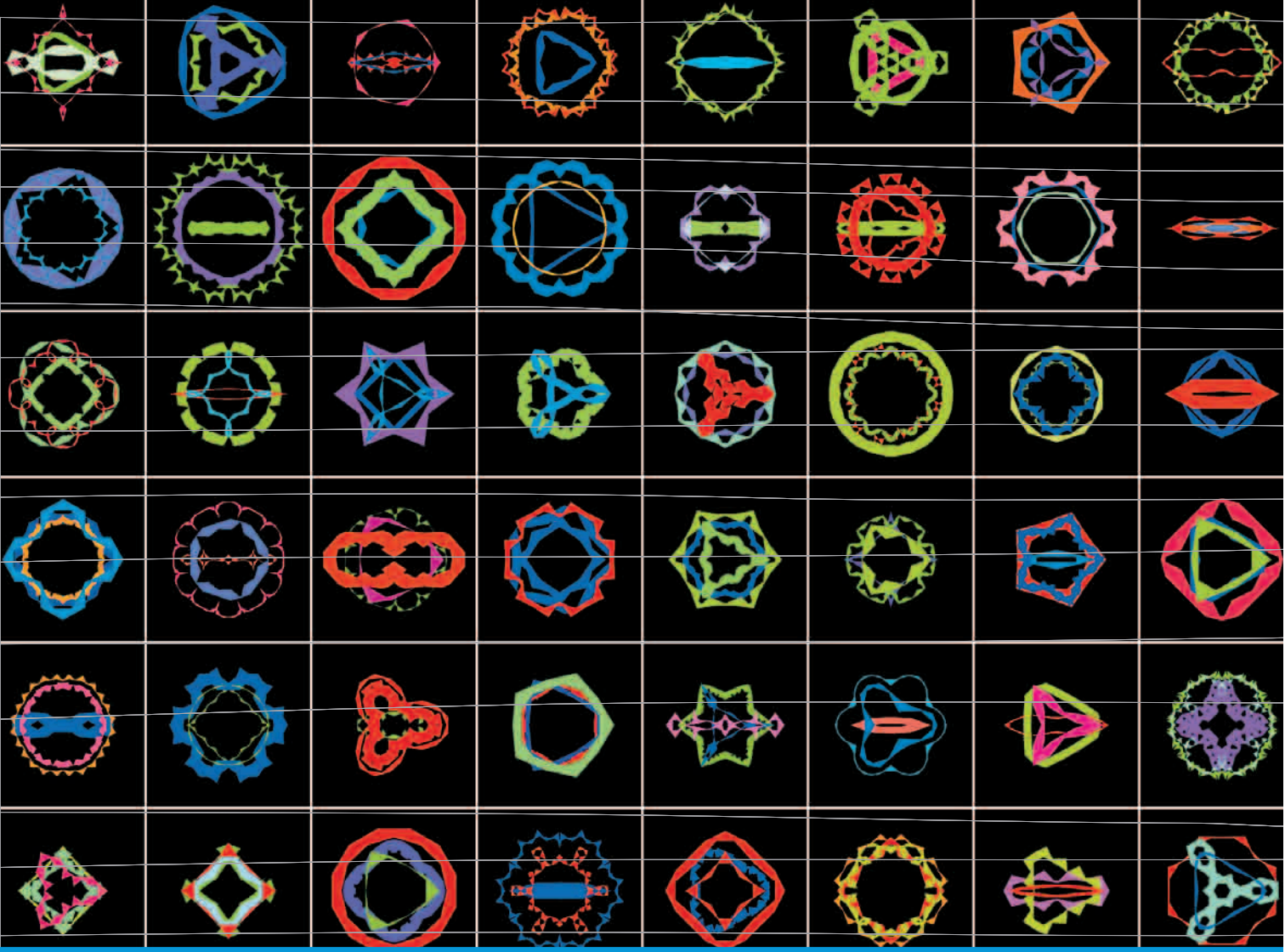

Queensland research and development investment strategy 2010–2020

Tomorrow's Queensland:
strong, green, smart, healthy and fair

Toward Q2 Tomorrow's Queensland

Queensland Government

Cover photo by A/Prof. Guy Wallis (Principal Research Fellow appointed jointly between the Queensland Brain Institute and School of Human Movement Studies at the University of Queensland), supplied courtesy of the Queensland Brain Institute, The University of Queensland. The image is used in the study of processes involved in visual short-term memory. A/Prof. Guy Wallis and his team are studying processes involved in visual short-term memory by monitoring electrical activity in the brain, searching for periods of synchrony and drive across those regions associated with vision and those associated with short-term memory. The images are fractals generated by an algorithm designed to produce spurious and random similarities between the stimuli, eliminating the types of systematic relations that can confound studies using real-world stimuli.

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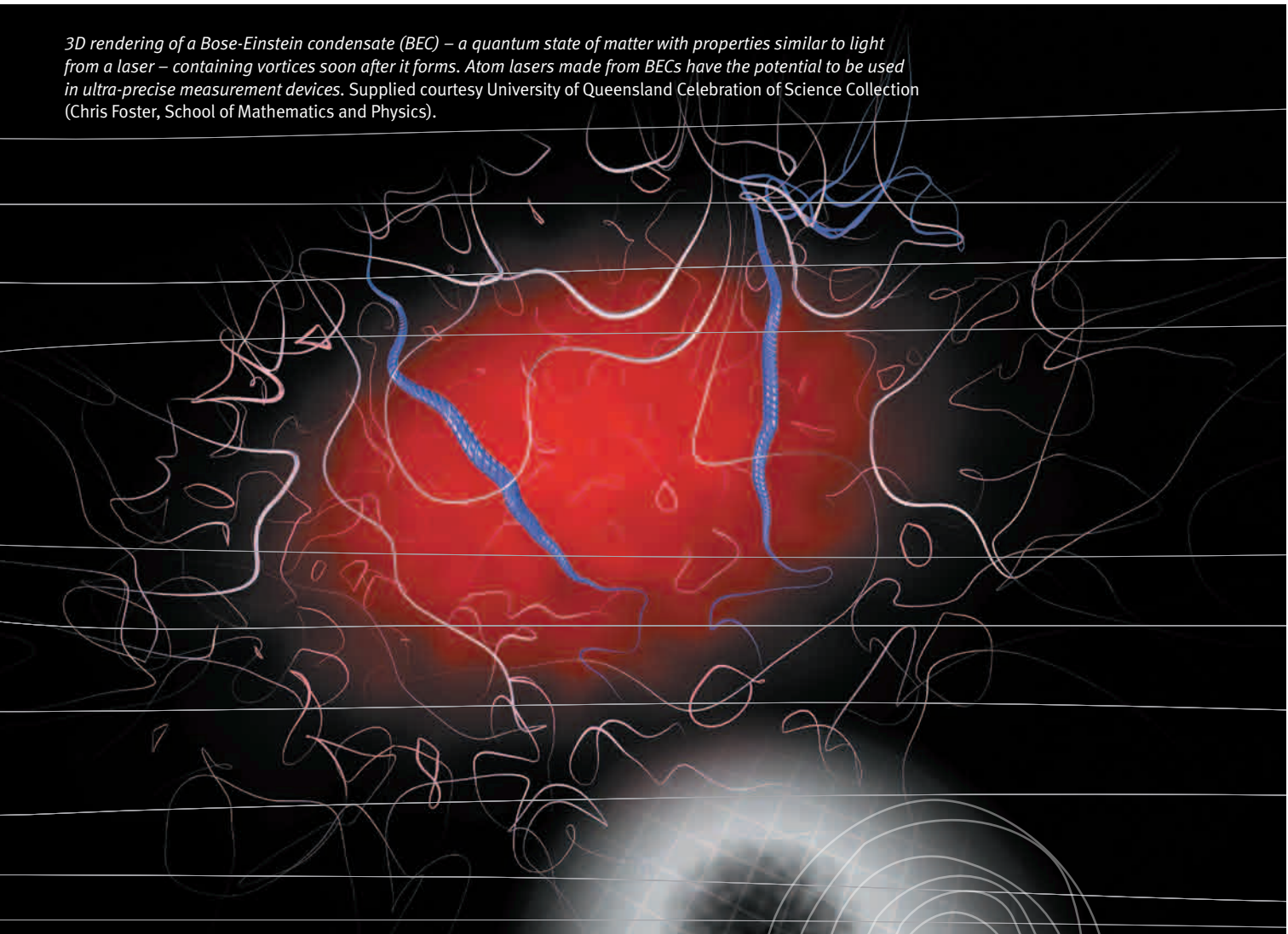
3D rendering of a Bose-Einstein condensate (BEC) – a quantum state of matter with properties similar to light from a laser – containing vortices soon after it forms. Atom lasers made from BECs have the potential to be used in ultra-precise measurement devices. Supplied courtesy University of Queensland Celebration of Science Collection (Chris Foster, School of Mathematics and Physics).



Foreword

Queensland has seen over 36 new research facilities and the number of researchers more than double over the course of the past decade.

