Initiative	Sustainability (Higher Education): Sir Samuel Griffith Centre (SSGC) for Sustainable Excellence	Griffith University	$21,000,000.00	$1,000,000.00
NCRIS / Super Science Initiative	Queensland Australian Institute of Marine Science	Integrated Marine Observation System - University of Tasmania	$3,152,950.00	$2,000,000.00
		Total	**$43,432,950.00**	**$12,610,000.00**

Investment in Research Infrastructure by National Research Infrastructure Roadmap Area – eResearch

Program / Round	Recipient	Lead Agency	Total Commonwealth Government Funding	Queensland Government Funding
eResearch				
NCRIS Round 1, Stage 2	Queensland Cyber Infrastructure Foundation (QCIF): 5.16: Platforms for Collaboration	QCIF	$10,000,000.00	$5,100,000.00
NCRIS / Super Science Initiative	University of Queensland: European Bioinformatics Institute Mirror	Bioplatforms Australia / Australian National Data Service	$4,000,000.00	$1,000,000.00
NCRIS / Super Science Initiative	Queensland Cyber Infrastructure Foundation	Queensland Cyber Infrastructure Foundation		$2,000,000.00
Super Science Initiative	Research Data Storage Infrastructure project National eResearch Collaborative tools and resources project National Research Networks project	UQ (RDSI) and University of Melbourne (NeCTAR) with QCIF as the CIF applicant	$10,800,000.00	$ 3,600,000.00
		Total	**$ 24,800,000.00**	**$11,700,000.00**

Investment in Research Infrastructure by National Research Infrastructure Roadmap Area – Frontier Technologies

Program / Round	Recipient	Lead Agency	Total Commonwealth Government Funding	Queensland Government Funding
Frontier Technologies				
NCRIS Round 1, Stage 1	AGRF 5.1: Evolving Bio-molecular Platforms and Informatics - Genomics	BioPlatforms Australia	$1,900,000.00	$1,248,400.00
NCRIS Round 1, Stage 1	UQ 5.1: Evolving Bio-molecular Platforms and Informatics - Genomics	BioPlatforms Australia	$378,400.00	$131,600.00
NCRIS Round 1, Stage 1	UQ: 5.1: Evolving Bio-molecular Platforms and Informatics - Metabolomics	BioPlatforms Australia	$1,000,000.00	$500,000.00
NCRIS Round 1, Stage 1	UQ: 5.3: Characterisation - Microscopy	Australian Microscopy and Microanalysis Facility (AMMRF)	$2,134,000.00	$2,000,000.00
NCRIS Round 1, Stage 1	QUT: 5.3: Characterisation - Microscopy	AMMRF	$252,000.00	$500,000.00
NCRIS Round 1, Stage 1	UQ: 5.4 Fabrication - Nanofabrication	Australian National Fabrication Facility (ANFF)	$7,000,000.00	$3,000,000.00
NCRIS / Super Science Initiative	University of Queensland: Australian National Fabrication Facility	ANFF	$5,580,000.00	$1,500,000.00
		Total	**$18,244,400.00**	**$8,880,000.00**

Investment in Research Infrastructure by National Research Infrastructure Roadmap Area – Safeguarding Australia

Program / Round	Recipient	Lead Agency	Total Commonwealth Government Funding	Queensland Government Funding
Safeguarding Australia				
NCRIS Round 1, Stage 2	# QPIF 5.6: Australian Biosecurity Network	CSIRO		$1,700,000.00
NCRIS / Super Science Initiative	Australian Biosecurity Intelligence Network (ABIN)	CSIRO	$2,171,000.00	$1,700,000.00
		Total	$2,171,000.00	$3,400,000.00

Investment in Research Infrastructure by National Research Infrastructure Roadmap Area – Promoting and Maintaining Good Health

Program / Round	Recipient	Lead Agency	Total Commonwealth Government Funding	Queensland Government Funding
Promoting and Maintaining Good Health				
NCRIS Round 1, Stage 1	QIMR: 5.1: Evolving Bio-Molecular Platforms and Informatics - Proteomics	BioPlatforms Australia	$1,900,000.00	$2,000,000.00
NCRIS Round 1, Stage 1	UQ: 5.3: Characterisation - Imaging*	National Imaging Facility (NIF)	$2,400,000.00	$2,725,000.00
NCRIS Round 1, Stage 1	QIMR 5.5: Biotechnology Products - Cellular Expansion	Research Infrastructure Support Services Ltd (RISS)	$890,000.00	$890,000.00
NCRIS Round 1, Stage 1	UQ: 5.5:- Biotechnology Products - Proteins	AusBiotech	$3,500,000.00	$4,000,000.00
NCRIS Round 1, Stage 2	UQ 5.7: Population Health and Clinical Data Linkages	University of Western Australia	$2,000,000.00	$1,000,000.00
NCRIS / Super Science Initiative	Research: Centre for Advanced Imaging	University of Queensland	$40,000,000.00	$2,000,000.00
NCRIS / Super Science Initiative	Protein Discovery Centre	Queensland Institute of Medical Research:	$2,500,000.00	$2,000,000.00
Super Science Initiative	Translating Health Discovery – UQ Biologics Facility	Therapeutic Innovation Australia	$3,250,000.00	$1,200,000.00
Super Science Initiative	Metabolomics Australia - UQ Metabolomics Facility	BioPlatforms Australia	$800,000.00	$250,000.00
Super Science Initiative	Translating Health Discovery - Queensland Collaborative Facility (TIA - Qld Node)	Therapeutic Innovation Australia UQ was CIF applicant	$5,900,000.00	$2,000,000.00
Super Science Initiative	Translating Health Discovery - Expanding the Qld Compound Library Functional Capability	Therapeutic Innovation Australia Griffith Uni was CIF applicant	$1,350,000.00	$550,000.00
Super Science Initiative		BioPlatforms Australia - Stem Cells Ltd/UQ was CIF applicant	$314,000.00	$470,000.00
		Total	**$64,804,000.00**	**$19,085,000.00**

Summary Table: Investment in Research Infrastructure by National Research Infrastructure Roadmap Areas

Total NCRIS Investment In Roadmap Areas	Queensland Government Commitment	Commonwealth Government Commitment
	$55,675,000	**$153,452,350**

The Atlantic Philanthropies – Funded Research Initiatives in Queensland 1998 to 2011

