



Queensland Government research and development expenditure report 2020–21



Key findings

Around **\$444 million** was spent by the Queensland Government (the government) on research and development (R&D) in 2020–21. This represents an increase of 16 per cent on 2019–20 where the total expenditure was around \$380 million.

R&D expenditure for 2020–21 includes **capital** and **current** expenditure:

- Capital expenditure refers to infrastructure spending such as buildings, land, and equipment
- Current expenditure refers to operational spending such as employee expenses, salaries, and other R&D related expenditure.

Approximately 94 per cent of the total expenditure, around \$416 million, was related to current expenditure.

Out of the \$444 million that was spent on R&D, leveraged funds from external sources made up approximately \$202 million or 45 per cent of the reported expenditure. By comparison, in 2019–20 leveraged funds made up approximately \$154 million or 41 per cent of the reported expenditure.

The department reporting the highest R&D expenditure was Queensland Health totalling \$152 million equivalent to 34 per cent of the total R&D expenditure for the year followed by the Department of Agriculture and Fisheries at \$101 million.

Queensland Health and the Department of Agriculture and Fisheries were also the two highest spending departments in 2019–20 at \$125 million and \$95 million respectively, or 32 per cent and 25 per cent of the total R&D expenditure for the year, and in 2018–19 at \$113 million and \$92 million respectively, or 31 per cent and 25 per cent of the total R&D expenditure for the year.

Report overview

The Queensland Government R&D expenditure report is published annually. This report provides information on:

- government's longitudinal R&D expenditure displaying research trends over time
- the research fields with the highest R&D expenditure as well as their alignment with the government's socio-economic priorities
- the collaborations between the government and partner organisations
- the benefits of R&D to Queenslanders.

R&D is one of the major driving forces behind economic growth, as shown by the existence of a positive correlation between a country's R&D intensity and gross domestic product (GDP) per capita. R&D directly influences the strength and competitiveness of industry by providing a basis for technological change and thereby encouraging economic development.

Investment in R&D not only monetises benefits to the economy but addresses various societal challenges faced in today's world, such as climate change, waste minimisation, food security, etc., resulting in improvements in the quality of our lives.

Defining research and development

For the purpose of this report, and in line with the guidelines provided by the Organisation for Economic Cooperation and Development (OECD), the definition of R&D used by the government is:

‘... creative and systematic work undertaken in order to increase the stock of knowledge—including knowledge of humankind, culture and society—and to devise new applications of available knowledge’

(Frascati Manual, 2015)

To fall under this definition, and therefore being eligible as R&D, an activity must be:

- novel
- creative
- uncertain
- systematic
- transferable and/or reproducible.

Some examples of R&D activities include (and are not limited to):

- laboratory research aimed at discovery of new knowledge
- searching for applications of new research findings or other knowledge
- conceptual formulation and design of possible product or process alternatives
- evaluation of product or process alternatives
- modification of the formulation or design of a product or process
- design, construction, and testing of preproduction prototypes and models
- design and development of tools used to facilitate R&D or components of a product or process undergoing R&D activities.

R&D excludes:

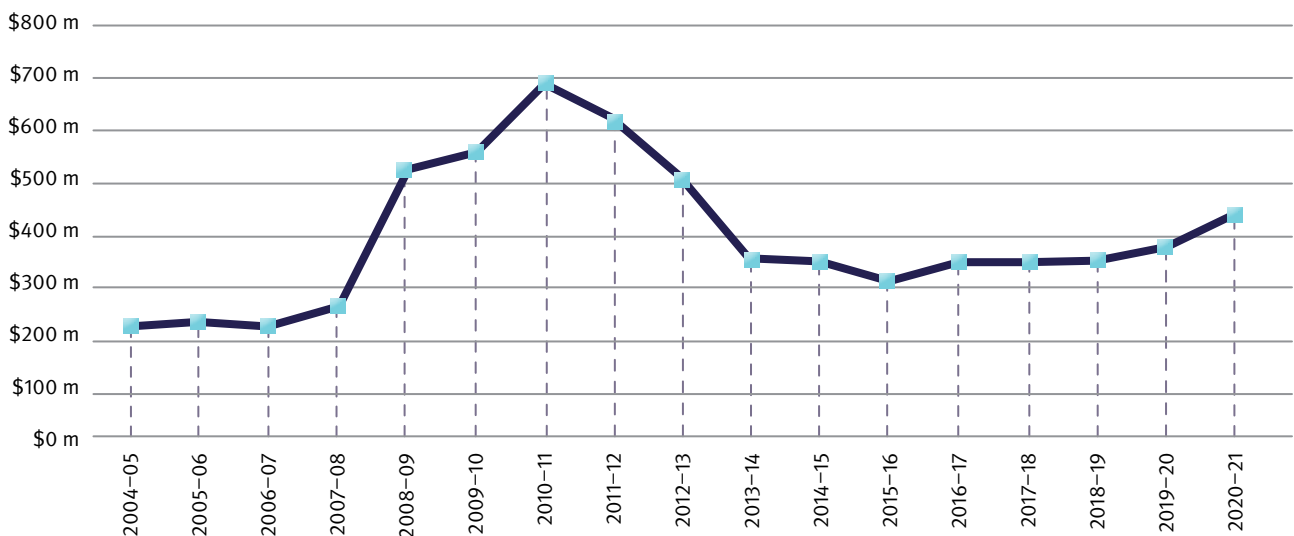
- market surveys
- extension or commercialisation of R&D
- routine computer programming and maintenance
- general purpose data collection using standard techniques without a research question
- policy-related studies using existing methodologies
- any other related activities that do not consist of elements of novelty or understanding causal relationship.

Expenditure over time

In 2020–21, Queensland Government agencies reported spending \$444 million on R&D, which represents a 16 per cent increase from the previous year's expenditure of \$380 million.