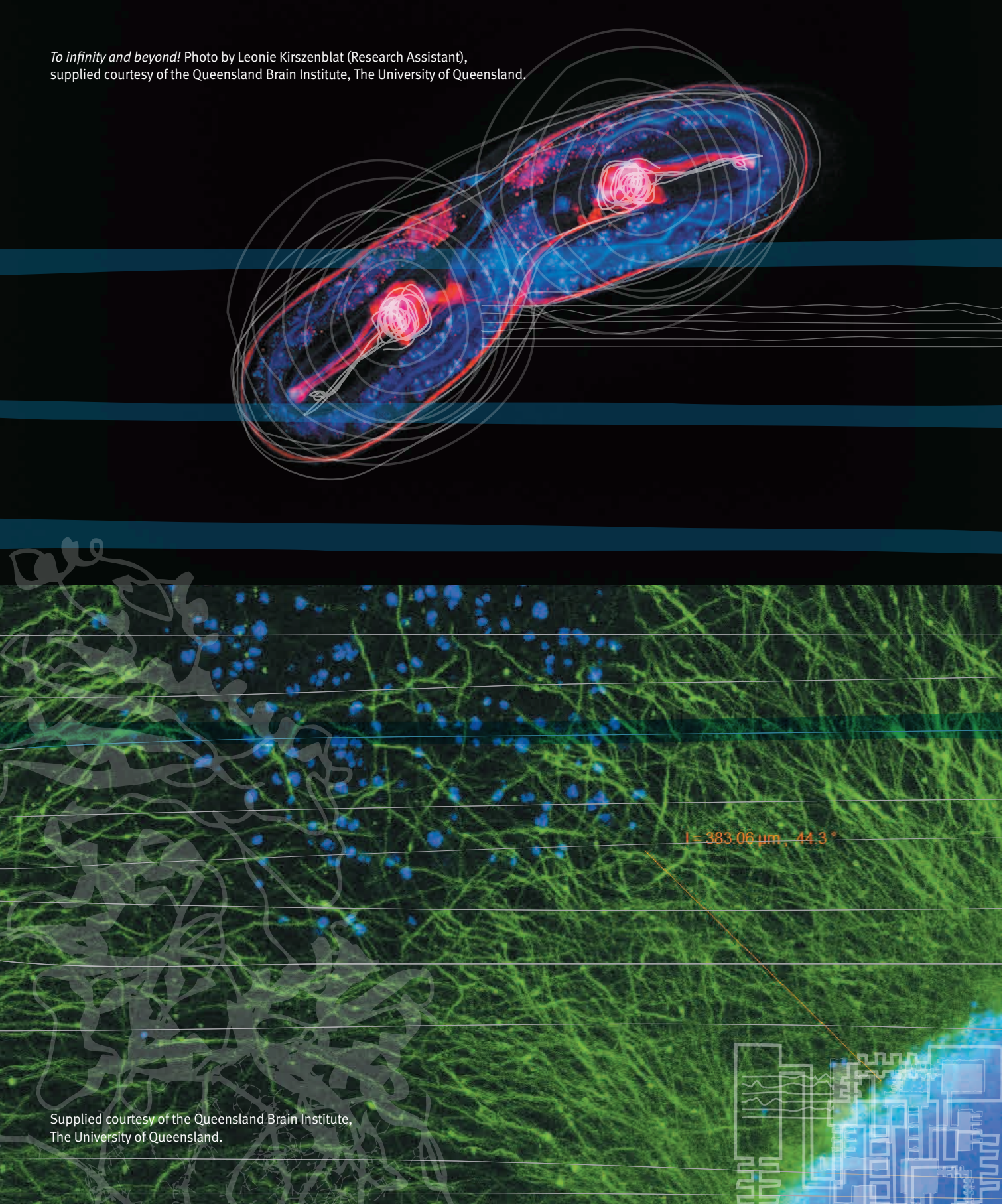
Underpinning that growth has been a Queensland Government investment of around $3.6 billion, aimed at the delivery of long-term economic, social and environmental outcomes for the people of Queensland.

This strategy details the research and development objectives behind that investment. It provides a clear framework to align research and development activities with the government's Toward Q2 targets for a strong, green, smart, healthy and fair Queensland in 2020.

As you will see in the strategies described here, the Queensland Government is committed to working with partners nationally and internationally to achieve our common goals.

I hope that this strategy will inspire your interest and I look forward to working with you.

Anna Bligh MP
Premier of Queensland



To infinity and beyond! Photo by Leonie Kirszenblat (Research Assistant), supplied courtesy of the Queensland Brain Institute, The University of Queensland.

Supplied courtesy of the Queensland Brain Institute, The University of Queensland.

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Research and development + science + innovation = economic, social and environmental outcomes

Supplied courtesy Australian Institute for Bioengineering and Nanotechnology.

Research and development comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge and the use of this knowledge to devise new applications. The basic criterion for distinguishing research and development from related activities is the presence of an appreciable element of novelty and the resolution of scientific and/or technological uncertainty.[1]

While focussed on research and development, this strategy also covers the complex interplay and interdependence between research and development and science and innovation. All three activities are vital to a sustainable and smarter future for Queensland.

1 *Frascati Manual 2002: Proposed Standard Practice for Surveys on Research and Experimental Development,* OECD, Paris, 2002

Surfers Paradise, Gold Coast.
Supplied courtesy Tourism Queensland,
Gold Coast Tourism Corporation Ltd .

Introduction

A recent report from the Australian Davos Connection, *Australia Report 2010: Risks and Opportunities*, uses methodologies developed by the World Economic Forum to evaluate the economic, political, environmental, societal and technological risks facing Australia.

The report identifies four stand-out risks that combine high probability with extreme severity. Three of these – extreme storm activity, heatwaves and water shortages – are largely beyond our control. The fourth – inadequate research, development and design – is entirely up to us. To quote the report:

Inadequate research, development and design is a standout risk, viewed as high in severity and almost certain to occur. The interconnectedness of this risk makes this finding particularly concerning since many of the challenges facing Australia – whether climate change, the ageing population or water scarcity – could be mitigated through innovations in technology, processes and human capital.[2]

The Queensland Government places similar weight on the importance of research and development. Since 1998, the government has invested more than $3.6 billion in research, development and innovation. Over the same period, the number of employed scientists in Queensland has more than doubled from 8500 to 18,100.[3]

Snapshot of Queensland research and development

- **Queensland is growing.**

  The current population of 4.4 million is expected to double by 2056. Two-thirds of those in the 25 to 34 age bracket have tertiary qualifications.

- **Public sector research and development is strong.**

  Investment in higher education research and development (HERD) consistently exceeds the OECD average. Queensland scientists publish more scientific articles per million of population than the OECD average, and citation rates also exceed the global average.

- **Overall research and development intensity remains low.**

  Business expenditure on research and development (BERD), although increasing, is lower than the OECD average, as is the number of patents filed per million of population.

- **Connections between public sector research and industry are increasing.**

  The number of university start-up companies formed per $100 million investment in research and development is triple the national average.

- **The state government is a significant investor in research and development.**

  Between 5 and 10 per cent of Queensland's overall research and development expenditure comes from the state government's investments in either internal research activities or external research contracts and collaborative grants. These state government research and development investments are directed towards specific economic, social and environmental outcomes consistent with the government's overall priorities.

2 *Australia Report 2010, Risks and Opportunities,* The Australian Davos Connection, in collaboration with KPMG, Melbourne, 2009, http://www.ausdavos.org/

3 Labour Force, Australia, Detailed, Quarterly, May 2009, Cat. No. 6291.0.55.003, Australian Bureau of Statistics, Canberra, 2009

Research and development in tomorrow's Queensland

The Queensland Government has developed a long term plan, *Toward Q2: Tomorrow's Queensland*,[4] which addresses some of the most pressing issues of our time, including climate change, the explosion in preventable diseases, increasing global competition and childhood disadvantage.

The plan is built around five ambitions – to make Queensland strong, green, smart, healthy and fair – and sets clear targets for the economy, environment, education, health and community to be achieved by 2020.

Achieving these ambitions and targets will demand the shared commitment of individuals and communities, businesses and industries, and all levels of government. In particular, the involvement of Queensland's researchers and scientists will be vital.

Strong: creating a diverse economy powered by bright ideas

An economy that will be Australia's strongest, with increased levels of innovation and research and development within business, and with infrastructure that supports growth.

Queensland's investment in research and development will support this ambition by:

- stimulating **industry development**, increasing collaborations between business and research, and increasing business adoption of science and innovation
- developing **enabling technologies**, such as clean technologies, information and communication technologies, biotechnology and nanotechnology which underpin the development and efficiency of existing industry sectors as well as creating new knowledge-intensive industries
- bolstering Queensland's key industry sectors, including **agriculture, mining** and **energy** to compete internationally and abate risks associated with peak oil, energy security and food supply
- building on our unique capabilities in **tropical** science to tap into emerging markets and meet the distinct environmental and community needs of those living in the tropics, both in Queensland and globally.

4 http://www.thepremier.qld.gov.au/tomorrow/introduction.aspx

Green: protecting our lifestyle and environment

The state aims to cut Queenslanders' carbon footprint and protect more land for nature conservation and public recreation.

Queensland's investment in research and development will support this ambition by:

- developing knowledge and strategies to conserve Queensland's unique **ecosystems and biodiversity**
- increasing the level of understanding of **climate science** and its uncertainties and developing adaptive strategies and technologies
- creating and deploying **renewable and low emission energy technologies**
- providing the knowledge, tools and technologies to address pressures on **land and water supplies**.

Smart: delivering world-class education and training

The state aims to provide all children with access to a quality education, commencing in early childhood, and to increase the numbers of Queenslanders who hold trade, training or tertiary qualifications by 50 per cent.

Queensland research and development will assist in delivering a world-class education and training by:

- identifying and developing teaching and workforce resources required for a **world-class education and training system**
- creating systems and technologies to deliver **tailored education and training** to all Queensland students.

Healthy: making Queenslanders Australia's healthiest people

The state aims to cut obesity, smoking, heavy drinking and unsafe sun exposure while having the shortest public hospital waiting times in Australia.

Queensland's investment in research and development will support this ambition by:

- developing systems and technologies for improved **health service delivery**
- developing technologies for the **prevention, early detection and personalised treatment of disease**.

Fair: supporting safe and caring communities

The state aims to address entrenched pockets of disadvantage by reducing the number of Queensland children living in households without a working parent, and increasing Queenslanders' involvement in the community through volunteering.