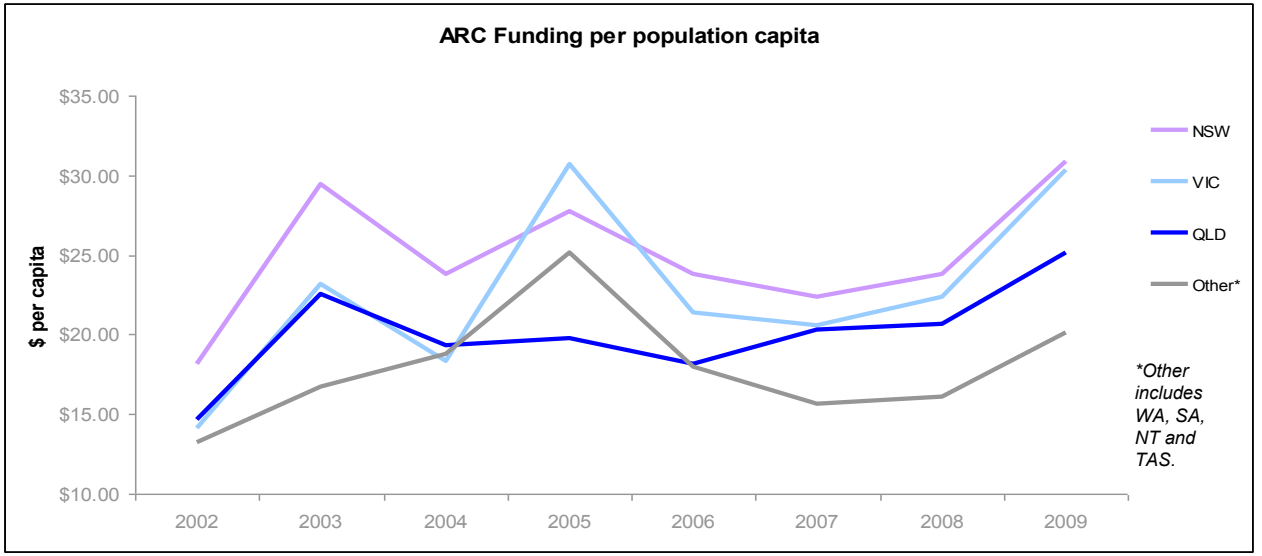
Yr of Initial Funding	Name of Organisation/ Research Centre	AP Investments	Queensland Govt Investment	Australian Govt Investment
1998	Queensland Institute of Medical Research	$20 million Cancer Research Centre (1998); $6 million Clinical research centre (2002); $3.425 million Cell-based cancer therapy centre (2006)	$20 million plus land (Radium institute) $4 million through NCRIS	$20 million (Centenary of Federal Funding)
1998	UQ Institute for Molecular Bioscience	$10 million	$15 million ($127.5 million operational funding)	$15 million (Centenary of Federal Funding)
2000	Royal Brisbane Hospital Stroke Unit	$5 million		
2001	QUT Institute of Health and Biomedical Innovation	$22.5 million	$22.5 million	
2001	UQ Australian Institute for Bio-Engineering and Nanotechnology	$17.5 million	$20 million	
2001	James and Mary Amelia Mayne Arts Centre, UQ	$5 million		
2002	QUT Australian Centre for Philanthropy and Nonprofit Studies	$750,000		
2002	UQ Centre (Graduation Hall)	$10 million		
2004	UQ Queensland Brain Institute	$20 million	$20 million ($25 million operational funding)	
2005	QUT Centre for Physical Activity, Health and Clinical Education	$20 million		
2005	UQ Centre for Clinical Research	$20 million	$20 million	
2005	Wesley Research Institute (Wesley Hospital) – Health and Medial Research Centre	$10 million	$1.42 million - Tissue Bank; $800,000 - Clinical Research Centre; $10 million - Health and Medical Research Centre	

The Atlantic Philanthropies – Funded Research Initiatives in Queensland 1998 to 2011

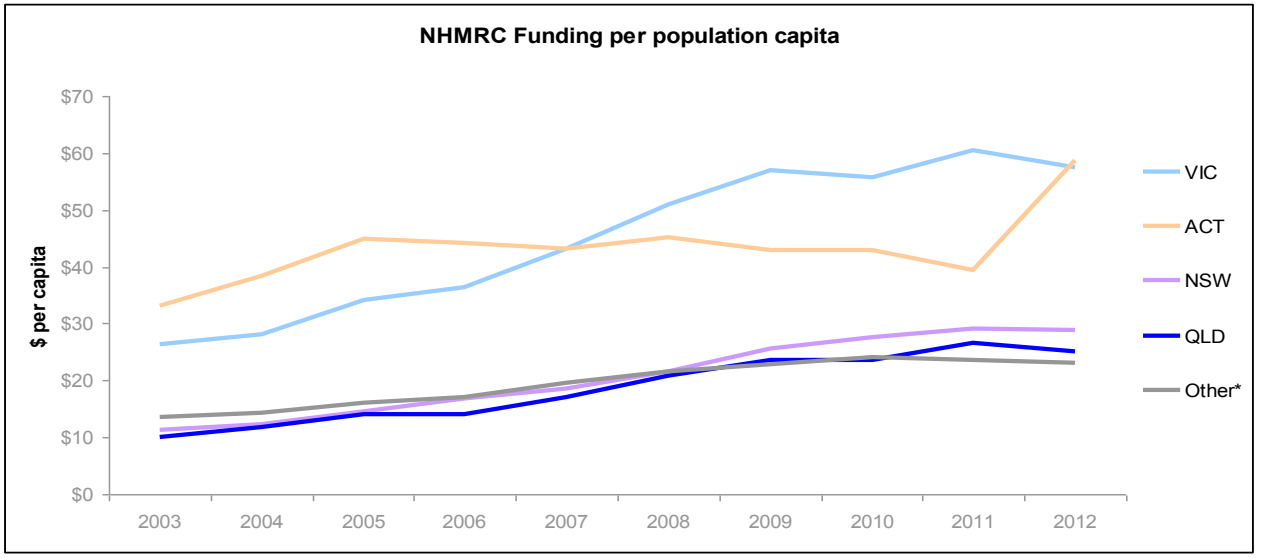
Yr of Initial Funding	Name of Organisation/ Research Centre	AP Investments	Queensland Govt Investment	Australian Govt Investment
2009	QUT School of Nursing and Public Health – funding of $10.5 million for two capacity-building projects QUT is leading in Vietnam, in the professions of nursing and public health.	$10.5 million		
2009	Translational Research Institute UQ, MMRI, QUT	$50 million	$100 million	$150 million
2009	QIMR Smart State Medical Research Institute	$27.5milion	$35 million	$110 million
2009	Science & Technology Precinct & Community Hub – incorporating the Science, Technology, Engineering and Mathematics Institute (previously known as the Hub for Sustainable and Secure infrastructure)	$25 million for the Hub for Sustainable and Secure infrastructure	$35 million for the Hub for Sustainable and Secure infrastructure	$75 million from EIF for the Science and Technology Precinct
2011	Queensland Head and Neck Cancer Centre	$5 million	$5 million (Co Investment Fund)	
	TOTAL (1998 to 2011)	**$288.17 million**	**$461.22 million**	**$410 million**

Attracting Federal Government Competitive Grant Funding

Between 2002 and 2009, Queensland has generally underperformed New South Wales and Victoria in terms of ARC funding per population capita. When compared to Western Australia, South Australia and Northern Territory, Queensland usually performed better save for 2005. The Australian Capital Territory receives greater than $100 funding per capita each year and is not included here.