The graph below shows the R&D expenditure by Queensland Government over the last 17 years. The large spike that began in 2008–09, peaked in 2010–11 (yearly expenditure of \$701 million) and finished in 2013–14 was due to significant investment in four major research infrastructure projects. Institutions such as the QIMR Berghofer Medical Research Institute, and the Translational Research Institute are two examples of this capital investment.

Following said spike, R&D expenditure stabilised around \$350 million. From 2015–16 onwards, R&D expenditure has been on a consistently increasing trend.



Capital and current expenditure over time

In 2020–21, out of the \$444 million spent on R&D by the Queensland Government, capital expenditure accounted for \$28 million while current expenditure accounted for \$416 million of the total budget.

Capital expenditure refers to infrastructure spending such as buildings, land, and equipment, while current expenditure refers to operational spending such as employee expenses, salaries, and other R&D related expenditure.

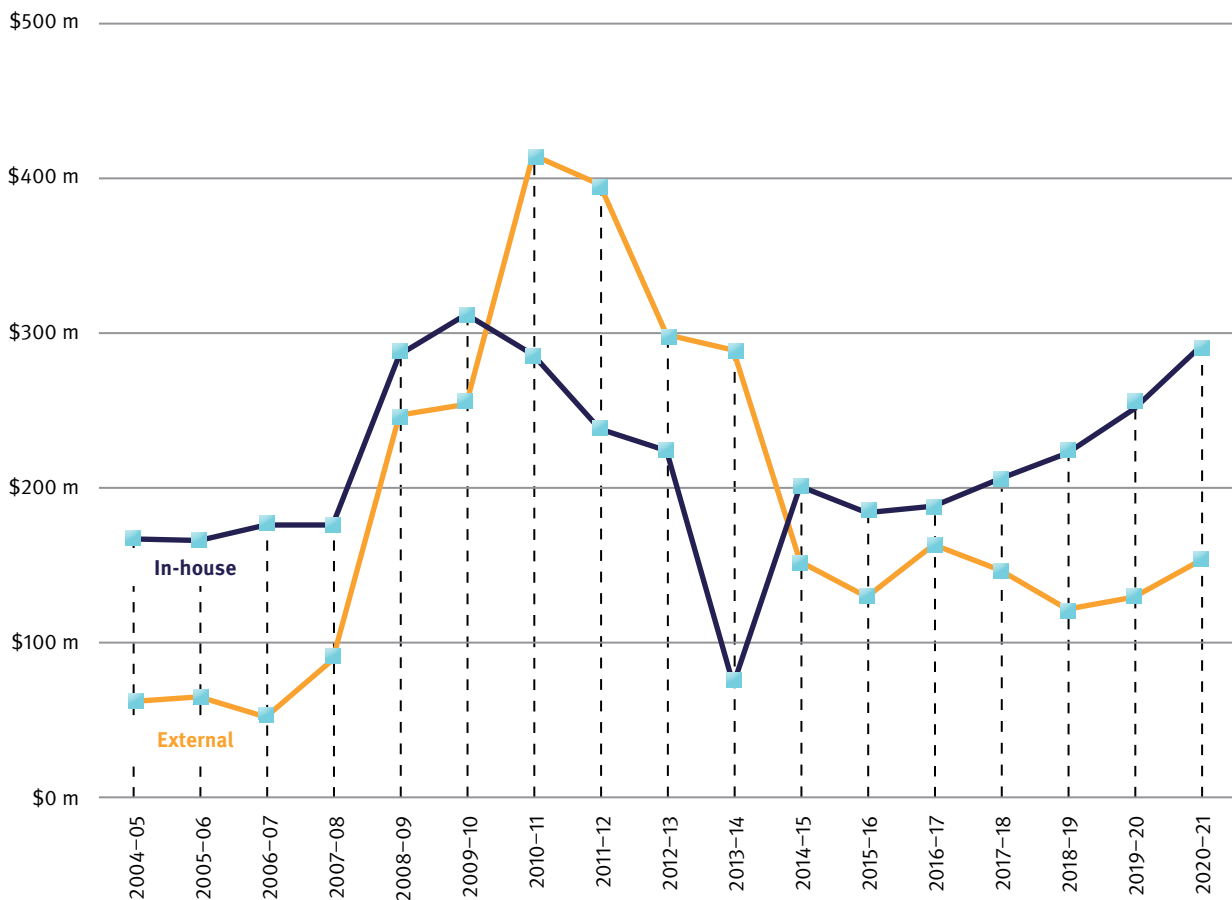
2009–10 was the first year where capital and current expenditure were reported separately. Prior to this, they had always been reported as a combined total amount.



Research location over time

The graph below reports the location where the R&D funding was spent as either in-house or external. In-house refers to R&D being conducted at Queensland Government sites. R&D activity occurring at non-Queensland Government facilities is categorised as external.