Queensland's investment in research and development will support this ambition by:

- building an understanding of the **causes and consequences of disadvantage** and social exclusion, and identifying integrated service delivery models that will help to address social needs
- understanding and managing Queensland's vulnerability to **crime, biosecurity threats and disasters**.

Supplied courtesy Australian Institute for Bioengineering and Nanotechnology.

Queensland research and development investment strategy 2010–2020

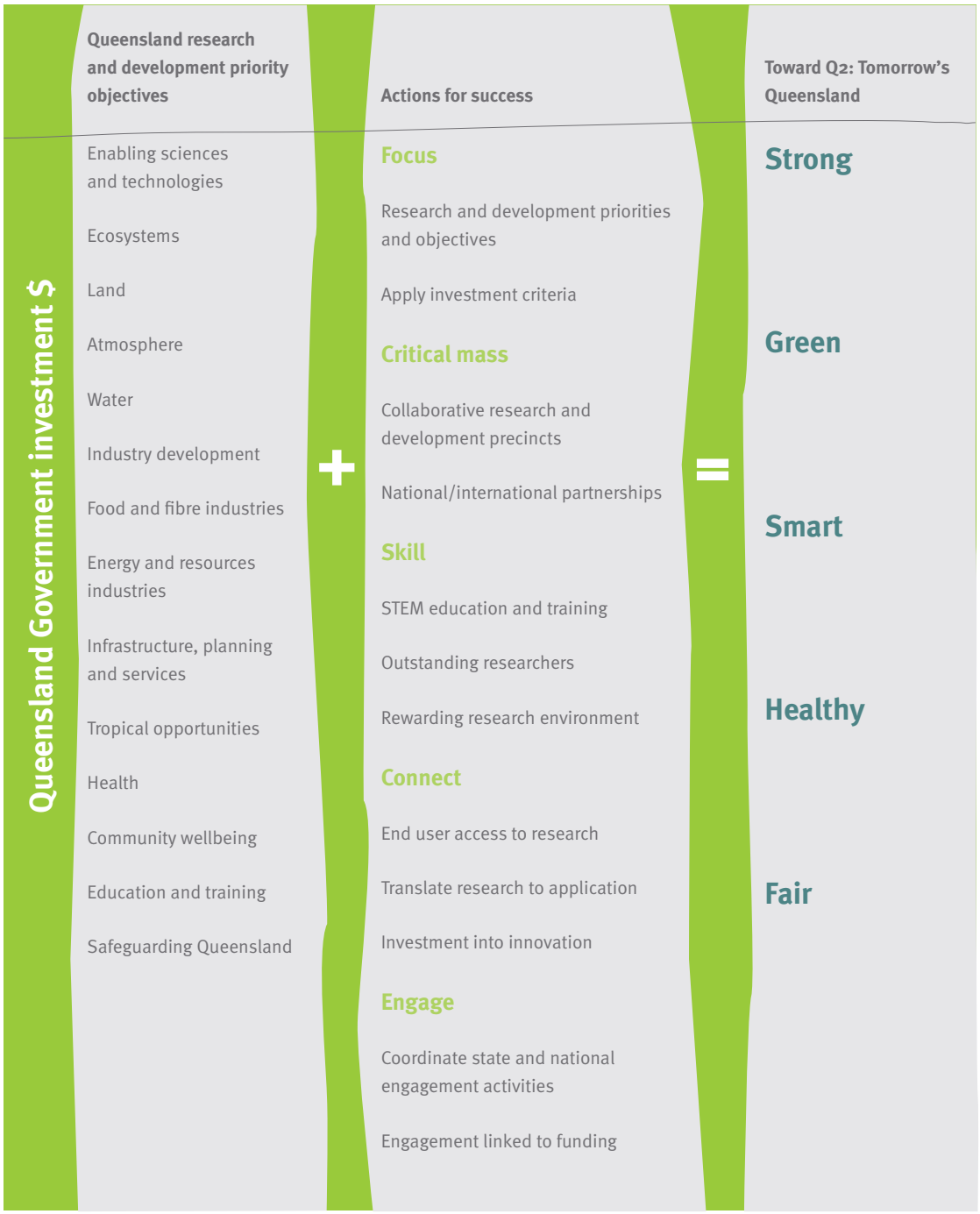
The purpose of this strategy is to ensure that Queensland's investment in research and development contributes to a strong, green, smart, healthy and fair Queensland. It provides a platform to increase coordination and integration of state government research and development investments, and introduces national and international stakeholders to Queensland's strengths and competitiveness in research.

To this end, it identifies five important areas for action and coordination across government:

1. **Focus** on needs and strengths
2. **Build** critical mass
3. **Skill** the workforce
4. **Connect** researchers, end users and investors
5. **Engage** the community.

It also profiles 14 research and development objectives within six research and development priority areas that form the basis for the Queensland Government's present and future research and development activities.

Queensland research and development investment strategy 2010–2020



Reef HQ Aquarium, Townsville

Action one: focus on needs and strengths

How

- **define research and development priorities and objectives**
- **apply clear investment criteria**

1.1 Define research and development priorities and objectives

Since 2004 the state government's investment in research and development has been allocated across six priorities[5]:

- Environmentally sustainable Queensland
- Health and wellbeing
- Smart industries
- Enabling sciences and technologies
- Tropical opportunities
- Safeguarding Queensland.

Within these priorities, 14 objectives have been identified that address major social, environmental and economic issues and are the subject of multi-disciplinary and cross-departmental research and development programs. The priorities and objectives are listed in Figure 1 and a detailed profile of research and development being undertaken within each of the objectives is provided in Appendix 1.

5 http://www.chiefscientist.qld.gov.au/about-priorities.aspx

Figure 1: Queensland research and development priorities and objectives

Research and development priority	Research and development objective To provide the knowledge, tools and technologies required to…
Enabling sciences and technologies	**Enabling sciences and technologies** …support development of capabilities in the enabling sciences and technologies
Environmentally sustainable Queensland	**Ecosystems** …protect and restore Queensland's diverse ecosystems
	Land …sustain and restore Queensland's land and soil
	Atmosphere …mitigate air pollution and adapt to climate change
	Water …ensure a sustainable balance between water demand and supply
Smart industries	**Industry development** …build Queensland's knowledge-intensive industries
	Food and fibre industries …enhance productivity and create new value-adding products and services in Queensland's food and fibre industries
	Energy and resources industries …support safe, sustainable and competitive energy and resources industries
	Infrastructure, planning and services …plan for and deliver cost-effective, efficient infrastructure and services
Tropical opportunities	**Tropical opportunities** …create globally competitive tropical expertise industries
Health and wellbeing	**Health** …prevent disease and deliver top quality patient care at sustainable cost
	Community wellbeing …identify and address the causes of disadvantage and better integrate the delivery of community services
	Education and training …underpin quality education and training for all Queenslanders
Safeguarding Queensland	**Safeguarding Queensland** …manage and prevent crime, biosecurity threats and natural and non-natural disasters

1.2 Apply clear investment criteria

To ensure the greatest probability of return on the Queensland Government's investment in research and development, Queensland Government funding is conditional upon satisfying the following investment criteria[6]:

- **Alignment with the Queensland research and development priorities and objectives**
  Clear delineation of economic, social and environmental outcomes that benefit Queenslanders.
- **Ability to deliver outcomes**
  Necessary technical and management expertise, competitive strength and access to infrastructure and capital to successfully deliver outcomes.

  Technical – available world-class researchers with the talent, energy, ideas and creative vision to provide research and development solutions.

  Management – management team/s with expertise in project management, entrepreneurship, marketing and finance.

  Competitive strength – market scanning and intelligence to identify viable opportunities in the local, national and/or global market.

  Infrastructure – access to adequate facilities and equipment to undertake the research and development.
- **Capacity to strengthen Queensland's research and development base**
  Encouraging collaboration and co-investment, building competitive strength and advancing the understanding of the value of research and development.

  Collaboration – effective cooperation, linkages, alliances and partnerships between agencies, industry and institutions across disciplinary and jurisdictional boundaries.

  Co-investment – leverage of co-investment from local, national and international sources including public, industry and philanthropic funding to build on the government's investment in research and development.

  Competitive strength – development of new knowledge and associated technology transfer to give Queensland a competitive and sustainable advantage nationally and/or internationally.

  Communication – dissemination of outcomes to a wider audience outside the research and industry communities to improve public understanding of the benefits and value of the government's investment in research and development.

6 The Queensland Government research and development investment criteria are available at http://www.chiefscientist.qld.gov.au/investment-criteria.aspx

Action two: build critical mass

How

- **invest in collaborative research and development precincts**
- **facilitate partnerships and networks**

With a population of just over four million, Queensland needs its researchers to collaborate broadly in order to access and diffuse the outputs of research and development internally and trade them globally.

Furthermore, because of their scale and complexity, many of the challenges facing Queensland (climate change, skyrocketing health bills, food security, disadvantage levels, ageing populations) cannot be solved by the research and development capacity of a single country or region. National and international partnerships and networks are therefore vital.

Queensland Bioscience Precinct
supplied courtesy of CSIRO Livestock Industries.

2.1 Invest in collaborative research and development precincts

The Queensland Government will continue to invest in research infrastructure which co-locates complementary research groups, industry, education organisations and associated activities to build a critical mass of talented researchers, scientists, innovators, entrepreneurs and investors. Examples include the Queensland Biosciences Precinct at the University of Queensland, the Tropical Science Precinct at James Cook University, the Da Vinci Precinct at the Brisbane Airport, and the new Ecosciences and Health Food Sciences Precincts in Brisbane.