Queensland has consistently received near the lowest levels of NHMRC funding per population capita in Australia since 2003, Queensland recipients received $25 per capita in 2012. Queensland and New South Wales shared the highest growth rate during the 2003-2012 period at 11% per annum, Victoria and the Australian Capital Territory grew at 9% per annum and 7% per annum respectively during this time.



Research Impact – Case Study 1

VitroGro®ECM – Queensland University of Technology (QUT) : From ground breaking research to innovative wound care technology

Funding (including Queensland Government $1.16 million, leveraging $1.19 million)

Queensland Government Funding: $1,162,903, leveraging $1,187,905 = total investment of $2,350,808 **Other Funding** ARC and NHMRC Projects: $1.9 million; Industry Funding $5.3 million, Foundations and Trusts $0.9 million **Total funding:** $10,587,533
Qld Smart State Fellowships **$300,000** QUT Funding: **$175,000** Tissue Therapies Ltd: **$150,000** Interdisciplinary Approaches to Creating Smart Wound Healing Solutions (2006-2009), *Z. Upton, G. George. S Rizzi.*
Qld Smart State Fellowships: **$150,000** QUT Funding: **$75,000** Tissue Therapies Ltd: **$75,000** VitroGro Delivery System for Tissue Regeneration: Co-Development of the Product and Commercialisation Concept *(2006-2008), S. Rizzi, Z. Upton*
Research-Industry Partnerships Program (Qld Smart State Future Innovation Fund) RIPP: **$712,903** Tissue Therapies Ltd: **$462,961** QUT Funding: **$249,944** VitroGro: Modern Wound Care Technology. (2009-2012), *Z.Upton, S. Mercer, D. Leavesley, N. Johnson, G. Shooter. D. Van Lonkhuyzen.*

The incidence of chronic wounds, such as diabetic, venous and pressure ulcers, is on the increase due to association with the increasingly ageing population and the sharp rise in diabetes and vascular disease. Innovative, cost-effective and safe therapies that can be used in primary care settings are urgently needed, as current treatments for chronic wounds tend to be only moderately effective. This is often due to a lack of good basic science to underpin the product.

VitroGro®ECM is an innovative wound care technology developed from ground-breaking research by tissue engineering and protein experts at the Institute of Health and Biomedical Innovation (IHBI) at QUT. This new liquid technology restores the normal wound healing process by creating a scaffold over the wound that allows normal skin cell attachment, and subsequent cell proliferation and migration. VitroGro®ECM is a safe, ease-of-use treatment that improves chronic wound healing, reducing treatment time and cost. Following successful large-scale cGMP manufacturing and recent clinical trial, VitroGro®ECM will be available for sale once CE Mark is granted by the British Standards Institute.

The first clinical trial of VitroGro®ECM commenced in 2010. The trial evaluated VitroGro®ECM as a treatment for chronic venous leg ulcers. Currently, healing rates for these wounds are only 25-30% following up to 20 weeks treatment with best practice compression therapy. In contrast, in the VitroGro®ECM trial, 82% of the patients' wounds were found to be partially, or completely, healed after 12 weeks. The average reduction in wound size was 65%, with no adverse events related to VitroGro®ECM reported. The success of this trial was highlighted by the ability of VitroGro®ECM to initiate wound healing in patients who had on average not responded for up to 37 months of standard care. Patients also reported that the pain associated with the ulcer had improved. A further feature of VitroGro®ECM is the consistency of response by patients.

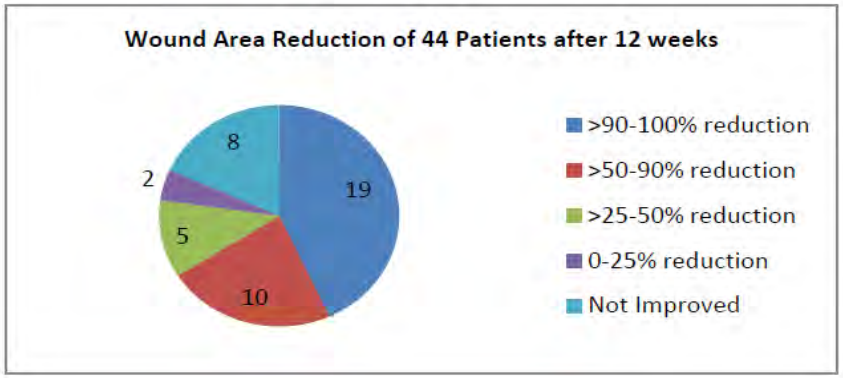
Research Impact – Case Study 1 (continued)

VitroGro®ECM – Queensland University of Technology (QUT) : From ground breaking research to innovative wound care technology

Details of Impact

In addition to the creation of an Australian-developed product that will generate economic revenue, plus clinical benefits and improved quality of life for people with wounds, impacts of the research include:

- Successful filing, prosecution and granting of several international patents owned by QUT and licensed to Tissue Therapies Limited (TIS).
- Formation of TIS, an ASX-listed company with a current market capitalisation of $70 million. TIS has successfully raised $40.5 million to support development of VitroGro®ECM.
- Employment of staff over a sustained period. Currently TIS employs 6 staff in Australia and 2 staff in Europe, while 4 staff are employed on a long-term basis through R&D contracts with QUT.
- Investment in translational research with TIS providing over $8 million in R&D contracts to QUT for further development of VitroGro®ECM and other wound care technologies. This funding has supported additional staff and HDR students.
- An increased focus on wound research at QUT that in turn underpinned the successful QUT-led bid to establish the $108 million + Wound Management Innovation CRC, the largest wound research initiative globally.
- Receipt of prestigious awards by the lead inventor and research team leader, Professor Zee Upton. These include:
  - 2011 Queensland Life Sciences Industry Award
  - 2010 Australian Society of Biochemistry and Molecular Biology 2010 Beckman Coulter Discovery Science Award in recognition of “involvement in research innovation and technology transfer”
- Increased awareness of Australian wound research through sponsored invitations to Professor Upton to present her findings at 23 international and 44 national scientific and industry meetings. These include sponsorship at the: 2011 Global Wound Care Conference, South Africa; 2011 US ENDO meeting; 2010 and 2011 Chinese Burns Society meetings; 2012 UK Tissue Viability Society meeting; the BIO2012 session on “From Wound Healing to Regenerative Medicine”, Boston; and at the upcoming 2012 World Congress of Wound Healing Societies Meeting, Japan where she is a speaker, Stream Leader and Faculty Member. The research has also been highlighted in numerous print, TV and radio interviews and technology profiles.