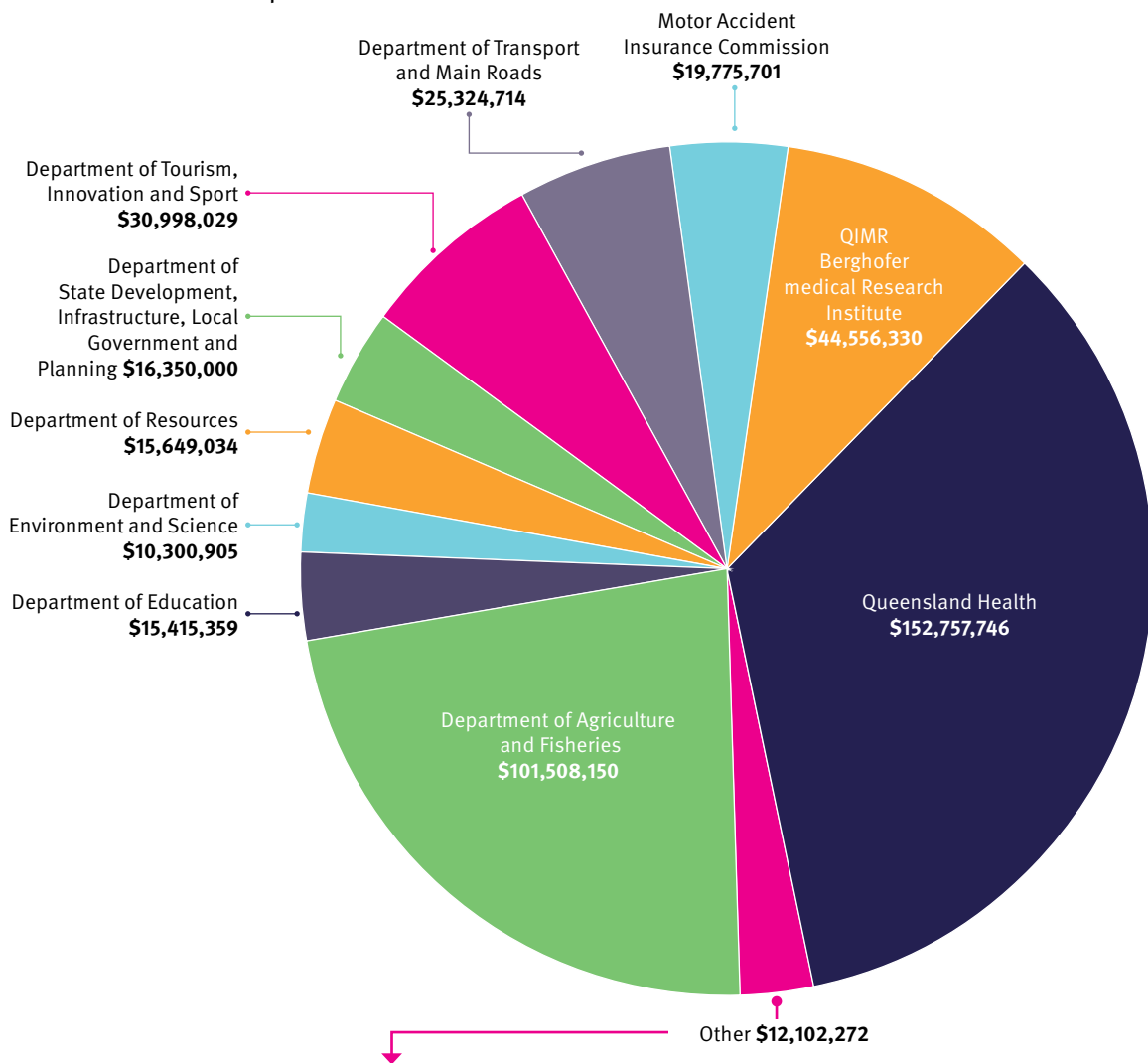
From 2004 to 2010, R&D carried out in Queensland Government facilities exceeded R&D at external sites. From 2010 to 2014, in line with the increase in capital expenditure, the trend shifted to having the larger portion of R&D expenditure being more at external sites. From 2014 onwards, the trend reverts to higher expenditure on in-house R&D activities.



Total expenditure by agency in 2020–21

Queensland Government agencies reported spending a total of \$444 million on R&D in 2020–21. The three agencies with the highest expenditure were:

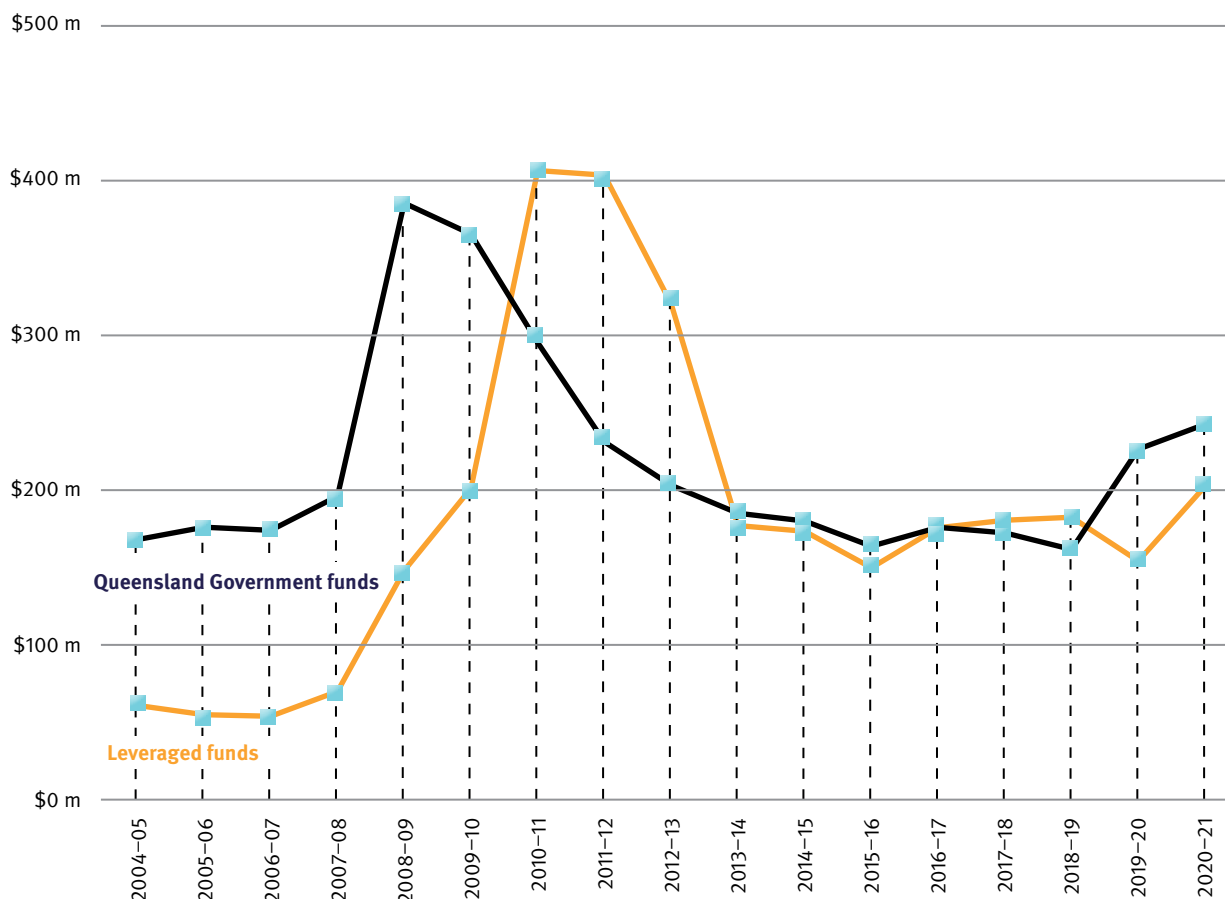
- Queensland Health—\$152 million accounting for 34 per cent of total R&D expenditure
- Department of Agriculture and Fisheries—\$101 million accounting for 23 per cent of total R&D expenditure
- QIMR Berghofer Medical Research Institute—\$44 million accounting for 10 per cent of total R&D expenditure