The Ecosciences Precinct is a partnering arrangement between Queensland and Commonwealth Governments' research organisations, co-locating over 1000 research staff in state-of-the-art facilities. The precinct will house scientists from the Department of Employment, Economic Development and Innovation, Department of Environment and Resource Management and the Commonwealth Scientific and Industrial Research Organisation (CSIRO), as well as visiting national and international researchers. It will be dedicated to solving major environmental concerns such as climate change, water supply and security.

Queensland will also build on these infrastructure investments by linking them with local businesses and communities, thereby leveraging further the outcomes from individual investments. Brisbane's 'knowledge corridor',[7] which is a spine of research precincts, tertiary education campuses, hospitals and cultural/creative facilities running through inner Brisbane, is a tangible expression of this smart communities approach.[8]

2.2 Facilitate partnerships and networks

The Queensland Government will continue to form national and international research collaborations and scientific networks to connect our researchers with knowledge being produced elsewhere in Australia and overseas.

National research networks such as the Terrestrial Ecosystem Research Network (TERN), enable Queensland researchers to collaborate with their Australian and international colleagues, in this case in terrestrial ecosystems science and management, to generate, share and apply research and development on a wider basis.

Co-investment by Queensland with other international governments and institutions means that Queensland researchers will continue to benefit from collaborations with the best researchers around the world. Examples include existing government to government relationships in the USA as well as in Canada, Europe, China, India and Japan.

The Queensland-Washington State Memorandum of Understanding (MOU) provides a good example of the benefits of international alliances. Almost $10.5 million has been invested by Queensland in collaborative projects with Washington State and the Bill and Melinda Gates Foundation has invested over $30 million in Queensland research institutes for projects in population health, dengue fever and banana biofortification. The MOU has also enhanced science skilling collaborations and enabled relationships with businesses such as Boeing and Microsoft to be strengthened.

7 *Smart Cities: Rethinking the City Centre*, Smart State Council, Brisbane, 2007, http://www.smartstate.qld.gov.au/partnerships/ss_councilreports.shtm#a7
8 http://www.science.qld.gov.au/dsdweb/v4/apps/web/content.cfm?id=11004

Action three: skill the workforce

How

- **deliver quality STEM education and training**
- **attract outstanding researchers**
- **provide a rewarding research environment**

In the 21st century, knowledge and innovation will be seen not only as the drivers of economic growth, but also as the providers of solutions to our most pressing social and environmental challenges. The global competition for the most talented researchers and technologists is becoming more intense.

3.1 Deliver quality STEM education and training

Although the demand for science, technology, engineering and mathematics (STEM) professionals in Australia is growing at twice the rate of the workforce as a whole, the absolute numbers of Queensland students pursuing year 12 studies in advanced mathematics, physics, chemistry and biology are in decline.

The Queensland Government is committed to reversing this trend through investments in STEM teacher training, curriculum and resource support, and linking STEM teaching and learning directly to real world applications in industry, higher education and the broader community.

Aviation High is a leader in education and training for the aerospace industry. It provides secondary students with unique opportunities to access education, training and industry experience in an array of aerospace careers. It is an initiative involving the Queensland Government, Boeing Australia and other industry partners which is developing the skills required for a globally competitive knowledge-intensive industry.

3.2 Attract outstanding researchers

Major investments in research infrastructure have resulted in a doubling of the number of talented researchers in Queensland over the course of the past decade. But more will be needed as the role of research and development in a region's global competitiveness ramps up.

The Queensland Government will continue to invest in programs aimed at attracting and retaining researchers at all career stages – from experienced and distinguished research leaders of national and international prominence to mid-career researchers and scholarship programs for outstanding Australian Postgraduate Award scholarship holders.

Queensland Senior Clinical Research Fellowships are the most generous health and medical research fellowships in Australia. They aim to attract and retain leading clinician researchers who will lead an invigorated health research workforce, build influential collaborations and attract funding. The results will include better health outcomes for Queenslanders and growth in the state's health and medical industry sector.

Outstanding researchers require the support of top quality technologists and technicians. Queensland's vocational education and training (VET) sector will play a vital role in working with industry and the research sector to provide the technologists that will support Queensland's move into a more knowledge-intensive and high technology-based economy and society.

3.3 Provide a rewarding research environment

The Queensland Government seeks to provide a stimulating research environment for government researchers through joint appointments, visiting research fellowships, postgraduate training, and national and international conference attendance. It is also moving to new models of integrating the Queensland Government in-house research capacity with external research providers, through the establishment of joint research programs based on contracts and grants, and the co-location of research facilities.

The University of Queensland (UQ) is establishing a new Institute called the Queensland Alliance for Agriculture and Food Innovation (QAAFI). QAAFI is a joint initiative of UQ and the Department of Employment, Economic Development and Innovation (DEEDI), and initially will integrate the research capacities of approximately 80 world class scientists from the UQ and DEEDI to deliver more powerful research outcomes and technologies to support Queensland's food and agribusiness sector.

Action four: connect researchers, end users and investors

How

- **facilitate end user access to research**
- **translate research to application**
- **attract investment into innovation**

Queensland, like Australia as a whole, has a strong public sector research base, as measured by its output of scientific articles and the number of citations per science publication. Technology transfer indicators are less encouraging, with patent levels being 50 per cent of the OECD average, and business investment in research and development, although increasing, remaining low by OECD standards.

Closer connections between researchers, industries and investors are essential.

4.1 Facilitate end user access to research

The Queensland Government will continue to invest in processes and organisations which strengthen research interactions with end users. Initiatives such as the Australian Institute of Commercialisation,[9] research and development forums and technology clinics are providing links to researchers and research solutions, and organisations that physically integrate public sector research with industry.

The Queensland Centre for Advanced Technologies (QCAT) is a collaboration between CSIRO, the Queensland Government, Cooperative Research Centres and industry and forms Australia's largest integrated research and development precinct for mineral resources and associated advanced technology industries. QCAT is generating products and processes of high value for Australia's mineral, energy resources, and manufacturing industries, especially those located in Queensland.[10]

The Queensland Government itself also generates knowledge by conducting and funding research and development. To facilitate the dissemination and application of this knowledge, the Queensland Government Public Sector Intellectual Property Guidelines and associated online training modules[11] provide guidance to Queensland Government agencies on intellectual property management and commercialisation.

9 http://www.ausicom.com/
10 www.cat.csiro.au
11 http://www.industry.qld.gov.au/dsdweb/v4/apps/web/content.cfm?id=6775

4.2 Translate research to application

Managing the commercialisation process and achieving the adoption and uptake of research outputs can pose challenges for researchers and end users alike. Consequently, the Queensland Government will continue to invest in programs which support the uptake of research and development by businesses through education and extension activities. It will also assist in developing the entrepreneurial skills of researchers and innovators through programs such as the Commercialisation Fellowships,[12] Queensland Wide Innovation Network,[13] and by investing in research infrastructure which co-locates research facilities with those required to undertake further development.

The Queensland Translational Research Institute will have the capacity to undertake the discovery, clinical testing and manufacture of new biopharmaceuticals under one roof. The Institute will be opened by the end of 2011 and will house approximately 600 researchers.

4.3 Attract investment into innovation

Access to finance for research and development, proof of concept and commercialisation is a significant issue for research institutions, start up companies, small business, entrepreneurs and established companies in converting research into outcomes.

The Queensland Government will continue to seek means to help Queensland firms access early stage investment capital through mechanisms such as its Proof of Concept Fund,[14] and to attract national and international companies to invest in research and development in Queensland.

In November 2009, DuPont and BSES Limited announced a research, development and commercialisation alliance to improve productivity and use of sugarcane varieties. DuPont, one of the world leaders in plant biotechnology expertise is investing in BSES because of its global leadership in development of sugarcane varieties and associated technology, and the global importance of sugarcane as a food and bio-industrial crop.

12 http://www.industry.qld.gov.au/dsdweb/v4/apps/web/content.cfm?id=10387
13 http://www.science.qld.gov.au/dsdweb/v4/apps/web/content.cfm?id=13654
14 http://www.industry.qld.gov.au/dsdweb/v4/apps/web/content.cfm?id=10388

Science on Saturday program. Supplied courtesy of the CSIRO and the Department of Employment, Economic Development and Innovation.

Action five: engage the community

How

- **coordinate state and national engagement activities**
- **incorporate research engagement activities into research and development investments**

A scientifically engaged community will enable Queensland to capitalise on technological opportunities to address the environmental and social challenges of the future, whether they be climate change, genetically modified foods or new materials.

A community that can critically understand and evaluate the role of science and research and development in almost every aspect of our lives will help raise the number of children studying and graduating in science, increase business uptake and diffusion of new ideas and technologies, and better inform our decision makers.

5.1 Coordinate state and national engagement activities

A recent Queensland Government scan identified 63 organisations, including government departments, industry and research and academic institutions, responsible for 164 science and technology community engagement activities.[15] To extract the maximum value from this current level of investment and effort, a more cohesive and strategic approach is required at both the national and Queensland state levels.

Queensland is a partner in the development of the National Science Communication Strategy to connect otherwise uncoordinated, overlapping or fragmented activities into a national public engagement framework.

At the state level, the Queensland Government has established the Queensland Science Communicators Working Group to achieve better collaboration across research and science community engagement activities. The group provides an opportunity to better coordinate Queensland's state and regional engagement activities which feed into the national framework.

The Queensland Government has the opportunity to expand this model to coordinate research and science communication activities, currently being undertaken in isolation through different departments. Government researchers have a role to play in this, by engaging with the community about the outcomes from their research and its impact on Queensland's economy, society and environment.

5.2 Incorporate research engagement activities into research and development investments

As a major investor in research and development in Queensland, the state government has the ability to use that investment to raise public awareness of, and engage it actively in better understanding, the role of science and research and development in economic growth and social and environmental wellbeing. Therefore, any research and development investment by the Queensland Government requires the incorporation of a communication or engagement activity as part of the funding agreement or allocation.