This graph summaries the clinical trial results obtained for VitroGro®ECM based on data sourced from TIS ASX announcement on 11 November 2011.
Source: QUT EIA 2012 Case Study

Research Impact – Case Study 2
University of Queensland (UQ) – Improving the clarity of images in Magnetic Resonance Imaging (MRI)

Magnetic Resonance Imaging (MRI) is applied in a wide range of applications from orthopaedic, cardiac and neural diagnoses, to functional MRI for imaged guided surgery and therapy.

As the technology and the applications have developed, there is increasing demand for higher field strength to provide medical practice with more definitive imaging capability. This requirement has presented researchers and developers with the great challenge to deliver enhanced capability, while also controlling factors such as increased electromagnetic noise and costs.

Electromagnetic noise compensation technology developed at The University of Queensland (UQ) is now incorporated into two-thirds of the world's high field MRI systems sold since 1996. In the last five years alone, GE and Siemens have reported sales of over 10,000 systems that use UQ technology. An estimated 8 billion patients worldwide have benefited from this improved technology. A provisional patent application was filed on the results in 1991, with the patent rights licensed to GE and Siemens in 1996.

The key publications relating to the underpinning research were published in 1992-94. Further research and development of the technology is continuing at UQ.

Funding and investment income

Queensland Government Funding: $1 million Research-Industry Partnerships Program (Qld Smart State Future Innovation Fund) *For development of Magnetica's second magnet product, in partnerships with UQ, Magnetic and Jastec*
2003-07: $1,142,290 *Advanced MRI Engineering,* Australian Research Council (ARC), S. Crozier
1999-2003: $443,874 *Magnetic Resonance engineering of new compact high field systems,* ARC (Senior Research Fellowships), S. Crozier
Investment income: The capability developed on the back of the research expertise and income from the noise compensation method led to a range of commercial activities by the research group. The start-up company, Magnetica Limited, has attracted approximately $6 million in capital and grants to advance new MRI magnet and coil designs, much of which has been applied to R&D activities with the team at UQ.

Research Impact – Case Study 2

University of Queensland (UQ) – Improving the clarity of images in Magnetic Resonance Imaging (MRI)

Details of the Impact

MRI imaging has been an important clinical diagnostic tool since the 1980s, with the current global market estimated to be around US$4.5 billion per annum from the sale of around 3500 systems per year (Global Industry Analysts, 2008; Frost and Sullivan, 2008).

The underlying research that led to this significant improvement in MRI capability was undertaken by Professor David Doddrell and Professor Stuart Crozier from UQ) with R&D syndicate funding. They developed a method to compensate for the eddy current-induced fields generated by the gradient coils in an MRI system, greatly enhancing the 'purity' of the imaging field and, in turn, the quality and definition of the system output.

The technology has greatest benefit when applied in high-field systems. It enables a reduction in the manufacturing cost of gradient coils due to the ability to manufacture them to a lower tolerance. The patent rights relating to the research results were licensed to GE Medical Systems and Siemens in 1996. Between them, GE and Siemens have been responsible for the supply of approximately two-thirds of the world's high field MRI systems since that time. These systems have all incorporated the noise compensation techniques developed by the UQ research team. From January 2007 to June 2012, GE and Siemens have reported sales of over 10,400 MRI systems incorporating the UQ technology. This amounts to a total sales revenue of approximately $8 billion over the period.

GE and Siemens high-field MRI systems can be found throughout the world, and UQ's contribution to the imaging field through the technology and resulting patents has aided its take up and use by reducing the trade-off between increased quality and systems cost for clinicians and, consequently, patients. A conservative estimate, based on Frost and Sullivan sales reporting systems, is that ~8 billion patients have been imaged using the patented method and have therefore had the benefit of improved diagnoses as a result of clearer images with better resolution and reduced distortion.

For the research group and the University, the commercial success of the patented research outcomes provided a basis for building a centre of excellence in MRI and further commercial activities. Most recently, Professor Crozier has been engaged as the consulting Chief Technical Officer to the start-up company, Magnetica Limited. The novel MRI magnet designs that Professor Crozier's team has developed at UQ for Magnetica led to the company's first commercial product, now manufactured in a joint venture with Jastec, a subsidiary of the Japanese industrial giant, Kobe Steel. These magnets were supplied to ONI Systems Inc in the USA for use in their new extremity MRI system. ONI has since been acquired by GE Medical Systems and GE is now selling and supporting the Magnetica-Jastec based product in the market. A total of 155 units have been sold to clinicians, predominantly in the USA, with GE having sold 100 of these.

Research Impact – Case Study 2 (continued)

University of Queensland (UQ) – Improving the clarity of images in Magnetic Resonance Imaging (MRI)

Additional Queensland Government funding in this area:

Smart State Funding looking to leverage this competitive advantage includes:

- **Queensland Nuclear Magnetic Resonance Network - $5.035 million (leveraging $12.22 million)** Smart State Research Facilities Fund
Acquisition of three NMR systems: 900 MHz high-resolution spectrometer for biomolecular studies; 700 MHz wide-bore microimaging system for creating detailed images of intact biological specimens; and 600 MHz high-throughput system incorporating hyphenated analytical technology (LC-MS) for use in biodiscovery and bioprospecting.

- **Centre for Advanced Imaging - $2 million** Education Innovation Fund
To expand the capabilities of the National Imaging Facility through the creation of the Centre for Advanced Imaging at the University of Queensland. This involves the procurement and installation of high quality research instrumentation at existing National Imaging Facility Nodes, and the establishment of additional Nodes in the National Imaging Facility network.

- **MedTeq (Centre for Medical Diagnostic Technologies in Queensland) - $1.83 million (leveraging $6.125 million)** Innovation Building Fund
A facility to enhance the development of Queensland innovations in medical diagnostic technologies through provision of equipment and laboratory facilities that will permit the closer alignment of leading world class academic research with clinical researchers in a range of disciplines.