Queensland Museum	\$6,389,208
Queensland Competition Authority	\$2,113,676
Department of Children, Youth Justice and Multicultural Affairs	\$1,082,303
Department of Regional Development, Manufacturing and Water	\$814,772
Queensland Fire and Emergency Services	\$505,000
Queensland Corrective Services	\$450,468
Department of Communities, Housing and Digital Economy	\$387,538
Department of Energy and Public Works	\$100,000
Inspector-General Emergency Management	\$95,097
Resource Safety and Health Queensland	\$65,406
Queensland Police Service	\$53,860
Department of Justice and Attorney-General	\$44,945

Queensland Government funds and leveraged funds by year

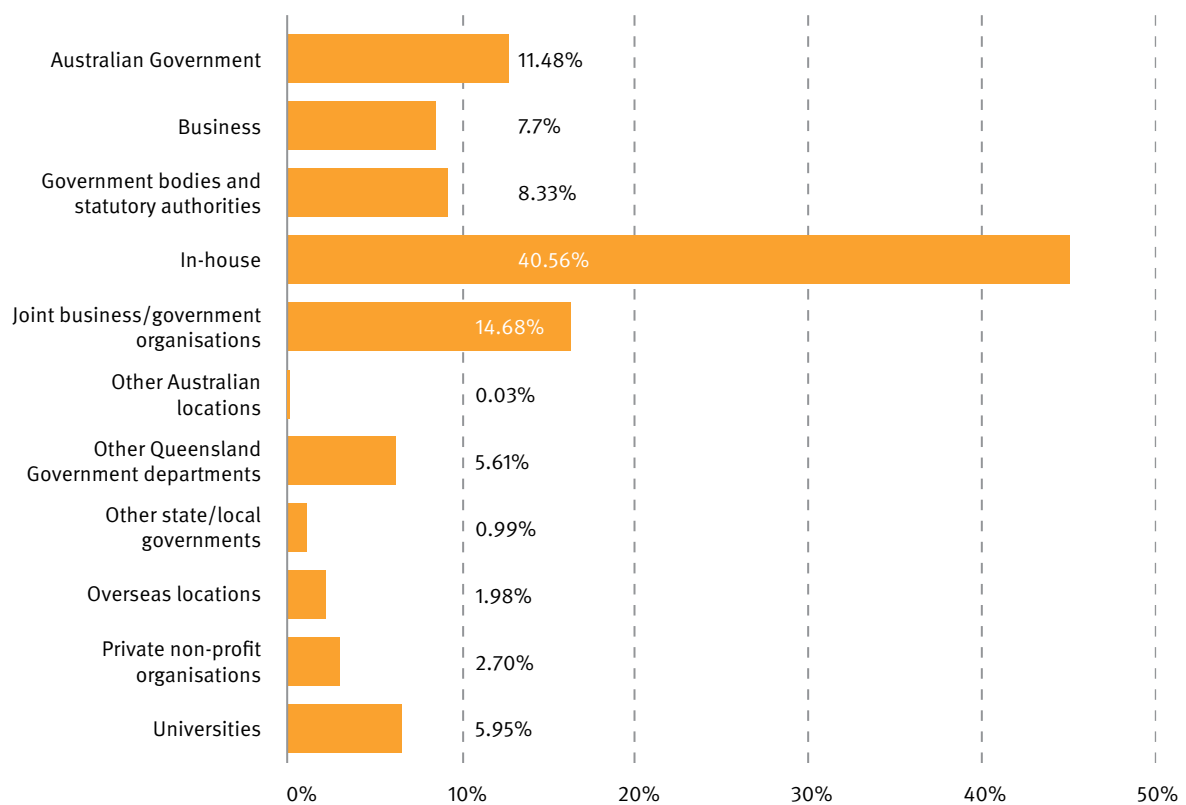
Queensland Government funds are those spent directly from the state budget allocation. Leveraged funds refer to cash contributions from external organisations towards R&D projects funded or performed by the Queensland Government. The trend reported below shows that leveraged funds have often been slightly lower than Queensland Government investment. A significant exception to this trend occurred from 2009–10 to 2012–13, where leveraged funds were used for the construction of research infrastructure.



Source of funds in 2020–21

In 2020–21, out of the \$444 million that was spent on R&D, Queensland Government leveraged \$202 million (45 per cent) from external sources. Comparatively, in 2019–20 this figure accounted for \$154 million or 41 per cent of the yearly R&D expenditure.