The Queensland Brain Institute (QBI) coordinates the Australian Brain Bee Challenge (ABBC), the Australasian arm of an international competition that inspires Year 10 school students to pursue careers in neuroscience research. The annual ABBC gives students access to world-class research and scientists and laboratories, which is particularly important for regional students who would not normally receive such an opportunity.

15 *Audit and Analysis of Science and Technology Community Engagement Activities 2009*, Department of Employment, Economic Development and Innovation internal working paper

Supplied courtesy Australian Institute for Bioengineering and Nanotechnology.

R&D Queensland committee

This strategy has been developed by R&D Queensland, a whole-of-government committee which provides strategic oversight to better integrate and coordinate the Queensland Government's investment in research and development across agencies and with its strategic priorities.

R&D Queensland will be responsible for the strategy's implementation across the Queensland Government, and will report annually on progress through the Queensland Chief Scientist's annual report on the state of science in Queensland.

The strategy will be reviewed regularly.

The *Queensland research and development investment strategy* is the outcome of a collaboration between staff representing both research and development Queensland member departments and others with an interest in particular areas of research and development:

Chair, R&D Queensland

- Queensland Chief Scientist (Professor Peter Andrews)

R&D Queensland member departments:

- Department of Employment Economic Development and Innovation
- Department of Health
- Department of Environment and Resource Management
- Department of Education and Training
- Department of Communities
- Department of Transport and Main Roads

Other supporting departments:

- Queensland Police
- Department of Infrastructure and Planning
- Department of Justice and Attorney General
- Department of Community Safety
- Department of Public Works

Secretariat:

- Office of the Queensland Chief Scientist

Appendix 1: Queensland research and development objectives and profiles

Research and development objective To provide the knowledge, tools and technologies required to....	**Understand** (Research and development to describe the system and better understand the interactions between its components)	**Optimise** (Research and development that will ensure the best outcome from the existing system)	**Transform** (Research and development that will change the nature of the system)
Enabling sciences and technologies ...support development of capabilities in the enabling sciences and technologies	...opportunities in the enabling sciences and technologies	...the contribution of the enabling sciences and technologies to society	...enabling sciences into new enabling technologies
Ecosystems ...protect and restore Queensland's diverse ecosystems	...the health of our diverse ecosystems, and the way in which they function	...the management of our ecosystems and their associated industries	...the interface between people and ecosystems
Land ...sustain and restore Queensland's land and soil	...the causes and consequences of changes in land condition and productivity	...land and soil management	...our land and soil resources through restoration and enhanced productivity of Queensland's arable land
Atmosphere ...mitigate air pollution and adapt to climate change	...air pollution and climate change at local and regional levels	...resilience of regions, industries and ecosystems to climate change	...the atmospheric environment through mitigation of air pollution and greenhouse gas emissions
Water ...ensure a sustainable balance between water demand and supply	...the relationships between water supply, demand, quality and use	...the efficiency of water use	...water supply and recycling patterns to provide for a population of eight million by 2050
Industry development ...build Queensland's knowledge-intensive industries	...the opportunities for accelerated industry growth	...the research and development intensity of industry sectors	...Queensland into a more knowledge-intensive diversified economy
Food and fibre industries ...enhance productivity and create new value-adding products and services in Queensland's food and fibre industries	...the interplay of environmental and economic factors affecting food and fibre industries at the global and regional levels	...food and fibre productivity, sustainability and profitability	...food and fibre industries to generate new value-added products and services

Research and development objective To provide the knowledge, tools and technologies required to....	**Understand** (Research and development to describe the system and better understand the interactions between its components)	**Optimise** (Research and development that will ensure the best outcome from the existing system)	**Transform** (Research and development that will change the nature of the system)
Energy and resources industries ...support safe, sustainable and competitive energy and resources industries	...existing and future resource and energy options	...the safety, efficiency and sustainability of existing energy and resources industries	...the energy and resources industries to clean and renewable alternatives
Infrastructure, planning and services ...plan for and deliver cost-effective, efficient infrastructure and services	...the interconnections between physical, informational, biological and social networks to effectively plan infrastructure and services	...delivery of vital infrastructure and services to both urban and rural Queenslanders	...Queensland into a network of economically, socially and environmentally sustainable cities and communities
Tropical opportunities ...create globally competitive tropical expertise industries	...Queensland's tropical resources and research capabilities and their global markets	...tropical research and development capability	...the quality of tropical living
Health ...prevent disease and deliver top quality patient care at sustainable cost	...Queensland's current and projected health patterns and costs	...the tools and techniques for improving health service delivery in Queensland	...the health of Queenslanders through prevention, early detection and innovative management of disease
Community wellbeing ...identify and address the causes of disadvantage and better integrate the delivery of community services	...the trends, causes and consequences of social exclusion at the individual and community level	...the delivery of integrated approaches to justice and human services	...community wellbeing by breaking the cycle of social disadvantage
Education and training ...underpin quality education and training for all Queenslander	...the components of a world-class education and training system	...teaching and resources for a world-class education and training system	...education and training to meet every individual's needs, regardless of academic ability, location or socioeconomic status
Safeguarding Queensland ...manage and prevent crime, biosecurity threats and natural and non-natural disasters	...Queensland's vulnerability and potential responses to crime, biosecurity threats and disasters	...capacity to manage crime, biosecurity threats and disasters	...community safety through prevention and/or early detection of crime, biosecurity threats and disasters

Enabling sciences and technologies

Research and development objective: To provide the knowledge, tools and technologies required to support development of capabilities in the enabling sciences and technologies.

Rationale

The emerging industries of the 21st century will be built on technologies spawned at the interfaces of the enabling sciences.

The enabling sciences of mathematics, physics, chemistry and biology are fundamental to both established and emerging industries.

In the established industries, disciplines such as mathematics and statistics underpin the financial sector, and chemistry drives many of the most significant advances in the efficiency and environmental sustainability of the manufacturing and mining sectors. In emerging industries, on the other hand, research at the intersection of the enabling sciences forms the basis of enabling technologies, such as information and communication technologies (ICT), biotechnology, nanotechnology and clean technologies.

While developing research capabilities in the enabling sciences is vitally important for Queensland to remain globally competitive in the maintenance and creation of sustainable industries, the resulting enabling technologies will also play a crucial role in addressing contemporary issues arising from the depletion of natural resources, population growth, health issues and environmentally sustainable economic development.

Sophisticated enabling tools are also required to manage the complexity of our environmental, health and social systems and the plethora of information generated as a result.

Focus of research and development

Understand opportunities in the enabling sciences and technologies.

- Profile Queensland's strengths versus global demands in enabling sciences and technologies.

Optimise the contribution of the enabling sciences and technologies to society.

- Increase knowledge in the enabling sciences and technologies and maximise its transition into new products and applications for environmental, social and economic returns.

Transform enabling sciences into new enabling technologies.

- Encourage interdisciplinary research and development in areas where revolutionary enabling technologies may capture opportunities from global economic, social and environmental challenges. Examples include environmentally sustainable mining, renewable energy, remote sensing, environmental modelling, smart grid systems, biocommodities, tropical health and early detection and treatment of chronic disease.

Ecosystems

Research and development objective: To provide the knowledge, tools and technologies required to protect and restore Queensland's diverse ecosystems.

Rationale

Of Queensland's 1351 regional ecosystems, 92 are classified as endangered and 516 are classified as of concern. Our challenge is to halt and reverse this decline.[16]

The preservation of Queensland's ecosystems is fundamental not only to our way of life and cultural heritage, but also to the livelihoods of many Queenslanders. Each year, the Great Barrier Reef alone generates more than $5 billion in revenue from tourism and fisheries,[17] and visitors to national parks contribute over $4 billion more from direct tourist expenditure.[18]

Queensland ecosystems are under threat from invasive plants and animals, increasing demand for urban and agricultural land, and the potential impacts of climate change.

Queensland has a wealth of research and development based knowledge on the management of tropical reef and rain-forest ecosystems, but more broad-ranging knowledge of ecosystem functioning is needed, particularly with respect to opportunities for improved resilience and ecosystem restoration programs.

Focus of research and development

Understand the health of our diverse ecosystems, and the way in which they function.

- Identify ecosystems of high biodiversity significance, including those which provide valuable corridors and buffer zones for flora and fauna, to add to the protected area estate.
- Monitor the condition and extent of terrestrial and aquatic ecosystems and species.
- Model the impacts of pests, pollutants, natural disasters and human interventions.

Optimise the management of our ecosystems and their associated industries.

- Develop detection and control measures for invasive plants, pathogens and pollutants.
- Identify alternative industry and community practices that reduce threats to ecosystems.

Transform the interface between people and ecosystems.

- Develop new farming systems that encourage on-farm wildlife and habitat conservation.
- Guide infrastructure and urban development planning to improve biodiversity management.
- Advance methods to protect, recover and enhance adaptation of species and ecosystems.

16 *State of the Environment Queensland 2007*, Environmental Protection Agency, Brisbane, 2008
17 *Measuring the Economic and Financial Value of the Great Barrier Reef Marine Park*, Access Economics Pty Ltd for Great Barrier Reef Marine Park Authority, 2005
18 *Valuing Tourism Spend Arising from Visitation to Queensland National Parks*, Sustainable Tourism CRC, Gold Coast, 2008

Land

Research and development objective: To provide the knowledge, tools and technologies required to sustain and restore Queensland's land and soil.

Rationale

Population growth, rising living standards and loss of arable land will all place increasing pressure on global soil resources throughout the first half of the 21st century.