- **Magnetica - $598,500 (leveraging $1.187 million cash or $2.55 million cash + in-kind)** National and International Research Alliances Program
High performance MRI superconducting magnets. Project to further the commercialisation of a patent protected technology developed in Queensland into the global magnetic resonance imaging market.

- **Head and Neck Cancer Research Centre - $5 million (leveraging $10 million cash or $15.27 million cash + in-kind)** Co-Investment Fund
To establish a Centre of Excellence for Head and Neck Cancer in Queensland and Southeast Asia. It will deliver novel diagnostic and treatment modalities, enable presymptomatic, non-invasive diagnosis, coupled to environmentally neutral treatments, along with financial returns from partnership with commercial collaborators. Head and Neck Cancers have a significant impact on morbidity, mortality and health costs in Queensland, Vietnam, China and India.

- **Herston Imaging Research Facility - $3.5 million (leveraging $14.005 million cash + in-kind)** Co-Investment Fund
This project will: provide Queensland researchers and clinicians with access to cutting-edge imaging technologies to observe disease processes in patients, in vivo, to support meaningful reform in health care delivery and place Queensland at the global frontier of human imaging research, clinical trials and patient care; and use cutting edge Narrow Band Imaging technology to diagnose head and neck (H&N) cancer lesions earlier and state-of-the-art Next Generation Sequencing to describe the molecular profile of H&N cancers.

Source: UQ EIA 2012 Trial – Research Impact Case Study

Research Impact – Case Study 3

Australian Institute for Bioengineering and Nanotechnology (AIBN)
Research supporting establishment of the BioPharmaceuticals Australia (BPA) / DSM Biologics commercial production facility in Brisbane

The BioPharmaceuticals Australia (BPA) Scale-Up Manufacturing Facility will manufacture small quantities of drugs and therapeutics for use in pre-clinical and clinical trials. The facility is due to be operational by July 2013. The Queensland Government provided $107 million to support the joint construction of the BPA facility ($7 million) and the co-located Translational Research Institute (TRI) ($100 million), at the Princess Alexandra Hospital campus, Brisbane.

The BPA Facility will specialise in producing biopharmaceuticals using mammalian cell culture. This primary focus is due to the immediate and unmet demand for such infrastructure as recognised at both the State and Federal levels. It will enhance the ability of Queensland and the nation to take drugs and therapeutics from the lab bench to the clinic. Only a small number of companies in Australia can do scale-up manufacturing, but none at the scale of operation or service quality level needed to properly address the current capability gap. Consequently, between A$15 million and A$60 million per year of manufacturing business currently goes offshore.

The new manufacturing plant will be unique in Australia and will incorporate the latest technologies for transitioning new bio-drug inventions into commercial products. Previously, Australian biotech companies had to out-source these highly specialised development, scale-up and manufacturing services overseas. These services will be available in Brisbane using the BPA facility from mid 2013.

DSM Biologics has been chosen as the commercial partner to operate the $64 million BPA facility. DSM Biologics are a 'blue chip' global contract manufacturing company, who have cited access to Australian Institute for Bioengineering and Nanotechnology (AIBN) research, facilities and people as one of the main reasons that they were attracted to Brisbane/Australia. AIBN's research activities in the field of biologics are highly regarded and acknowledged internationally. The new biologics capability means that Brisbane is one of a very small number of locations world wide that can develop end-to-end new biologic drugs in a highly competitive international market. It is anticipated that these activities will attract other investments and create significant critical mass in a rapidly advancing medical precinct.

Source: UQ EIA 2012 Trial – Research Impact Case Study

Research Impact – Case Study 3

Australian Institute for Bioengineering and Nanotechnology (AIBN)
Research supporting establishment of the BioPharmaceuticals Australia (BPA) / DSM Biologics commercial production facility in Brisbane

Impact

In 2010 AIBN commissioned the Allen Consulting Group to review the institute's economic contribution in its first seven years. The group found AIBN was highly successful in attracting additional investment to Queensland, with the funds making a significant contribution to the state's economy. Figures in the report showed every $1 invested in AIBN during 2003 - 2009 increased Queensland's economic output by $4.50 to $6.30. At a national level, the report suggested GDP increased between $2 and $2.90 for every additional $1 attracted by AIBN.

Over the past five years, AIBN researchers have been actively working to develop and progress new biologics towards commercial and clinical outcomes. In addition, AIBN researchers have developed a strong international profile in biologics research, which has helped attract DSM Biologics to Brisbane. Key examples of these include:

- ***Establishment of the National Biologics Facility:***

The current facility includes clean rooms and associated equipment are custom designed to be used for bioprocess development and production of recombinant proteins and monoclonal antibodies for a large number of Australian Researchers and SMEs. As well as the hard infrastructure, support was also provided to allow 12 FTEs to run the operation. The facility has received in excess of $13 million from the Federal Government's NCRIS (National Collaborative Research Infrastructure Strategy) initiative as well as over $3 million from the Translating Health Discoveries Program within the Super Science Initiatives. The QLD state government has also provided multimillion-dollar support via the Bionano development fund and Smart Futures Funding. The facility underpins both the research programs listed below and was a key factor in bringing DSM to Brisbane by offering support for early stage projects as well as extensive process development capabilities.

- ***Production of a monoclonal antibody for Hendra virus (HEV) infection in humans:***

Hendra virus is transmitted from bats to horses and then to humans. Of seven people known to be infected, only three have recovered. AIBN researchers produced batches of a monoclonal antibody that may be a potential therapeutic for Hendra virus (HeV) infection in humans. AIBN biotechnologist Dr Trent Munro and his team at the National Biologics Facility (NBF) developed a process to produce large amounts of high-quality antibody from cells originally developed by US scientist Professor Chris Broder. The project has taken advantage of the world-class facilities at AIBN that were established through significant state and federal government support for production of complex therapeutic proteins.

- ***Biosceptre International Limited – AIBN collaboration***

This was initiated to develop a process for the production of monoclonal antibodies to treat cancer. The research and development will include antibody and cell line development, bioprocess development, and recombinant protein production in pre-commercial quantities ahead of preclinical trials.

Research Impact – Case Study 4

UQ - Titanium fabrication for aerospace materials

Titanium is an attractive element for metal Component manufacture as it is light, high strength and corrosion resistant. Unfortunately, titanium alloys are expensive and difficult to manufacture into useful components. Cost factors have always limited the use of titanium to niche applications, for example, the biomedical, petrochemical and aerospace industries. However, it is in these particular markets that demand for titanium is rapidly growing. Researchers at the University of Queensland, who are part of the CAST CRC (headquartered at UQ) and UQ's Defence Materials Technology Centre, have developed significant technical capability, reducing manufacturing costs.