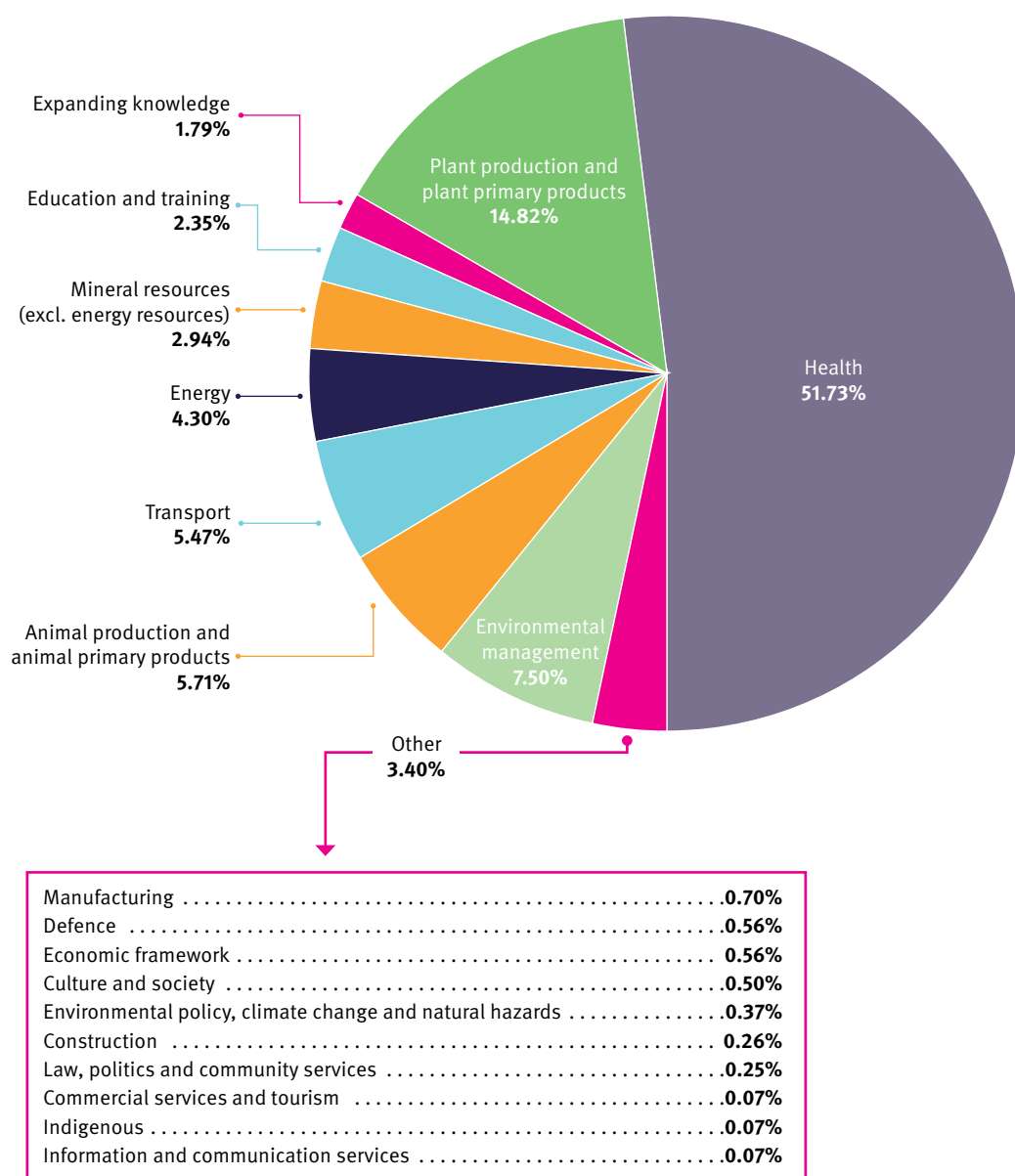
Queensland Government’s funds include in-house, government bodies and statutory authorities, and other Queensland Government departments. External sources include funding from the Australian Government, universities, private non-profit organisations, overseas locations, other state/local government, other Australian locations, joint business/government organisations, and businesses.