Queensland's land and soil resources are under threat in two ways:

- Since the 1980s, Queensland's population growth has exceeded that for the rest of Australia, thereby increasing demands for urban development of otherwise arable land.[19]
- Over 80 per cent of Queensland's land area is devoted to agricultural activities, some of which have resulted in significant land degradation. Of Queensland's 30,500 agricultural businesses, around half report problems with soil compaction, erosion, salinity, alkalinity or related issues.[20]

The challenge is to use our research and development to build the knowledge and technologies to ensure a sustainable balance between developmental and environmental objectives while maintaining and increasing the quantity and productivity of Queensland's arable land.

Focus of research and development

Understand the causes and consequences of changes in land condition and productivity.

- Comprehensively map, monitor and model soil and vegetation condition and land use change.
- Quantify the impacts of urban development, agricultural production and other industries on land availability, condition and productivity.
- Identify socio-economic factors affecting changes in land use management and practice.

Optimise land and soil management.

- Develop tools to minimise soil degradation and contamination by agriculture, industry and the built environment.
- Advance methods to reduce the discharge of nutrients, agricultural waste and biocides from farmland and pollutants from industrial processes.
- Develop mechanisms to support social change with regard to land management practices.

Transform our land and soil resources through restoration and enhanced productivity of Queensland's arable land.

- Develop techniques for soil and landscape rehabilitation and the bioremediation of contaminated land.
- Advance technologies for sustainable, highly productive agriculture, including genetically enhanced plants and animals, tailored fertiliser and pesticide delivery, and optimal water use.

19 *Information Brief – Australian Demographic Statistics, June Quarter 2009*, Office of Economic and Statistical Research, Brisbane, 2009

20 *Queensland Statistics, August 2008 – Natural Resource Management on Queensland Farms, 2006-07, Cat. No. 1318.3,* Australian Bureau of Statistics, Canberra, 2008

Atmosphere

Research and development objective: To provide the knowledge, tools and technologies required to mitigate air pollution and adapt to climate change.

Rationale

The economic and environmental costs of presently projected climate changes will be greater in Queensland than any other state or territory in Australia.[21]

With five World Heritage sites including the Great Barrier Reef, and the greatest biodiversity in Australia, Queensland's ecosystems are at significant risk from the potential impacts of climate change, including higher temperatures and rising sea levels.

At the same time, Queensland greenhouse gas emissions are among the highest in the world. This results not only from the strength of greenhouse intensive industries such as mining and agriculture, but also very high levels of household greenhouse gas emissions.[22]

With an increasing population, an increasing reliance on motor vehicles and the need for industry to support our economy and population, air quality will face continuing threats, in particular from increasing industrialisation in urban areas.

Research and development will play a substantial role in developing and implementing air quality control measures and in the mitigation of, and adaptation to, climate change. New technologies will be needed in the energy, manufacturing, agriculture and construction industries.

Focus of research and development

Understand air pollution and climate change at local and regional levels.

- Identify communities, industries and ecosystems under threat from declining air quality and from climate change impacts.
- Monitor and model air quality, temperature changes, sea level, rainfall and extreme climate events at a regional and local level.
- Quantify the cost and impact of different mitigation and adaptation strategies and technologies.

Optimise resilience of regions, industries and ecosystems to climate change.

- Develop technologies to build cities and infrastructure resilient to rising sea levels and extreme weather conditions.
- Implement technologies as part of sectoral industry strategies that take advantage of changing climatic conditions.

Transform the atmospheric environment through mitigation of air pollution and greenhouse gas emissions.

- Develop innovative processes, technologies and strategies to improve energy efficiency and reduce greenhouse gas and other emissions from industry, transport and household activities.

21 *ClimateQ: toward a greener Queensland*, Department of Environment and Resource Management, Brisbane, 2009
22 *ClimateQ: toward a greener Queensland*, Department of Environment and Resource Management, Brisbane, 2009

Water

Research and development objective: To provide the knowledge, tools and technologies required to ensure a sustainable balance between water demand and supply.

Rationale

Faced with an increasing population and highly variable rainfall, securing our water supply is a major challenge for Queensland.

The Millennium drought in South East Queensland led to the implementation of unprecedented water conservation measures by government and community, resulting in average daily household water use being reduced to approximately half that of former levels.[23]

Despite that success, Queensland communities and industries remain very heavy consumers of water. This is likely to continue in the face of continued population and economic growth, rainfall variability and the potential impacts of climate change. Ensuring the sustainable management of the state's water resources, including those which protect our diverse ecosystems, will remain a key challenge for Queensland.

Productive research and development partnerships between universities, industry and state and federal governments are delivering a clearer picture of water supply and water quality issues. There is now a need to integrate these activities with research and development around the social implications of water usage to provide whole-of-system models of fresh water demand and supply. Research and development will also be needed to develop and deploy cost-effective, safe and socially acceptable alternative water sources and methods for collecting, storing and distributing water efficiently.

Focus of research and development

Understand the relationships between water supply, demand, quality and use.

- Engage with community viewpoints on water management/supply and drinking water quality issues.
- Monitor and model current and future scenarios for water supply and usage.

Optimise the efficiency of water use

- Develop technologies that improve efficiency of water use in water-intensive industries.
- Strengthen principles and practice of water sensitive urban design and construction.
- Provide ways to improve social and community engagement in water management.

Transform water supply and recycling patterns to provide for a population of eight million by 2050.

- Develop economically viable alternative sources of water for urban and industrial use and reuse.

23 "Residents continue to save", media release; Queensland Water Commission (www.qwc.qld.gov.au.), accessed 7 January 2010

Industry development

Research and development objective: To provide the knowledge, tools and technologies required to build Queensland's knowledge-intensive industries.

Rationale

In the 21st century, productivity will be driven by innovation and research and development, and economic growth will be driven by productivity.

Emerging industries are redrawing the boundaries of global markets. In many leading international economies, research and development intensive industries such as biotechnology, nanotechnology and ICT are a powerful source of competitive advantage, job creation and economic growth. Their innovations are dramatically transforming products and services around the world.

In more established industries, such as manufacturing and services, research and development helps build capacity to produce higher-valued goods and services, and thus sustain economic growth in the face of increasing global competition.

Investment in industrial research and development and innovation is therefore a key element in the Queensland Government's approach to building diversity and economic resilience in the state's industry base.

Focus of research and development

Understand the opportunities for accelerated industry growth.

- Identify industries with a combination of competitive advantage and market potential as priority sectors.
- Identify industry opportunities from changing circumstances (for example climate change, consumer trends) and enabling technologies (for example ICT, biotechnology, nanotechnology).

Optimise the research and development intensity of industry sectors.

- Advance technologies and processes to increase the efficiency and competitiveness of priority industry sectors.
- Develop industry capacity to adapt and apply knowledge to solve problems hindering industry growth.

Transform Queensland into a more knowledge-intensive diversified economy.

- Create new industries, products and services based on public and private sector research and development.

Food and fibre industries

Research and development objective: To provide the knowledge, tools and technologies required to enhance productivity and create new value-adding products and services in Queensland's food and fibre industries.

Rationale

Food and fibre industries are the world's oldest, largest and most essential industries. They are also a major component of Queensland's economy.

Projections of global population growth indicate that global demand for food will double by 2050. Queensland can effectively and sustainably contribute to meeting this projected demand through:

- increased production based on new productivity-enhancing technologies
- value-adding to meet rising demands for functional and high quality foods
- exporting services and technologies based on Queensland's global advantage in tropical and subtropical production systems.

Research and development directed towards areas of current strength and future opportunity has the potential to more than double the size of Queensland's food and fibre industries by 2020. Research and development will also be vital to address the challenges of climate variability, rising energy and labour costs, exotic pests and diseases, soil degradation, drought and consumer demands for more acceptable animal welfare standards and greater food safety.

Focus of research and development

Understand the interplay of environmental and economic factors affecting food and fibre industries at the global and regional levels.

- Monitor and model the biological and physical processes that affect food and fibre production.
- Integrate biological and economic factors to identify products, services and markets with the best prospects for growth.

Optimise food and fibre productivity, sustainability and profitability.

- Create new and enhanced breeding technologies, production systems, biosecurity systems, pest management systems, remote sensing technologies, and farm management support tools.

Transform food and fibre industries to generate new value-added products and services.

- Generate new value-added food and fibre products to meet future market demands.
- Open up new markets for capability-building technologies and services.

Energy and resources industries

Research and development objective: To provide the knowledge, tools and technologies required to support safe, sustainable and competitive energy and resources industries.

Rationale

Queensland's economic reliance on the energy and resources industries is coupled with the highest per capita rate of greenhouse gas emissions in the country.

Queensland is the world's largest exporter of seaborne coal and has strong industries in copper, lead, silver, zinc, bauxite, phosphate rock, magnesite and silica sand. There is also significant potential in natural gas, geothermal energy and solar energy.

A major challenge facing Queensland and its provision of a sustainable energy supply arises from it having the second highest population growth rate of all states,[24] with the highest energy intensity in Australia.[25] Other challenges include the economic, environmental and social risks associated with peak oil and energy security.

Continued research and development is essential to dealing with these challenges. In particular, the demonstration and deployment of low emission coal technologies and the implementation of renewable energy generation technologies are critical to reducing greenhouse gas emissions. Research and development also plays a role in the identification and development of new resources in a cost-effective and safe manner, including those from low quality or less accessible reserves.

Focus of research and development

Understand existing and future resource and energy options.

- Monitor industry and market trends to identify demand for Queensland's commodities.
- Model costs and benefits of alternative freight and port infrastructure investments.
- Map Queensland sites for carbon dioxide storage and wind, solar and geothermal energy generation projects.
- Acquire geological, geophysical, geochemical and drill hole information and apply it to industry.

Optimise the safety, efficiency and sustainability of existing energy and resources industries.