A CAST CRC and Ferra Engineering partnership has been highly successful in developing techniques to manufacture titanium components for the F-35 Joint Strike Fighter (JSF), a defence force combat aircraft being developed by the United States, Australia and eight other partner nations. The JSF is the centrepiece of a $300 billion program with 6,000 aircraft expected to be produced. The light metals technology developed with CAST helped Ferra to secure seven out of the 21 contracts in Australia for the JSF Project. These long term, high precision metal component supply contracts will result in significant growth for Ferra, and over the life of the project will be worth an estimated $1 billion to the company.

Details of the impact

Australian industry has become more competitive in winning work to manufacture titanium parts for JSF production as a result of research carried out by UQ researchers that was funded through the CAST CRC. Titanium is a common component in aircraft production. It is lighter and stronger than most metals and resistant to corrosion and high temperatures. In 2007, Ferra tendered to be part of the Joint Strike Fighter project that provided an opportunity valued at up to $11 billion for Australian manufacturers (JSF Australian Industry Participation Plan).

Ferra Engineering was successful in winning some initial contracts with the help of CAST CRC capability. In transferring these new technologies, the research teams of UQ and the CAST CRC have worked with Ferra, SMEs and other major aircraft prime contractors, including BAE Systems and Lockheed Martin, to develop the light metals technology needed to win supply contracts for the Joint Strike Fighter (JSF). This work has demonstrated that it is possible for Australian industry to engage in the global JSF supply chain. In addition to bringing Australia into the JSF supply chain, through the development of research and supply chain contacts, UQ researchers have been able to extend the target markets for these innovations beyond defence and aerospace into other areas of precision manufacturing, for example, medical devices. Expanding this target market means that UQ researchers have had impact on Australian industry by achieving cost savings and potential new business as they tap in to new supply chains.

Primary Source: UQ EIA 2012 Trial – Research Impact Case Study

Research Impact – Case Study 4 (continued)

UQ - Titanium fabrication for aerospace materials

Supporting statement from Mark Scherrer, CEO Ferra Engineering

Ferra is one of Australia's leading suppliers of precision light metal components, produced to exacting quality standards, and exported around the world. We supply components to such demanding industries as aerospace, high-end automotive, telecommunications, medical industries and many major manufacturers (Hewlett Packard, Filtronic Comtek and Boeing). We have worked with CAST for more than 10 years. CAST's involvement with Ferra has been critical in enabling us to rapidly shift our commercial focus.

Recently, CAST has helped us upgrade our technology capacity to secure work in the defence and aerospace sectors. Light metals technology developed by CAST helped Ferra to recently secure seven out of the 21 contracts let in Australia for Lockheed Martin's Joint Strike Fighter (JSF) Project. These long term contracts will result in significant growth for our company. Such exports contribute in excess of 70% of our business. CAST's processing technology knowledge and research skills are both high quality and relevant to our business.

CAST's support has helped us build ongoing relationships with the JSF program and helped secure confidence that Australia had the expertise to accommodate the needs of Lockheed Martin and its sub-contractors. I estimate that one-third of Ferra's competitive worth is due to CAST research. We are currently investigating further partnership opportunities with CAST in relation to titanium research.

Image: F-35 Joint Strike Fighter, A-Variant (CTOL) LRIP aircraft

Research and investment income (CAST CRC)

2010: $50,000 Queensland Government Proof of Concept Funding *Factory Demonstration of Laser Assisted Machining*
2008-2010: $404,509 Lockheed Martin *Factory Demonstration of Laser Assisted Machining*
2009: $150,000 Department of Defence *Laser Assisted Machining;* 2007: $10,000 Department of Defence *Affordable Machining*
2005-2008: $300,000 Ferra Engineering, contribution as CRC partner *High Speed Machining*

Additional Queensland Government funding to CAST CRC

2008-2015: $1.8 million (Total project value $5.4 million) National and International Research Alliance Program *Defence Materials Technology Centre*
2000-2006: $2.6 million + $750,000 *CRC for Cast Metals Manufacturing, Centre for Alloy Solidification Technology Metals Manufacturing (CAST mm) for 4 + 3 year periods as part of Commonwealth Agreement*
2004: $300,000 *Value Chain Integration – Excellence in Research, Training, Commercialisation and Early Market Entry*
2006: $62,500 Partnerships-Alliances Facilitation Program *Facilitating a CRC-Industry Alliance with Queensland's Ferrous Engineered Components Industry*
2007: $720,000 Research-Industry Partnerships Program *New Wear Resistant Alloy Products – Dr Matthew Dargusch*

Case Study: Infrastructure - Projects - Skills - Outcomes

The Institute of Health and Biomedical Innovation (IHBI)

Description

The Institute of Health and Biomedical Innovation (IHBI) is a collaborative institute based at the Queensland University of Technology's (QUT) Kelvin Grove campus. It was officially opened in October 2006 and is devoted to improving the health of individuals through research innovation. IHBI's researchers focus on three broad health areas: prevention; mind and body health; and recovery.

IHBI researchers aim to bridge the gap between science and better health by developing solutions to real world problems, advance health and biomedical innovation by developing new and innovative solutions to health issues, and make better health a reality in our lifetime by improving the health of individuals and communities.

Infrastructure Funding

The Queensland Government provided a $22.5 million loan to QUT towards the construction of the IHBI building. The State has also provided grants totalling almost $7.2 million to support various research projects, fellowships and PhD scholarships located in IHBI.

Case Study: Infrastructure - Projects - Skills - Outcomes
The Institute of Health and Biomedical Innovation (IHBI)

Results of providing the infrastructure funding

Within a span of six years, the Queensland Government's investments at IHBI have resulted in many research projects with promising outcomes for public good.

For example, IHBI is developing key products to enhance wound healing and in the process of taking these products to the market to benefit patients requiring management of tissues degraded through trauma, ageing related disease and/or associated surgery.

IHBI researchers have contributed significantly to the advancement of knowledge in the vision sciences, for example:

- Professor David Atchison's extensive basic vision science has set the ground work and informed a wide range of key research questions in vision scholarship. This includes his early research into the design of spectacle lenses, contact lenses and intraocular lenses; aberrations of the eye and their effects on visual function; myopia; and how the optics of the eye change with age.
- Professor Nathan Efron conducts research into the effectiveness of examining nerves in the eye to identify diabetic nerve damage.
- Both IHBI researchers were recognised by The American Academy of Optometry through the Glenn A. Fry Award.