Socio-economic objectives

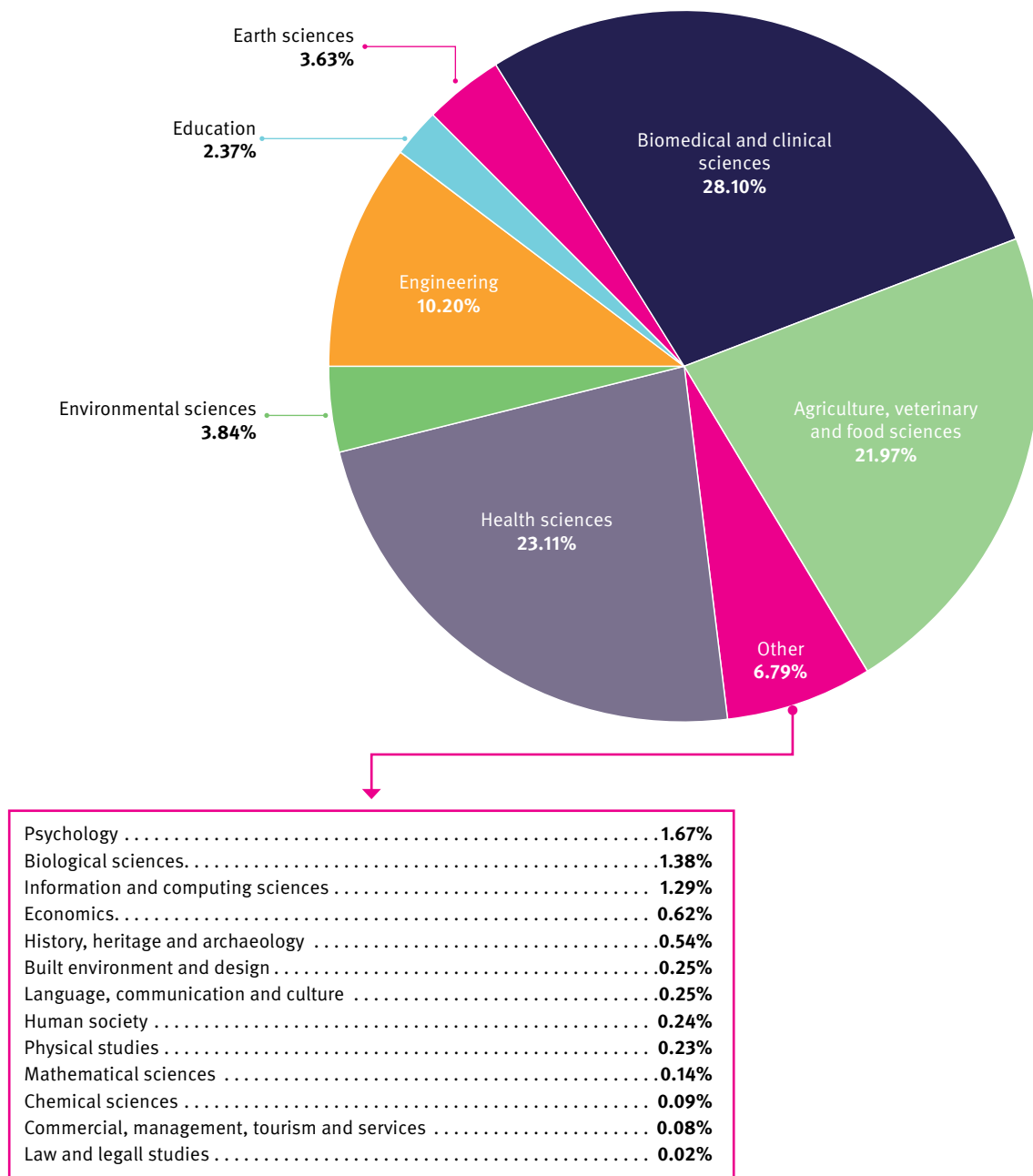
Agencies classify R&D investment according to the Australian Bureau of Statistics' socio-economic objectives. The objectives relate to the impact of the research and are standardised fields. The distribution of expenditure reflects the socio-economic focus of the government policy priorities at the time.

In 2020–21 the greatest reported expenditure was allocated to health objectives. This accounted for 52 per cent (\$230 million) of the R&D expenditure for the year and was mainly due to research around SARS-CoV-19. The second largest expenditure at 15 per cent (\$65 million) was for research on plant production and plant primary products followed by environmental management accounting for 7.5 per cent (\$33 million). This is in line with what happened in 2019–20 where health accounted for 53 per cent (\$203 million) of the overall R&D expenditure, followed by plant production and plant primary products at 18 per cent (\$71 million) and environment at 6 per cent (\$25 million).



Field of research

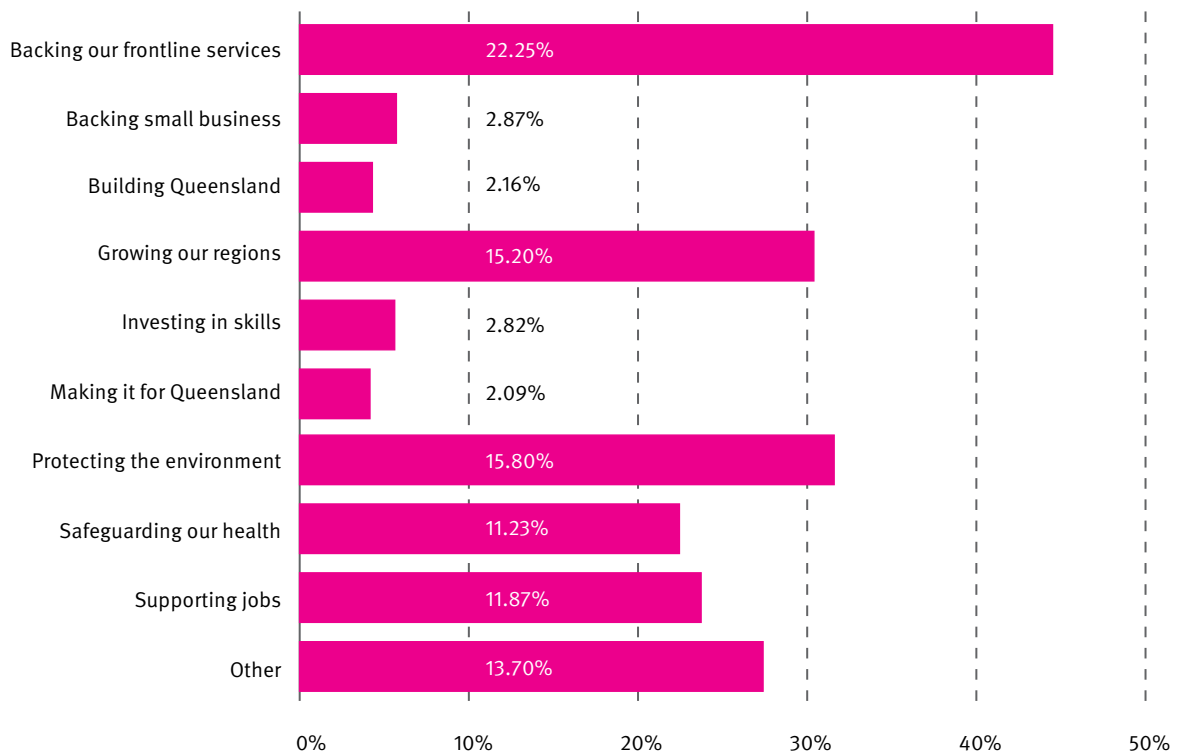
Similar to socio-economic objectives, fields of research are also defined by the Australia Bureau of Statistics. This categorisation of R&D activities is done following the methodology used—not the activity nor the purpose. In 2020–21 the top three reported fields of research were: Biomedical and Clinical Sciences accounting for 28 per cent (\$125 million), followed by Health Sciences accounting for 23 per cent (\$102 million) and Agricultural, Veterinary and Food Sciences accounting for 22 per cent (\$97 million). This shows that 73 per cent of the total expenditure is concentrated in three of the 23 fields of research. This mirrors the highest spending agencies, namely Queensland Health, the Department of Agriculture and Fisheries, and QIMR Berghofer Medical Research Institute. This trend is in line with what was reported in 2019–20 where Medical and Health Sciences account for 52 per cent (\$200 million) of the overall expenditure, followed by Agricultural and Veterinary Sciences at 21 per cent (\$23 million).