- Demonstrate low emission coal technologies.
- Provide innovative solutions to ensure energy security.
- Use remote sensing technology and off-site simulators to reduce fatalities, injuries and production losses in the mining industry.

Transform the energy and resources industries to clean and renewable alternatives.

- Develop and deploy clean and renewable energy technologies.
- Advance automation technologies to improve the productivity and safety of the global mining industry.

24 *Information Brief, Australian Demographic Statistics June Quarter 2009*, Office of Economic and Statistical Research, Queensland Treasury, Brisbane, 2009
25 *The Queensland Renewable Energy Plan*, Department of Employment, Economic Development and Innovation, Brisbane, 2009

Infrastructure, planning and services

Research and development objective: To provide the knowledge, tools and technologies required to plan for and deliver cost-effective, efficient infrastructure and services.

Rationale

The next 50 years will require infrastructure that uses the same underlying resources to deliver services to twice as many Queenslanders.[26]

Effective planning and delivery of infrastructure and services are essential not only to provide for population and industry growth in Queensland's highly dispersed remote communities, but also to manage increasing congestion and land use pressures in the highly urbanised areas of South East Queensland, Australia's fastest growing region.[27]

The Queensland Government aims to build an integrated and holistic approach to infrastructure and service delivery which balances the social, economic and environmental benefits and costs of developments, optimises cost-effectiveness and performance, and ensures flexibility and responsiveness to change.

Research and development, by integrating information on the array of factors impacting infrastructure and services, and providing technologies to improve performance and cost-effectiveness, is critical to ensuring the implementation of a sustainable, integrated infrastructure and service delivery system for Queensland.

Focus of research and development

Understand the interconnections between physical, informational, biological and social networks to effectively plan infrastructure and services.

- Better understand and model factors impacting infrastructure and service needs and performance.
- Assess the economic, environmental and social benefits and risks of planning scenarios.

Optimise delivery of vital infrastructure and services to both urban and rural Queenslanders.

- Provide technologies and urban designs that improve performance, safety and cost effectiveness, and reduce negative environmental and health impacts of infrastructure and services.
- Provide technologies to deliver services to, and promote growth in, rural and remote areas.

Transform Queensland into a network of economically, socially and environmentally sustainable cities and communities.

- Develop intelligent systems to reduce demand on transport and centralised services and sustain increasing population densities.
- Advance tools to model the dynamic, complex systems impacting infrastructure and services for accurate, integrated long-term planning.

26 *Population Projections, Australia, 2006 to 2101, Cat. No. 3222.0*, Australian Bureau of Statistics, 2008

27 "South East Queensland – Overview", Department of Infrastructure and Planning (http://www.dip.qld.gov.au/seq), accessed 7 January 2010

Tropical opportunities

Research and development objective: To provide the knowledge, tools and technologies required to create globally competitive tropical expertise industries.

Rationale

In the 21st century, tropical economies will be among the world's fastest growing and least contested markets for new goods and services.

Queensland is one of the few developed regions in the tropical world, with unique mega-biodiverse tropical ecosystems and a strong tropical research base. This is an excellent position from which to expand and create expertise-based industries, and provide new tropical goods and services to rapidly developing tropical nations in Asia, Oceania and the Americas.

Many of these products will be fundamental to meeting the environmental and community needs of tropical Queensland, including the preservation of ecosystems such as the Great Barrier Reef and the Wet Tropics; the design of infrastructure resilient to tropical conditions; and the containment and treatment of diseases and health conditions unique to tropical environments.

By translating Queensland's strengths in tropical research and development into knowledge-intensive products and services, tropical industries have the potential to contribute up to $30 billion to the Queensland economy by 2025.[28]

Focus of research and development

Understand Queensland's tropical resources and research capabilities and their global markets.

- Develop an inventory of the competitive strengths of Queensland's tropical research and resources.
- Identify issues distinct to tropical Queensland, whose resolution requires tropical research and development.
- Explore market opportunities for tropical expertise industries in the developing tropical world.

Optimise tropical research and development capability.

- Build consortia drawing together Queensland's research and development expertise in tropical health, agriculture, environment and living.

Transform the quality of tropical living,

- Develop solutions to manage tropical ecosystems, prevent and control tropical diseases, improve tropical building and design, and improve tropical agricultural practices.

28 Calculation by the Office of the Queensland Chief Scientist based on: *World Factbook*, Central Intelligence Agency, http://www.cia.gov/cia/publications/factbook/, accessed April 2005); and *OECD Science, Technology and Industry Scoreboard 2007*

Health

Research and development objective: To provide the knowledge, tools and technologies required to prevent disease and deliver top quality patient care at sustainable cost.

Rationale

The 21st century will be about improving the quality of the 20 years of life expectancy we added in the last century.

Queensland has unacceptably high rates of smoking, obesity and physical inactivity, leading to a chronic disease bill of $5 billion per year in direct health care costs, and an additional $22 billion in lost productivity.[29]

With one third of Queensland's population living in regional Queensland, improving accessibility to medical services has become a high priority. This has particular significance for Queensland in reducing the health gap for Indigenous, rural and remote and culturally and linguistically diverse populations.

Ultimately, the costs of providing health services to Queenslanders can only be contained by shifting the focus of health care from the treatment of established disease towards its early detection and prevention. This shift will be built on changes to community attitudes at the interface of social and health services, and the translation of the government's already substantial investment in research and development in biomedical and biomolecular science into innovative health-care products and services.

Focus of research and development

Understand Queensland's current and projected health patterns and costs.

- Investigate relationships between the prevalence of disease in the community and the risk factors for disease in key population groups.
- Model future cost projections and potential impact of measures for prevention, early detection and treatment of disease.

Optimise the tools and techniques for improving health service delivery in Queensland.

- Develop technologies such as e-health, telehealth and remote diagnostics to deliver health and medical services to regional and remote populations.
- Facilitate the application of evidence-based medicine.

Translate biomedical and clinical research into improved drugs, medical devices and procedures.

- Transform the health of Queenslanders through prevention, early detection and innovative management of disease.
- Develop strategies for healthier living to reduce the incidence and severity of disease and premature death.
- Develop technologies for the prevention, early detection and personalised treatment of disease (eg screening programs, biomarker research, personalised medicine).

29 *Queenslanders tackling chronic disease: becoming Australia's healthiest state*, Smart State Council, Brisbane, 2008

Community wellbeing

Research and development objective: To provide the knowledge, tools and technologies required to identify and address the causes of disadvantage and better integrate the delivery of community services.

Rationale:

Despite a resilient economy and a comparatively low unemployment rate, Queensland suffers from pockets of entrenched disadvantage.

Several target groups are in particular need of attention. These include vulnerable children, at-risk youth, Indigenous communities, some groups from culturally and linguistically diverse backgrounds, people with disabilities, the elderly and people with mental illness.

The factors influencing disadvantage for individuals and communities are complex and multi-dimensional and can relate to issues of education, employment, health and cultural background.

Research and development investments have an important role to play in reversing the cycle of social disadvantage. To be effective, they will require close cooperation between disciplines, between universities and governments, and between departments of justice and human services. Most of all, they will need to involve people and their communities.

Focus of research and development

Understand the trends, causes and consequences of social exclusion at the individual and community level.

- Develop improved indicators, methodologies and tools for data collection, integration, analysis and modelling.
- Evaluate the efficacy of community programs and service delivery systems undertaken in Queensland to address social disadvantage.

Optimise the delivery of integrated approaches to justice and human services.

- Develop and implement the tools and systems to deliver streamlined, holistic services, particularly for individuals and communities with multiple and complex needs, at the individual and community level.

Transform community wellbeing by breaking the cycle of social disadvantage.

- Support coordinated community services to strengthen the self-reliance of individuals, families and communities and encourage continuing education and training, workforce participation and the adoption of healthy and socially active lifestyles.

Education and training

Research and development objective: To provide the knowledge, tools and technologies required to underpin quality education and training for all Queenslanders.

Rationale

An educated and informed populace is fundamental to a productive, knowledge-intensive economy and well functioning society.

Although education and training attainment is demonstrably linked with greater employment and personal development opportunities, the performance of Queensland's students against various national and international measures of literacy, numeracy and scientific skill suggest that many of them are not achieving their full potential.

In particular, Queensland is faced with the challenge of addressing the special learning needs of remote and Indigenous students as well as those from low socioeconomic backgrounds, while ensuring gifted students are given the opportunity to excel.

More than ever, the 21st century will require high level skills in science, mathematics and technology to underpin a globally competitive knowledge-intensive economy, and a society in which all Queenslanders can make informed decisions about their environment and health. Research and development will provide the evidence base to improve teaching methods and curriculum and optimise the educational and training outcomes of all Queenslanders, regardless of academic ability, location or background.

Focus of research and development

Understand the components of a world-class education and training system.

- Identify teaching practices and learning environments that improve student performance according to international best practice, particularly for disadvantaged groups and gifted students.
- Identify drivers of, and obstacles to, student engagement, uptake of further education and transitions to employment.
- Forecast Queensland's skills needs.

Optimise teaching and resources for a world-class education and training system.

- Use longitudinal studies to assess the impact of curriculum, teaching methods and other factors on learning outcomes, with a focus on improving school readiness and literacy, numeracy and science education.
- Trial and evaluate new approaches to workforce attraction and retention, teacher development, teaching methods, curriculum and pathways to further education and employment.

Transform education and training to meet every individual's needs, regardless of academic ability, location or socioeconomic status.

- Use new technologies and best practice educational design to tailor teaching methods, resources, assessment and delivery to individual needs.

Safeguarding Queensland

Research and development objective: To provide the knowledge, tools and technologies required to manage and prevent crime, biosecurity threats and natural and non-natural disasters.

Rationale

The 21st century brings new risks from a range of natural and non-natural causes. Our challenge is to improve our ability to predict, prevent and respond to these incidents.