A potential breakthrough test was developed in IHBI for predicting the likelihood of the spread or return of breast cancer. Helen McCosker's PhD has found that a breast cancer's interaction with its surrounding environment holds the key to predicting whether it would grow, become dormant or spread to other organs. This finding will enable doctors to select the most appropriate treatments for individual patients.

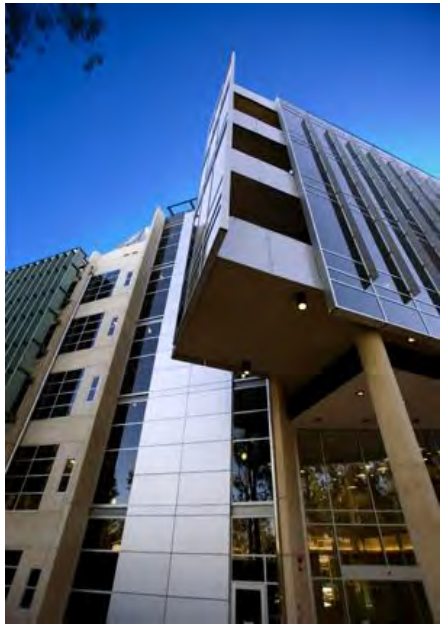
A translational project will investigate signalling pathways in the brains of addicts and consider corresponding pharmaceutical therapies that target these pathways. Professor Selena Bartlett has identified chemical pathways within the brain that are activated when those who are alcohol-dependent consume alcohol. This helped to identify medications that block the pleasurable reinforcing sensations associated with drinking.

In 2011, QUT reported that IHBI has: 900 researchers and students who make up IHBI; $28.8 million in external competitive funding received; $5,000,476 in corporate and philanthropic grants received; 33 international visitors and 32 high-profile national visitors; 611 higher degree research students from QUT Faculties; 27 new international and Australian collaborations established; and 683 peer-reviewed papers published.

Australian Institute for Bioengineering and Nanotechnology (AIBN) including the Bio-nano Development Facility (BnDF)

Description

The Australian Institute for Bioengineering and Nanotechnology (AIBN) is an integrated multi-disciplinary research institute bringing together the skills of world-class researchers in the areas of bioengineering and nanotechnology. The AIBN was officially opened in October 2006. The AIBN conducts research across 4 major programs: Nano Materials; Cell and Tissue Engineering; Systems Biotechnology; and Nano Biotechnology. The AIBN also houses the Bionano-products Development Facility (BnDF) which supports research in the development of bioproducts in Queensland.



Infrastructure Funding

The Queensland Government provided $20 million for the construction of the $75 million multi-storey AIBN building at The University of Queensland's UQ) St Lucia campus. Further funding of $6.5 million was awarded for the acquisition of plant and equipment to establish the BnDF which forms part of the AIBN. As a result of building the infrastructure, the AIBN has received additional support from the Queensland Government for research projects and science fellowships. Since 2006, 27 projects, totalling $22.5 million, have been supported through annual science funding rounds. In May 2009, the three new facilities within the AIBN were officially opened, namely the Biologics Facility, the Metabolomics Facility and the Australian National Fabrication Facility. The Queensland Government has committed $14 million to the new facilities within the AIBN, with another $11.5 million provided through the Federal Government's National Collaborative Infrastructure Strategy (NCRIS) and $4.75 million by UQ.

Results of providing the infrastructure funding

Within a span of six years since opening, the Queensland Government's investments at AIBN enabled capabilities that will deliver real benefits to Queensland and beyond. For example:

- **Needle-free vaccine delivery system** - Professor Mark Kendall is progressing the needle-free vaccine delivery system developed at AIBN, through clinical testing in conjunction with biotechnology company Vaxxas and international pharmaceutical company Merck.
- **Sustainable Aviation Fuels** - The Queensland Government awarded $300,000 to the Queensland Sustainable Aviation Fuels Initiative to progress research at the AIBN and to investigate the business case for the technology. The aim of the research is to manufacture sustainable aviation fuel components and diesel from Queensland sugarcane, supply the aviation fuel market in Australasia and help seed a strong and sustainable domestic advanced biofuel industry.
- **The establishment of the Industrial Affiliate Program** – The program assists businesses to partner with AIBN scientists and access know-how and capabilities to address technological issues industries face. This aligns with Queensland Government's commitment to partner with universities to deliver practical and applied research that meets the needs of the industries.

As at 2011, UQ reported that AIBN has:

- 450 people who make up the AIBN
- 19 research groups that working on various research projects in the areas of biological, chemical and physical science to alleviate human health and environmental issues
- 236 formal international collaborations contracted
- $4.3 million worth of contracts secured for consultancy and research activities, service agreement from over 20 companies
- 120 research higher degree students make up the AIBN Student Association
- 275 peer-reviewed papers published, many in top global journals.

Appendix 16: Smart Futures Premier's Fellowships

The Smart Futures Premier's Fellowships provide funding for fellows to lead nationally and internationally prominent research teams in Queensland. Premier's Fellows are ambassadors for Queensland's research community and the Fellowships seek to attract and retain internationally recognised research leaders in Queensland, increase the national and international profile of Queensland's research community, support cutting-edge research which will benefit Queensland, and develop networks with national and international researchers.

The six fellowships are:

- Professor Ian Frazer, Diamantina Institute, UQ (2006) Effective immunotherapy for chronic infection and cancer
- Professor Mandyam Srinivasan, Queensland Brain Institute, UQ (2007) From small brains to novel aerospace technology
- Professor Ove Hoegh-Guldberg, Global Change Institute, UQ (2008) Ensuring a sustainable future for Queensland through the science-based solutions to climate change on the Great Barrier Reef
- Professor Colleen Nelson, Institute for Health and Biomedical Innovation, QUT (2009) Development of new therapeutic approaches for prostate cancer progression – dissecting the effects of diabetes and obesity in cancer progression
- Professor Anton Middelberg, Australian Institute for Bioengineering and Nanotechnology, UQ (2010) Delivering smarter vaccines faster through nanotechnology
- Professor Matthew Brown, Diamantina Institute, UQ (2012) Advancing health through modern genetics

Under the Smart Futures Premier's Fellowships, 6 fellowships were awarded $1.25 million each, with a total of $7.5 million leveraging $9.46 million of additional funds. Grants were $1.25 million (excluding GST) over five years for distinguished research leaders to lead Queensland based research teams.