State priorities

The chart below reports the weighted percentage of the state priorities for 2020–21. The highest percentage was found for ‘Backing our frontline services’ accounting for 22%, followed by ‘Protecting the environment’ at 15 per cent, and ‘Safeguarding our health’ at 11 per cent. The chart reports a more balanced distribution compared to 2019–20, where ‘Keep Queensland healthy’ accounted for 51 per cent of the total state priorities.

‘Other’ stands for projects that did not align with state priorities and in 2020–21 accounted for 13 per cent of the overall projects. This represents a significant decrease from 2019–20 where ‘Other’ accounted for 31 per cent of the overall projects.



Highlights of R&D delivering for Queenslanders

Stimulating regional tourism through virtual reconstruction of Queensland's WWII heritage



© Department of Tourism, Innovation and Sport

Dr Brent Moyle, Griffith University received a \$300,000 Advance Queensland Research Fellowship for the 'Stimulating regional tourism through virtual reconstruction of Queensland's WWII heritage' project.

A secret WWII base uncovered on the edge of Charleville was primarily a maintenance base during the WWII Battle of the Coral Sea, housing more than 3000 American soldiers. The site uncovered an aircraft hangar, revetments, a building to house the Top-Secret Norden bombsight, living quarters for soldiers and nurses, kitchens and ablution blocks.

Dr Moyle used 3D scanners and augmented and virtual reality to reconstruct the regional heritage, resulting in a truly unique tourism experience.

Highlights of R&D delivering for Queenslanders

Cooperative Research Centre for Living with Autism Spectrum Disorders



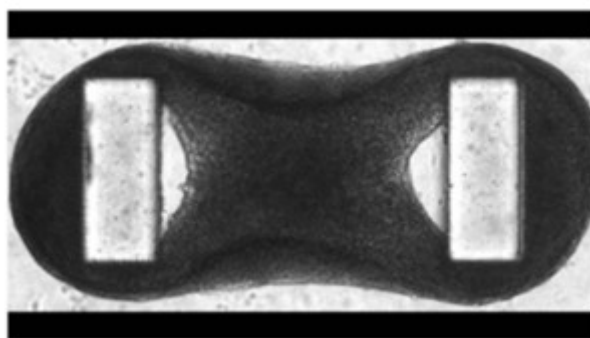
© Department of Education

The Autism Cooperative Research Centre (CRC) is the world's first national, cooperative research effort focused on autism. Research covers a whole-of-life view, from diagnosis and the early years through school years and into adult life. In July 2013, the Department of Education committed to be an Essential Participant of the Autism CRC, the only education department in Australia to be an Essential Partner.

Guided by the department, one of the priority areas of the Autism CRC has been to research the provision of appropriate educational environments and programs for students with autism. The translation of the Australian education needs analysis through inclusionED has supported the capability building of teachers to improve outcomes for students with autism, alongside the resources of the department's Autism Hub and regional Principal Advisors, Autism.

Highlights of R&D delivering for Queenslanders

Research identifies cause and potential treatment for COVID-19 induced heart damage



© QIMR Berghofer Medical Research Institute

QIMR Berghofer researchers have discovered some of the ways COVID-19 damages the heart, and identified a class of drugs that could potentially protect or reverse this cardiac injury. In severe cases of COVID-19, the immune system overreacts to the infection, releasing inflammatory molecules called cytokines into the bloodstream. This so-called 'cytokine storm' can damage multiple organs, including the heart. Canadian company Resverlogix has used the QIMR Berghofer research findings as the basis for expanding its clinical trial of the drug, apabetalone, in COVID-19 patients. Apabetalone belongs to a new class of drugs that has been in clinical trials for cardiovascular disease for more than five years. It has received breakthrough therapy designation from the US regulator, the Food and Drug Administration. Resverlogix initially planned to study apabetalone to improve clinical status in SARS-CoV-2 infected patients, but will now also examine if it can treat heart damage.

The head of QIMR Berghofer's Cardiac Bioengineering Research Group, Associate Professor James Hudson, said his team used thousands of lab-grown, miniature human heart organoids to understand how COVID-19 causes cardiac damage. Associate Professor James Hudson says by understanding the biological basis of heart damage will help identify drugs with a much higher chance of success.

Researchers have exposed the bioengineered, stem-cell-derived heart tissue to COVID-19 patient blood and found it caused dysfunction even when the virus didn't infect the tissue. The experiments revealed which inflammatory factors are potentially causing the cardiac problems. These factors activate bromodomain protein 4 in the heart, which was the key driver of cytokine storm damage. Associate Professor Hudson then used mini heart organoids to screen several existing drugs that inhibit this protein and found they could prevent and reverse the damage. One of the drugs was apabetalone, which was effective at blocking the inflammatory response. It is already in phase III clinical trials for treating cardiovascular disease and could be available sooner to treat COVID-19 patients.