Overall, the cost of crime to the Australian community is estimated to be in excess of $30 billion per annum.[30] In particular, the exploitation of new technologies for criminal gain poses challenges for law enforcement agencies, with identity fraud, for example, costing the Australian community approximately $3.5 billion annually.[31]

Queensland also experiences disasters from natural causes, such as cyclones, bushfires and floods, and human error, such as oil spills. Along with biosecurity incidents, such disasters cause significant disruption to lives and livelihoods, communities and industries.

A substantial research and development program in tropical biosecurity has been important in maintaining both Queensland's agricultural industries and Queensland's unique natural environment. Further research and development investments will provide a deeper understanding of the various threats that confront Queenslanders and help identify opportunities to exploit new technologies for safety and security purposes.

Focus of research and development

Understand Queensland's vulnerability and potential responses to crime, biosecurity threats and disasters.

- Evaluate the nature of different threats, including the vulnerability of individuals and communities, and weaknesses in Queensland's law enforcement and disaster prediction and response systems.

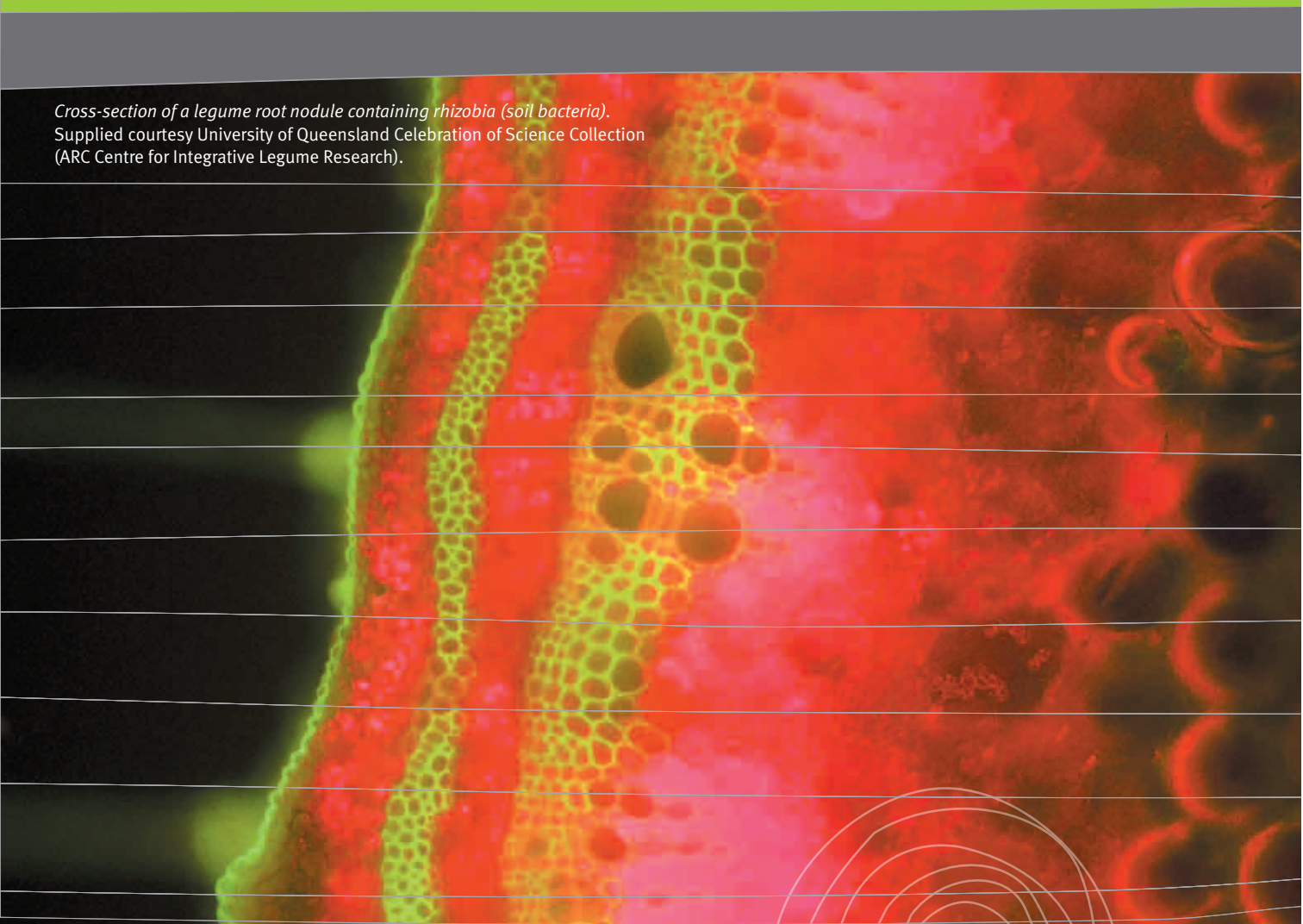
Optimise capacity to manage crime, biosecurity threats and disasters.

- Enable integration of data and intelligence at the regional, state and national levels.
- Develop technologies and methodologies to improve the flexibility of police service delivery, biosecurity management and disaster response systems.
- Provide mechanisms to improve community engagement in crime and disaster response management.

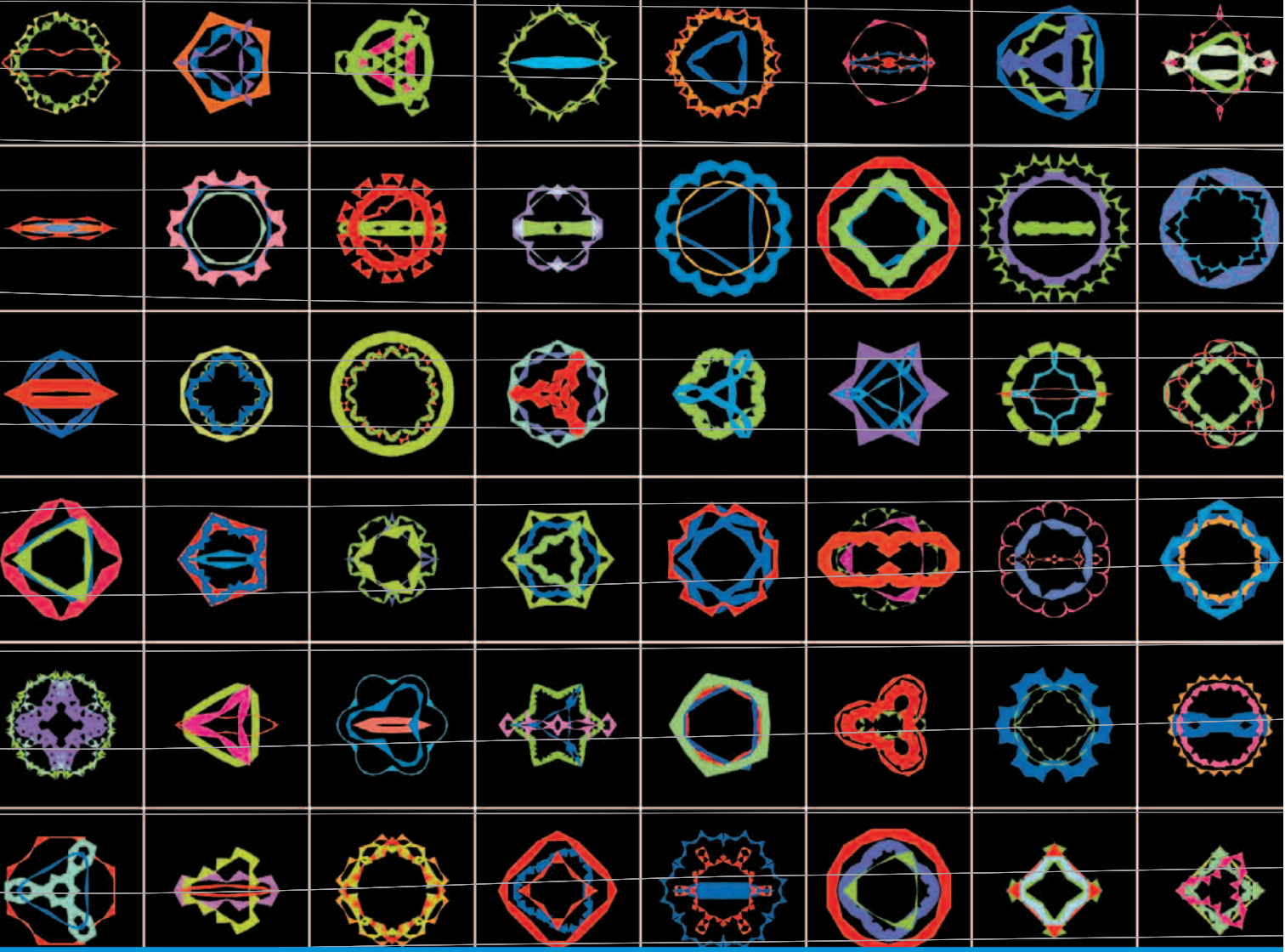
Transform community safety through prevention and/or early detection of crime, biosecurity threats and disasters.

- Provide rapid, sensitive, comprehensive and cost-effective surveillance and security technologies to detect and eliminate or avoid threats before they become significant hazards.

30 "Latest costs of crime data released by the Australian Institute of Criminology", media release; Australian Institute of Criminology (http://www.aic.gov.au/en/media/2008/april/20080424.aspx), Canberra, 2008
31 *Annual Report 2001-02*, New South Wales Crime Commission, Sydney, 2002



Cross-section of a legume root nodule containing rhizobia (soil bacteria).
Supplied courtesy University of Queensland Celebration of Science Collection
(ARC Centre for Integrative Legume Research).



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