Professor Mandyam Srinivisan (The University of Queensland) - 2006

Award: Premier's Fellowship valued at $1,250,000 over five years. (Due for completion in 2013)

The fellowship draws inspiration from biology to produce novel designs for engineering applications. The flight behaviour of bees is being analysed to understand how they detect and track moving targets. In parallel, algorithms are being designed to guide robotic vehicles with a variety of applications in the areas of surveillance, security and defence.

Mid-air collision avoidance by honeybees has been investigated to characterise collision avoidance strategies. A vision system for aircraft guidance has been developed which monitors and controls roll, pitch and yaws based on a novel sky compass that emulates insect vision. The vision system is currently being integrated into an aircraft guidance system that orchestrates extreme aircraft manoeuvres autonomously.

Professor Ove Hoegh-Guldberg (The University of Queensland) - 2008

Award: Premier's Fellowship valued at $1,250,000 over five years. (Due for completion in 2014)

The fellowship will provide an increased understanding of the impact of rising sea temperatures and ocean acidification on the coral ecosystem of the Great Barrier Reef (GBR). These climate change induced events pose a significant threat to natural ecosystems, including the GBR, and human welfare. There is potential for climate change to destroy reefs throughout the world.

The fellowship addresses five key components, viz. geography, biology, eResearch tools, management and communication. A web based tool for integration into eReefs has been developed. eReefs is a collaboration between the Great Barrier Reef Foundation, CSIRO, AIMS, Bureau of Meteorology, and Queensland Government to develop an information system that will provide a picture of what is currently happening on the reef, and what will likely happen in the future.

Special mesocosms have been designed at Heron Island which allow different climate scenarios to be tested on living corals in large tanks. The first experiments have shown that the future climate conditions predicted by the Intergovernmental Panel on Climate Change (IPCC) have potentially devastating impact on coral. The findings also indicate that organisms which form skeletons are severely affected by ocean acidification, especially under warming conditions. This includes coral and red coralline algae.

Professor Paul Meredith (The University of Queensland) – 2006

Award: Mid-Career Fellowship valued at $300,000 over 3 years

Professor Meredith received funding to develop high tech materials for use in solar cells and biosensors. An anti-reflective coating for solar cells was developed that produces 3% more output power and 5% more output energy than the world's best performing solar anti-reflection coating. Improvements were also made in the area of anti-soiling coatings, as the build-up of soil on solar systems reduces output power. The project developed the world's first combined anti-reflection and anti-soiling coating.

What the researcher said: *"The fellowship was central in my remaining at the University of Queensland. Also, the ability to remain engaged with XeroCoat whilst still maintaining and growing my mainstream research program gave me the flexibility to contribute across multiple areas of interest and gain invaluable in commercialisation and technology development. When XeroCoat established in California in 2007/08 I was able to suspend the fellowship for one year and assist in the rapid development of the company without having to make a permanent move to the United States."*

Dr Ming Wei, Griffith University – 2007

Dr Jian Zhou Fellow who studied the use of an engineered bacterium from eastern grey kangaroos against lung cancer tumours

What the researcher said: *"The fellowship kept me in Queensland, as I had received an offer from the University of Technology in Sydney. I now have an outstanding publication record, good research team and excellent teaching record. My laboratory has gained an international reputation in cancer gene therapy using bacterial systems, and I have been awarded two honorary professorships with Chinese universities".*

Professor Mark Kendall, Australian Institute for Bioengineering and Nanotechnology, The University of Queensland – 2006

Fellow who developed small nanopatches for delivering drugs and vaccines and The Australian Innovation Challenge 2011 winner.

What the researcher said: *"The Fellowship helped me to return to Australia from Oxford University, and provided interim funding until I secured Australian Research Council (ARC) and National Health and Medical Research Council (NHMRC) grants. The funding enabled me to build a new research technology platform, and initiated new collaborations – most notably with Professor Ian Frazer".*

Dr Robin Beaman (James Cook University) - 2009

Award: Early-Career Fellowship valued at $150,000 over 3 years.

Dr Beaman developed a new, high resolution depth model for the Great Barrier Reef (GBR) World Heritage Area and adjacent Coral Sea utilising elevation data from satellite, aerial and ship-based platforms. A new digital model was developed called GBR100. This 100m resolution dataset covers an area of almost 3 million square kilometres from the Gulf of Papua to northern New South Wales, and is a significant improvement on previous models. New maps of the undersea landscape revealed unprecedented detail about the deep GBR and Coral Sea. For example, there are 109 mapped submarine canyons draining from the GBR shelf edge into the adjacent deep basins, with many reaching depths of 2000 metres.

What the researcher said: *"The fellowship was a huge boost to my scientific career as it provided salary, project funds and the prestige that allowed me to pursue the goals of the project. I am especially proud that I could undertake it from Cairns, with its strong marine-based tourism and fishing industries ."*

Kathy La Fauce (James Cook University) - 2006

Award: PhD top-up Scholarship valued at $22,500 over 3 years.

Kathy received funding to evaluate gene therapy as a method of stopping a debilitating virus from stunting prawns. In Australia the banana prawn (Penaeus merguiensis) is prone to a type of hepatopancreatic parvovirus (HPV). There is no current effective strategy to treat existing or prevent further HPV outbreaks.

The research developed a virus 'silencing' technique that could save the Australian prawn industry from millions of dollars in losses and the research investigated how to reduce the spread of a virus which is robbing Australian aquaculture farms of their prawns. Penaeus merguiensis densovirus (PmergDNV) is the Australian strain of hepatopancreatic parvovirus, which stunts the growth of prawns, leaving them vulnerable to other infections, and often results in death. Through RNA interference, the research has developed a gene 'silencing' mechanism that occurs naturally in plants and animals which identifies the virus genes responsible for the replication of PmergDNV within an animal.

What the researcher said: *"The PhD Scholarship provided financial assistance that not only let me stay in Townsville to continue my research at JCU but also assisted in my travels to conferences, prawn farms etc. to present my work and meet with scientists from around Australia."*

Christopher Doropoulos (The University of Queensland) - 2009

Award: PhD top-up Scholarship valued at $22,500 over three years.

The research examined the effects of ocean acidification and warming on the recruitment and success of reef building corals and reef algae, and the interaction between these groups.

The research showed that ocean acidification reduced coral (Acropora millepora) settlement and crustose coralline algal cover by more than 45%. The crustose coralline algae that are most important for inducing coral settlement were the most deleteriously affected by ocean acidification. The results suggested that ocean acidification may reduce coral population recovery by reducing coral settlement rates, disrupting larval settlement behaviour, and reducing the availability of the most desirable coralline algal species for successful coral recruitment.

What the researcher said: *"The scholarship allowed me to focus intensively on my research, and assisted me with some costs associated with my field work."*