Highlights of R&D delivering for Queenslanders

Commonwealth Health Department funding for the National Mental Health Service Planning Framework tool



© Queensland Health

Queensland Centre for Mental Health Research is funded by the Commonwealth Department of Health to develop and support implementation of the National Mental Health Service Planning Framework (NMHSPF). The NMHSPF is an evidence-based tool supporting service planning across Australia by estimating population need for mental health services, the types and quantities of care required for different groups, and associated resource targets.

In 2020–21, the team led by Dr Sandra Diminic completed research to update NMHSPF modelling and documentation; developed training for planners in health departments, hospital and Primary Health Networks; and provided expert advice to NMHSPF users and the Commonwealth.

Highlights of R&D delivering for Queenslanders

Transforming mango futures



© Department of Agriculture and Fisheries

Research led by the Department of Agriculture and Fisheries (DAF) has shown that transforming mango orchards to high-density plantings produces higher yields and improves long-term profitability, with benefits for cyclone resilience, spray efficiency, automation and robotics. This was the result of a project funded by the Cooperative Research Centre for Developing Northern Australia, which examined the potential of high-density mango orchards to improve profitability based on the success of high-density plantings in other tree crops. Increasing industry profitability through higher yields and lower input costs is a key priority for the Australian mango industry.

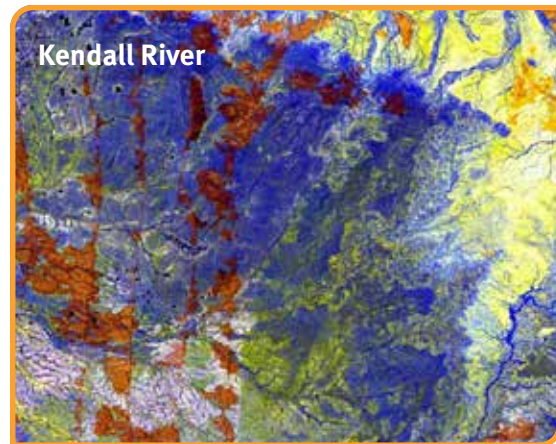
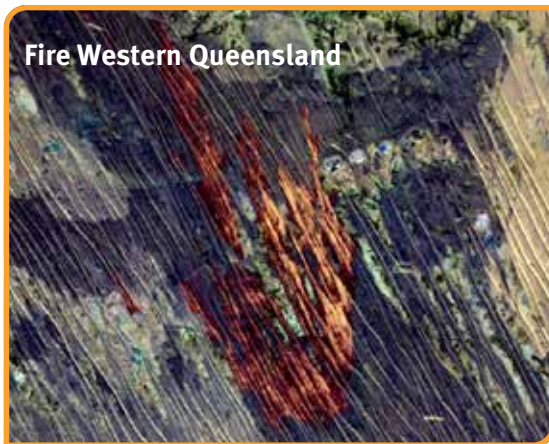
For the three-year project, DAF partnered with Manbulloo Ltd, Marto's Mangoes and the Australian Mango Industry Association to establish and assess trials of high-density plantings across three sites in Queensland and the Northern Territory. The trial design was based on knowledge gained from the DAF mango planting systems trial established at the Walkamin Research Facility in 2013. The trees in high-density mango orchards are shorter and thinner and the width between rows is reduced. Trees are managed as slim hedges or on trellises which improves canopy support and light interception, and maximises canopy leaf area to produce more fruit. Sprayers and harvesters work more efficiently along rows with short and narrow canopies, leading to reduced pesticide use and increased opportunities for the application of ag-technologies like robotic harvesting.

An economic case study released from the project in May 2021 compared farm level investments in conventional low, medium and high-density orchard systems and a trellis high-density orchard system for mango production. The study found that, at their peak, the new high-density and trellised orchards could: produce up to 66 tonnes per hectare/ per year—over 3.5 times more than existing low-density plantings, improve on-farm efficiency of mango growing, spraying and picking costs, reduce annual fruit production costs (per kg/fruit) by approximately 20%, and improve long-term grower and industry profitability.

While the adoption of high-density slim hedge and trellised planting requires a higher level of investment during establishment and over the first 10 years than conventional lower density planting systems, this is rapidly recouped by the higher revenues achieved by increased yield per hectare. Results from this research will help growers select the right orchard management design for their business when establishing new mango plantings.

Highlights of R&D delivering for Queenslanders

Fire scar mapping



© Department of Environment and Science

Scientists have developed an improved way of using satellite imagery to map where fires have occurred across Queensland. The new fire scar maps detail the extent and changes in burnt areas in a way that can be easily used by land managers and emergency management agencies.

Queensland's diverse landscapes, vegetation and soil types, combined with the effects of cloud, smoke and other landscape dynamics make it challenging to accurately map burnt areas using satellite imagery. To address this issue, scientists from the Department of Environment and Science and the Joint Remote Sensing Research Program at the University of Queensland have collaborated to develop a new way of mapping fire scars.

The new methodology uses the European Space Agency's high frequency Sentinel-2 satellite imagery combined with machine learning and specialised mapping technology to produce detailed maps of areas impacted by fire every month for the entire state. This method builds on previous work which mapped Queensland's fire history using Landsat satellite imagery.

Thank you

The Office of the Queensland Chief Scientist has been working with Queensland Government departments and organisations since 2004 to identify and report R&D that is carried out or funded by the Queensland Government.

The data is used to monitor R&D investment and record the partnerships and research priorities across agencies.

Thank you to all the staff—internal and external to government—for assisting the Office of the Queensland Chief Scientist with gathering and validating the extensive data. Collection and finalisation of robust data is an intense process that requires a high level of accuracy.

Past reports are published on the Office of the Queensland Chief Scientist website, and detailed data from all the reports is available on the Queensland Government open data portal.

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